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PROJECT PAPER

DRYLAND AGRICULTURE APPLIED RESEARCH

Applied Agricultural Development

MOROCCO

PROJECT 608-0136

April 13, 1978
(Updated June 20, 1978

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LIST OF TERMS

MARA = Ministry of Agriculture and Agrarian Refor

DMV = Directorate of Development (of MARA)

DRA = Directorate of Research (of MARA)

INAV = Institut National Agronomique et Veterinaire (National Agronomic and Veterinary Institute)

ENA = Ecole Nationale d'Agriculture (National School of Agriculture, Mekne

Ingenieur = B.S. of M.S. level technician

Ingenieur Agronome = University degree approx. equivalent to the U.S. M.S. degree. It entitles holder to a Civil Service position or rank of "Ingenieur d'Etat".

Ingenieur d'Application = University degree approx. equivalent to U.S. B.S. degree. It entitles holder to Civil Service positior or rank of same name.

IENCY FOR INTERNATIONAL DEVELOPMENT

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10. ESTIMATED COSTS ($000 OR EQUIVALENT $1 –)

A. FUNDING SOURCE	FIRST FY B. FX	FIRST FY C. L/C	FIRST FY D. TOTAL	LIFE OF PROJECT E. FX	LIFE OF PROJECT F. L/C	LIFE OF PROJECT G. TOTAL
AID APPROPRIATED TOTAL						
(GRANT)	(2096)	( )	(2096)	(4,500)	( )	(4,500)
(LOAN)	( )	( )	( )	( )	( )	( )
OTHER U.S. 1.						
OTHER U.S. 2.						
HOST COUNTRY		1300		2,900		2,900
OTHER DONOR(S)						
TOTALS	2096	1300	2096	7,400		7,400

11. PROPOSED BUDGET APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C. GRANT	PRIMARY TECH. CODE D. LOAN	E. 1ST FY 78 F. GRANT	E. 1ST FY 78 G. LOAN	H. 2ND FY 79 I. GRANT	H. 2ND FY 79 J. LOAN	K. 3RD FY 80 L. GRANT	K. 3RD FY 80 M. LOAN
(1) FN	121	080		2096				1685	
(2)									
(3)									
(4)									
TOTALS				2096				1685	

A. APPROPRIATION	N. 4TH FY 81 O. GRANT	N. 4TH FY 81 P. LOAN	Q. 5TH FY 82 R. GRANT	Q. 5TH FY 82 S. LOAN	LIFE OF PROJECT T. GRANT	LIFE OF PROJECT U. LOAN
(1) FN			719		4,500	
(2)						
(3)						
(4)						
TOTALS			719		4500	

12. IN-DEPTH EVALUATION SCHEDULED: MM 07 YY 81

12. DATA CHANGE INDICATOR. WERE CHANGES MADE IN THE PID FACESHEET DATA, BLOCKS 12, 13, 14, OR 15 OR IN PRP FACESHEET DATA, BLOCK 12? IF YES, ATTACH CHANGED PID FACESHEET.

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14. ORIGINATING OFFICE CLEARANCE

SIGNATURE: Albert P. Disdier

TITLE: Mission Director

DATE SIGNED: MM 04 DD 18 YY 78

15. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF: MM DD YY

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II. RECOMMENDATIONS

USAID/Rabat recommends that:

A. The NE Bureau authorize a grant of $4,500,000 as the U. S. contribution to total costs of a 5-year project entitled Dryland Agriculture Applied Research. The purpose of the project is to establish an applied agronomic research program and train Moroccan staff to operate the program on a permanent basis and transmit the results to farmers. A corollary to the agronomic research program will be a socio-economic research activity which will examine the behavior of the dryland farmers and thus provide a sound basis for extension of the technology to be developed. The goal of the project is to increase food and food crop production in the rainfed areas, beginning in the semi-arid regions.

B. The MidAmerica International Consortium (MIAC) will be selected as contractor for the project. MIAC was selected through open competition to conduct the feasibility study for the project with the understanding that it might be called upon to implement the project. MIAC is fully aware of the problems to be addressed; MIAC has a good understanding of the Moroccan setting and some MIAC staff have developed an effective working relationship with the Moroccan social scientists who will be conducting the socio-economic research. USAID believes that project implementation would benefit greatly by the selection of MIAC as a contractor.

C. The NE Bureau authorize a waiver of the host-country contracting requirements. There are several reasons why we believe an exception to AID policy is justified in Morocco. The strong French orientation and independent approach of the Moroccan Governemnt to project implementation, even though in collaboration with a foreign donor, makes project monitoring difficult in the best of circumstances. The French language itself is always a potential stumbling block, particularly regarding contracts. The Moroccan system of selecting a contractor is differenct from ours, and a great deal of time would doubtless be spent in explaining the American system. Moroccans are not familiar with U. S. firms or U. S. universities. Negotiations would be difficult, time-consuming, and might well produce early strains in the host government-contractor relationship. In the end, USAID might well become more involved than is desirable.

The Doukkala irrigation loan experience, though a supply rather than service contract, has provided abundant evidence of the Moroccan tendency to pursue an independent course, based on their own practices, if they do not understand the relevant U. S. provisions. On the technical assistance side, the Michigan contract—a host country contract a few years ago for upgrading the Ministry of Plan's policy planning capability--is a good example of the government's using its contractor personnel as operational staff and pursuing objectives

different than USAID has intended. Under that host-country contract arrangement, USAID had little monitoring authority and could not even acquire copies of the studies prepared by the contractor as they were classified by the government. The latter situation has even arisen, though not as serious, under a current project implemented via direct AID Contract.

Under the circumstances described above, USAID believes that direct contracting is essential in Morocco in order to assure colse Mission monitoring and a reasonable chance of achieving the project purpose.

III. THE PROJECT

A. BACKGROUND AND PURPOSES

Agricultural Land Resource and Utilization

Morocco's agricultural land resource includes some 10 to 12 million hectares of rangeland which are generally overstocked and producing well below their potential, and about 8 million hectares of cropland. Of the 8 million hectares of cropland, about 5½ million are cultivated annually, ½ million hectares are in orchards and vineyards, and the remainder is left fallow. Cereals occupy 84% of the cultivated land. The major cereals are in order of importance; barley, durum wheat, bread wheat and maize. Together with grain legumes—broad beans, chick peas, lentils and peas—which occupy 10% of the cultivated land, cereals constitute the staples of Moroccan diet. According to statistics published by the Banque Marocaine du Commerce Exteriour, about 45% of the bread wheat production was marketed annually during the 1971-72 - 1975-76 period. Corresponding figures were for maize - 9%; durum wheat - 6%; and barley - 2%. Clearly cereal production and consequently, Moroccan agriculture, is still largely a subsistence level activity. This is not surprising if one considers that 91% of the private land owners hold 51% of the arable land in units of less than 10 hectares and 97% of all land holdings are less than 20 hectares in size.

1. Irrigated Agriculture

Morocco i with substantial water resources. For the past twenty years, GOM agricultural policy and investments have been directed, on a priority basis, toward the development of irrigated agriculture on a targeted area of 1 million hectares. To date, half of the area has been brought under irrigation. Completion of the irrigation development program is planned for the late 1980s.

The irrigation program has absorbed considerable financial investments and much of the best-trained agricultural manpower. The primary objectives have been and are to satisfy the sugar requirements of the country and increase its foreign exchange earnings through the export of citrus and

vegetables. To date about half of the sugar consumed is produced locally, and by 1990 Morocco will be able to satisfy about 75% of its requirements. Citrus and vegetable export earnings have increased substantially but seem at present to have an uncertain future. The irrigation program has also permitted sizeable increases in milk production. However, in general, it has not had much of an effect on the levels of food imports. It is not likely to make a significant impact on these imports in the foreseeable future.

2. Rainfed Agriculture

Over most of the country, the rainy season extends from October to April or May with the maximum precipitation between January and April. Usually, except in the mountainous areas, little if any rain occurs in the period from May to September. In general, rainfall decreases as one moves southward. For example, average annual precipitation is 606 mm in Tetouan, 574 mm in Meknes, 523 mm in Rabat, 404 mm in Casablanca, 391 mm in Settat, 336 in El-Jadida, 242 mm in Marrakech and 226 mm in Agadir. Rainfall is also highly variable in distribution during the season and in amount from year to year. In any year it may vary as much as a third above or below the mean annual precipitation. This uncertainty grows as one moves east and south, and is largely responsible for the wide variations in yearly crop production that occur. To illustrate, during the five-year period 1971-72 - 1975-76, an average of 4.5 million tons of cereal was produced, but the actual harvest ranged more than 25% higher and lower. Similarly, yields/hectares are highly variable from year to year and from region to region. For example, bread wheat ranged from 1.3 - 2.2 MT in Meknes, .5 - 2.0 MT in Fes, .6 - 1.2 MT in Settat and .08 - .8 in Safi. If Moroccan agriculture is to evolve into a market-oriented activity, ways must be found to stabilize both yields and production levels, or at least reduce the magnitude of the variations noted above.

Agricultural Research

The Agronomic Research Directorate (DRA) of the MARA is by statute responsible for developing, among other things, improved production technology which the Division of Agricultural Production and the Division of Extension, both of the Development Directorate (DMV), in turn make available to farmers. In fact, the DRA conducts very little or no research directed systematically at solving the problems facing the rainfed farmers. Its staff time is largely taken up by administrative chores and, in general, the staff is composed of relatively young ingenieurs (M.S. or B.S.-level technicians) who were not trained to organize and conduct applied research programs effectively.

The failure and inability of the DRA to develop reliable production-oriented information has led the DMV to establish within the Division of Agricultural Production a Dryland Bureau which conducts, in several and widely scattered semi-arid locations, an annual series of trials in which different methods of land preparation, rates and times of planting and

rates of fertilization are compared. The performance of the Dryland Bureau to date indicates that its staff, like that of the DRA, suffers not only from insufficient numbers, but also from lack of training and experience. As time goes on, the number of ingenieurs assigned to both the DRA and the Dryland Bureau will undoubtedly increase. However, additional staff alone is not likely to improve significantly the effectiveness of these agencies unless the new ingenieurs have the depth of specialized training that production-oriented research requires. This kind of training is not available in Morocco at the present time. Nor is it likely to become available in the near future.

Higher Agricultural Education

The highest level of training now offered in Morocco is that of the "Ingenieur Agronome" which is the approximate equivalent of the U. S. Master of Science degree. But in several disciplines, including all of those required in an applied research program, students can obtain basic specialized training only by attending foreign institutions for one or both of their last two years in the Moroccan system of higher agricultural education. The one institution in that system which grants the Ingenieur Agronome diploma is only ten years old. As suggested by the arrangement mentioned above, it will be several years before the system can have the capability to offer in Morocco the level of specialized training necessary for productive research.

Agricultural Extension

Through some 15 provincial directorates, MARA operates about 100 Centres de Travaux (C.T.) or work centers which are staffed by over 900 extension agents. The C.T.s are limited to the rainfed areas. A separate network of extension centers called Centres de Mise en Vabeur (C.M.V.) functions in the irrigated perimeters under the control of the Regional Irrigation Development offices.

Each C.T. (work center) is equipped with tractors and implements to perform custom services, primarily plowing, disking and combining. The cost of these services is subsidized by the GOM and priority is given to those farmers who are participating in the various programs sponsored by the MARA such as; "Operation Cereals", "Operation Labovr" (plowing), "Operation Betterave" (sugarbeet), etc.

In general the extension agents have had 1 or 2 years of vocational training. Relatively few hold a college degree, and fewer still are technically competent enough to give sound advice to farmers since there is little or no improved technical knowledge to extend. The extension service as a whole also suffers from inadequate operating funds, particularly for transportation of the agents. These attributes and a belief that Vulgarisation (transmitting the printed word) is the way to improve the technical skills of farmers, combine to make the extension service a largely administrative unit. Its ineffectiveness has not escaped MARA officials who

have requested that A.I.D. undertake an evaluative study of the extension system. This study will begin in April, 1978.

Growing Population - Food Deficit

The population of Morocco is estimated at 18 million and is growing at an annual rate of about 3.0%. Largely rural a hundred years ago, the population has been migrating increasingly to the urban centers. In 1965, an estimated 71% of the population still lived in rural areas. Only 61% did so in 1975, just ten years later. It is estimated that in 1990 half of the population, some 12 million people, will be crowded in the cities and towns.

Population growth and migration in combination with a higher income level have increased the food requirements of the country and also modified the traditional consumption paterns. As a result, Morocco has become a food deficit country and its dependence on food imports has been increasing:

— Bread wheat utilization rose from 618,000 MT in 1965 to 1,675,000 MT in 1975. Bread wheat imports rose from 312,000 MT to 1,384,000 MT in the same period.

— Utilization of edible oils rose from 88,300 MT in 1965 to 175,000 MT in 1975 and imports doubled from 80,500 to 160,000 MT.

— The foreign exchange cost amounted in 1975 to 960 million DM ($213 mill) for wheat and 435 million DM ($96 mill) for edible oils, which together represented 40% of the value of all major agricultural commodities imported.

— In 1977/78 Morocco will import 1.7 million tons of wheat.

The demand trend reflected above will very likely continue unchanged, due to the inevitable population increase. On that basis, the World Bank has estimated that Morocco will be consuming about 2,460,000 MT of bread wheat and 280,000 MT of edible oils in 1985 and, if recent production trends remain unchanged, the imports of wheat and oil seed will rise to 1,860,000 MT and 265,000 MT respectively. The estimate of wheat imports apparently is too low, since imports of 1.7 million tons of wheat are planned for 1977/78. Morocco is thus facing a food deficit which could become a serious constraint to national development.

Short of drastic and probably undesirable measures, little can be done to control changing consumption patterns. A modest effort is currently underway to reduce the rate of growth of the population and there are indications that it will be expanded. However successful such a program may be, it will not by istelf eliminate the food deficit. Demographers have estimated that even if the number of children per family could be reduced to only 2, compared to 5 presently, the population of Morocco would still double in the next fifty years, which suggests that, almost inevitably, the population will in fact double in less than twenty-five years.

Therefore, ways must be found to utilize the food production potentials of the country more fully and more efficiently than is the case presently. Achievement of this objective will probably necessitate several policy and program changes. But, a more basic requirement will be to improve the ability of the rainfed farmers to increase their efficiency as food producers, and this in turn implies that the farmers must have continuing access to improved technology and the means to use that technology.

GOM Request for Assistance

In October, 1975, the GOM requested U. S. assistance to develop and implement a project in order to increase agricultural production in the areas receiving 200 to 400 mm of average annual rainfall. It was then the view of the Ministry of Agriculture and Agrarian Reform (MARA) that the range production system and the highly mechanized dryland technology of the western U. S. could be applied easily to Moroccan conditions in a major production project. In response to that request A.I.D. fielded a contract team from the MidAmerica International Agriculture Consortium (MIAC) which comprises the landgrant universities of the states of Iowa, Kansas, Missouri, and Nebraska. The team visited Morocco in November - December, 1976, and submitted its report to AID/W in January, 1977, and to the GOM in March, 1977.

The team concluded that the dryland technology of the western U. S. which was developed over a long period of time in response to specific climatic, soil and socio-economic conditions, could not be applied directly and generally in the vastly different setting of Morocco. Yet there was no reliable information both technical and social on which a sound alternative could be proposed. The team recommended that, prior to undertaking large scale production programs in the dryland areas, the GOM should make a systematic effort to develop the information, presently lacking, which is essential for their planning and implementation. Specifically, the team recommended that: (1) an agronomic research program be established on a permanent basis to adapt existing technology to Moroccan conditions; (2) a corollary socio-economic research program be conducted to analyze the behavior of dryland farmers and thus provide a basis for extension to farmers of improved production technology; and (3) sufficient Moroccan staff be trained to carry out the applied research and transmit the results to farmers. The team estimated that up to ten years might be needed to fully achieve these objectives.

MARA officials responded favorably to these recommendations and requested A.I.D. assistance to implement them. They indicated, however, that although much of the dryland areas is better suited to range livestock production, than to crop production, no range improvement component should be included in the project since the GOM intended to undertake a nation-wide range development program. Consequently, U. S. assistance should focus primarily on food crops—cereals and pulses chiefly in the beginning—and annual forage crops that can be profitably incorporated into local crop rotations or sequences.

The Project

This project is proposed as an attempt to fill a major gap in Morocco's capacity to exploit more fully its food production potentials. It is designed with the recognition that the problems facing the dryland farmers are not susceptible to quick and easy soluctions and also that time and much hard work will be required to develop, test and transmit to farmers improved technology that they can use without increasing the naturally high risks that dryland crop production entails.

The purpose of the project is to establish:

1. 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. 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.

Duration and Phases

Although up to ten years may be required to fully achieve the goal of increasing food and feed production throughout the rainfed areas, the project is planned for a period of five years (referred to in this PP as Phase I). U. S. assistance will be critical during that period and should permit the GOM to successfully continue and expand the programs independently in Phase II.

Target Area

The cultivated rainfed area covers approximately 7 million hectares which represents 90% of Morocco's crop land. As already indicated, it will take more than five years to affect production levels over such a vast area. Consequently, a more modest and realistic area has been defined as the project target area.

Project activities will be limited to the semi-arid regions, i.e. those where annual rainfall averages between 325 mm and 450 mm, thus providing a reasonably good probability for successful crop production.

Beneficiaries

The knowledge developed by this project is clearly targeted to the poorer Moroccans whose farms are small in size (see section 5 page) and produce incomes far below the national average. The current average gross income ($491) from grain per farm family in the project area is a little less than national per capita income ($500). Net incomes, per capita, even with income from livestock included, would be considerably below incomes in the better farming areas and in cities. While the socio-economic surveys will quantify the status of dryland farmers more precisely there is no question that they are a needy group, and agricultural specialists have identified existing production potentials for the rainfed areas.

The critical issue is whether technology capable of exploiting the potentials can be adapted for the use of the smaller of the dryland farms.

Under a strictly free market situation the larger and medium sized farms would be in a better position to avail themselves of technology which might depend upon mechanical equipment. But, there are output increasing improvements which might depend upon mechanical equipment. But, there are output increasing improvements which are neutral with respect to scale, such as seed, nitrogen fertilizer and non banded phosphate fertilizer. There are also other items which can be scaled to small size and which are complementary to abundant labor and existing animal power i.e., hand operated weed sprayers and animal drawn spike tooth harrows for better seed bed preparation. The project stresses development of these types of technologies.

One of the major outputs of the project will be sociological, economic and technical information on how production programs can be made applicable to various farm groups in keeping with national developmental and income distribution objectives. For example, the combined agronomic research and investigations into various mechanization options might reveal small scale equipment, as compared to larger equipment, to: (1) be equal in physical output terms, (2) be profitable but less so than larger equipment and (3) allow distribution of benefits to accrue equally among small holders, tenants, equipment operators and equipment suppliers whereas the benefits of larger equipment accrued to larger farm operators and the cost efficiencies would create pressures to displace small perators. If information of the above nature can be made available, policy decisions can be made and executed through tax and subsidy mechanisms to pursue growth along lines which conform to social and economic goals.

In summary, Phase I of the project will develop tested information on how small dryland farmers can increase their productivity.

Information will be available on the costs and returns to various production technologies and to various program options in their broader social and income distribution implications

B. THE AGRONOMIC RESEARCH PROGRAM

Basic Considerations: A detailed analysis of rainfed agriculture in Morocco is presented in the Technical Analysis Section of this project paper. From that analysis derive the basic considerations which will guide the agronomic research program.

1. Throughout the major food crop producing area rainfall distribution is erratic, and in much of the area the amount is limited. Soils are often shallow, and have a low moisture-holding capacity. These unfavorable conditions influence greatly the potential yields that farmers can obtain, and they are not subject to change.

2. Other factors in the present production systems also effectively limit the yields obtained as well as the productivity of the farmers and they are subject to change. Unsuited tillage implements, ineffective tillage operations, poor seeding practices, inadequate weed control, low soil fertility, near total lack of disease and insect control, and generally poor varieties -- all are factors which limit the yields and can be changed.

3. The lack of suitable implements for tillage, seeding and weed control, is a basic factor that must be corrected before there can be any major advance in crop yields. In other words, the benefits from other changes in technology cannot be fully realized unless present tillage practices are changed.

4. The productivity of the farmers is further limited by inefficient harvesting and, in the case of the small farmers who are in the majority, by inefficient threshing practice

a. Research Activities

The program will be guided at all time by the real technological problems the farmers, and field work will be carried out, as much as possible under conditions similar to those obtaining in farmers' fields, or in cooperation with farmers.

Research activities will be organized and carried out in such a way that they can be followed directly and personally by the research staff to ensure the validity of the results. Most major experiments will be established at the principal research center but as soon as staff and other required inputs are available, experiments will also be established at off-station locations in cooperation with the agricultural extension service. Such sites will be selected to provide a greater variety of environmental conditions than can be found at any one station and will be necessary to ensure the applicability of the research results. In short, these outreach activities will constitute an essential component of the agronomic research program and a permanent linkage among researchers, extension workers and farmers.

In the beginning, project activities will be restricted to Settat province which lies in a semi-arid zone with average annual rainfall ranging from 350 to 425 mm. As soon as feasible, activities will be extended first to the neighboring provinces of El-Jadida, Safi, Essaouira along the Atlantic coast where rainfall averages 325 mm and later to the inland provinces of Khouribga, El Kalaa and Marrakech where rainfall averages less than 325 mm. Some experiments will also be conducted at the National School of Agriculture in Meknes Province which receives more than 425 mm. and is a major producer of cereals, grain legumes and forage crops. Expansion of the program into these provinces will take place mostly in Phase II.

Research Topics

The management principles for successful crop production in rainfed areas are well known and in the U.S. and other countires are commonly applied using appropriate and often large scale technology. Adapting these principles and related techniques and practices to the varied environment of Morocco will inevitably raise numercus problems which must be resolved if the productivity of the farmers is to increase. Therefore, all aspects of the production systems currently used by the dryland farmers will be addressed.

On the other hand the type of program proposed in this PP will constitute a new experience in Morocco. It must demonstrate as rapidly as possible that adaptive research can produce results that are beneficial to farmers. Otherwise the project will not generate the continuing and adequate support of the GOM decision makers.

In view of the above and considering that qualified project staff will be limited during Phase I, priority will be given to those components of the production system which are critical to increasing yield, namely: tillage practices, including seed bed preparation, planting methods, rate and date of planting, and weed control. Next will come soil fertility and management, crop varieties, crop sequences and rotations, disease and insect control. harvesting, handling and storage.

Principal Research Center: Sidi El Aidi

The main research center will be located near the village of Sidi El Aidi some 50 kilometers (30 miles) south of Casablanca and 15 kilometers (9 miles) north of the town of Settat. Settat province is the major rainfed agricultural area in the semi-arid zone, receiving between 350 mm and 425 mm of average annual rainfall. A 38-hectare (25 acres) tract of land that is owned by the Ministry of Agriculture will be developed and equipped to serve that function. Facilities at the center will include:

a. one laboratory for forage and soil analysis
b. one seed house for drying, processing, storage and handling of seeds and experimental plant materials
c. one shop for machinery and equipment servicing and repair (fuel storage and pumps included)
d. storage rooms for fertilizers and chem

The research facilities of Sidi El Aidi will be reinforced by the central DRA laboratories in Rabat, such as soil physics and soil microbiology, and other appropriate DRA units such as data processing and plant breeding.

A.I.D. will provide consultant services to assist the MARA in the planning and design of the facilities.

Provincial Centers

As already indicated, it is not anticipated that qualified staff will be available during Phase I of the project to permit establishment of permanent research centers in the provinces. Therefore, no decision on the precise location of the provincial dryland research centers is warranted at this time. Nor is any provision made in the Phase I budget for equipping any of the provincial centers. However, in Meknes province, project activities will be carried out at the farm of ENA and with the participation of the faculty in agronomy and plant pathology.

Research and Extension Staff

The permanent staff of the agronomic research program will consist of specialists in the following fields

Production Agronomy	Plant Pathology
Soil Science	Entomology
Weed Science	Production Economics

and Agricultural Extension

Presently such a staff cannot be assembled from the cadres of MARA. In view of this, A.I.D. will provide the services of a number of agricultural scientists who are experienced in applied dryland research and extension. Three of them will be specialized in soil science, forage crops and cereals production respectively, and will reside in Morocco for the duration of Phase I. The others will perform short term assignments as needed in such fields as weed control, plant pathology, entomology, production economics, statistics, climatology, and extension. For its part, the GOM will assign a minimum of twenty two (22) engineers who will work with the U.S. staff and receive specialized advanced training in the U.S. and/or the international agricultural research institutes. They will constitute the nucleus of the permanent research and extension staff of the program.

Laboratories

Increased productivity of the farmer will depend in part on their ability to manage soil fertility and on the existence of a sound national fertilizer program. Both of these factors in turn presuppose accurate knowledge of the nutrient requirements of the soils farmers are to cultivate.

In order to develop that information, a soil testing program will be initiated in Settat Province in the third or fourth year of Phase I. The soil testing program will be headed by a technician who will have received special training for that purpose. Laboratory facilities will also be needed for analyses of the various forage materials and crop physiology. A.I.D. will contribute to the establishment of these facilities at the Sidi El Aidi Center, not only through the training program but also by providing some of the scientific equipment needed.

Machinery and Equipment

While the agronomic research program will be concerned with the total production system, a special effort will be made at the same time to introduce suitable machinery and equipment that the farmers (both modern and traditional) can use. (See Section C below)

On-Station Tractor-drawn, tillage and planting equipment

Commercially available sweep machines which permit shallow tillage to (1) control weeds effectively at or just before planting time, and (2) prepare a firm seed bed with little waste of soil moisture, will be introduced and tested.

Similarly, tractor-drawn drills will be introduced and tested to permit farmers to plant seed and place starter fertilizer with it, instead of broadcasting both seed and fertilizer and mixing them in the surface soil with a covercrop (tandem disc). The results of the mechanized operations at the experiment station and the on-farm demonstration will be fed into the mechanization activities as they evolve.

Role of U.S. Scientists - Moroccan Counterparts

The role of the U.S. scientists will be that of senior but temporary associates in the establishment of the program. Under no circumstances will they be allowed to function as substitutes for unavailable Moroccan staff. Therefore, from the beginning an adequate number of Moroccan ingenieurs will be assigned to work with them. Others will be added annually in order to meet program requirements and permit the advanced training of those who will make up the permanent staff at the end of Phase I. The training program described below is planned accordingly.

b. Training

Both MARA and USAID recognize that of the many factors which condition the success of an applied research program — as measured in terms of useful, applicable results — none is more crucial than the quality of its staff. Both also agree that the considerable financial resources they propose to invest in this project would not and cannot be justified

unless, upon the departure of the U.S. scientists, equally qualified Moroccans were available to take their place and ensure the continuation and expansion of the program. Consequently, a sizable amount of the resources that A.I.D. will provide will be invested in training of the Moroccan staff.

At least 11 Moroccan ingenieurs will receive Ph.D level training in the U.S. — three in Production Agronomy, two each in Soil Sciences and Forage Crops and one each in Weed Science, Plant Pathology, Entomology and Production Economics. At least eleven others will be trained at the M. S. level — four in Production Agronomy, two in Forage Crops and one each in the other 5 fields of specialization.

Although the training these igenieurs will receive in the U.S. wil_ be just as vigorous as that offered American students, they will not be required to complete the requirements for the Ph.D and M.S. degrees while in the U.S. Degree candidates will be expected to do their thesis research in Morocco and will have the option of submitting their theses to the Hassan II Agronomic Institute for the degree of Doctorate d'Etat or Ingenieur Agronome, or to the U.S. university for th Ph.D or the M.S. degree. It is anticipated that each trainee will spend 2 to 2-1/2 years in the U.S.

Whenever appropriate and feasible, the network of international agricultural research institutes will be utilized in the training program. Among these institutes, three in particular will be considered: CIMMYT in Mexico, ICARDA in Syria and ICRISAT in India.

In addition to the above 22 ingenieurs, up to ten may be selected for specialized study or for short-term training in agricultural extension, plant breeding, agricultural machinery, grain storage, and control of grain storage pests. (See Training Plan in Part IV - Implementation.)

Pilot Extension Activities

Given the complexity of the problems and the uncertainties inherently associated with dryland crop production, and given the limited qualified staff that will be available to address these problems during Phase I of the project, it is not anticipated that sufficiently reliable results will be generated to justify a large scale extension effort.

However, it is likely that some discrete and limited improvements of the production system will be realized — in the control of weeds for instance — which could be transmitted to farmers. Whenever warranted field days will be organized at the Sidi El Aidi Center and at the off station plots to introduce farmers to the usable results of the research program. As the reliability of these results increases, selected farmers will be encouraged to aply them under the guidance of the extension staff.

As soon as feasible, special training programs will be organized at the Main Research Station for the extension agents starting with those

from the neighboring extension centers and extending gradually throughout the target area. This training will be practical and aimed at improving the technical competence of the agents and their ability to communicate to farmers the research result.

c. Mechanization and Equipment Activity

Recent world experience with grain production in 200-400 mm rainfall areas, and where soil types are less than highly productive, indicate that farm equipment and adequate power sources are critical to maintaining production at profitable levels. Even with adequate equipment, and other inputs, yields can dip below profitable levels in very dry years but appropriate mechanization has proven to be a very significant factor in increasing the overall productivity of dryland agriculture. Even fertilizer application and modern plant protection systems, as well as timely tillage operations, require mechanization, except perhaps on the very tiny plots. Improved seed can be hand broadcast, but even in seeding there are some savings to be made by drilling seed. If seed is drilled, along with fertilizer application, better plant population stands can be established from a given amount of seed.

Assuming a farmer could get access to adequate blocks of land U. S. dryland farming technology could probably be adapted in a fairly short time to the Moroccan setting. But given the land tenure and operating patterns, relative low-costs of labor and social costs of displacing labor the scale of U. S. technology is most likely not appropriate. However, the apparent answer, very small equipment, may not be a practical answer either.

Given the engineering, or technological "size" requirements, that the various machines possess in order to perform their functions, the power required to operate them, and the costs inherent therein it is not likely that the smaller scale Moroccan farmer can afford to own a full, or even partial line of equipment just for their own operations. The issue as to what equipment is appropriate, and productive in a very demanding environment is, therefore, a researchable topic and a critical one. Social, economic and technological factors are involved, and important decisions will have to be made regarding introduction or design of equipment.

The nature of the problem centers on the limited number of technological options available, the relatively low value of commodities produced per land unit and the variability in the natural resource--soil types and rainfall patterns. In comparison to irrigated farming where one has a number of options with respect to crop types, times and types tillage, planting dates and soil management programs dryland farming options are limited. The crop production agriculture practices are land intensive, timeliness of operations is very important, and the value of the output per land unit is low. It follows that any mechanization must therefore be able to cover a significant amount of land in a timely fashion and the machine costs must be spread over enough output to justify its purchase. In effect there are

pronounced economies of scale for mechanization of cereal production compounded by factors which may not be economic but which exist, i.e. desire to have excess power in case of unusual need, or to further reduce labor should its price rise and for the prestige of operating large machines. Nevertheless, there may still be a role for small scale mechanization even though some efficiency may be sacrificed. Given labor costs, existing draft animals and complementary livestock and cereal production system of some farms and pursuing the optimal in economics of scale might be attendant by excessive social costs. The lower limits on size of equipment would be dictated by technological factors and economics, ineffective equipment being neither economically or socially useful.

While on-farm-application will be an integral part of the applied research in tillage, planting methods, weed control and the fertility maintenance research the role of mechanization will be researched as a separate topic because the application of new technology may, to a significant degree, hinge upon improving farmers' access to better equipment.

As indicated mechanization possibilities range from large to small scale and the determinates of "appropriateness" stem from efficiency as well as other goals and objectives. Within Phase I of the project the mechanization element consists of three major components:

I Investigation of the nature of the mechanization problems and securing base line data,

II Recommendations for a mechanization action activity.

III Organization and execution of the action activity.

I Problem Investigation

The project technical assistance contractor, in cooperation with the host government, will organize and conduct a survey of the mechanization potentials and problems. The survey will be a combined effort of technical personnel and the socio-economic research group. The objective will be to generate knowledge for formulation of various research or action program recommendations. Base line information will be required on items such as the following:

a) soil types, in a given zone
b) rainfall patterns, for a given zone
c) functions to be performed by a given set of machines
d) power requirements for given machines
e) crop yield expectations, and their net value, from use of various equipment if used in a timely fashion
f) costs of various equipment

g) range in scale of present farm operations by tenure class, trends in scale of farm size
h) present use of private mechanization, custom hire (government and private), present mechanization problems, degrees of underutilization, machinery available for tractors.
i) present animal power available, by type, their costs in terms of feed, animal improvement potential with respect to drafting power, secondary products (meat, milk)
j) social custom with respect to joint ownership of productive resources
k) organizational and management options with respect to gaining access to farm equipment by small scale farmers
l) relevant world wide experience and trends in mechanization (visit S.I.S.C.O.M.A., Dakar, Senegal; ICRISAT; IITA)

The information will form the basis of determining what is feasible for an action program.

II Recommendations for the Action Activity

Various options may be determined as a result of initial investigations. They might include better utilization of existing equipment, importation of machinery for either the private or government sector, reorganization or improving efficiency of the present CT service networks, importing small scale powered or animal drawn equipment or even developing specialized equipment for Moroccan conditions, with either engine or animal powered. The analyses and recommendations will include a section on income distribution effects as well as benefits, costs and production effects.

III Organization and Execution of the Action Activity

The contents, financing and execution plan for any mechanization activity will be determined by the studies cited above. But it is anticipated that by the end of the second year of the project a plan would be submitted which would likely call for a project revision or possibly a companion project, depending upon the nature, and costs of the proposed program.

C. SOCIO-ECONOMIC RESEARCH PROGRAM

1. Introduction

The following socio-economic research program was developed by the Department of Social Sciences of the Hassan II Agronomic Institute which will be responsible for its implementation. The program was prepared in consultation with USAID and the rural sociologist who participated in the MIAC study of the project target area.

2. The Target Area

The area to be studied first is the High Chaouia region located between Settat and the Oumer-Rebia river. It is semi-arid in climate, it has been increasingly settled over the past fifty years, and throughout the region, improved farming practices have been witnessed with regard cereal and legume crops. The area is also well known for its long history of pastoral livestock farming. In addition to the proposed agronomic research program, ranching operations are expected to be initiated in the region.

The High Chaouia region is critically located in the project area. However, considerable variation exists in the socio-economic pattern as well as the farming practices within the larger dryland regions. Therefore, it will be necessary to repeat the study outlined below in other parts of the project area. These will be selected based upon needs of the larger project.

3. Objectives of the Study

The primary objective of the socio-economic program is to develop a more detailed understanding of the farming systems in the target area of the agronomic research activity. The results of the latter will be useful only if the practices recommended are compatible with existing farming systems. At present definitive knowledge is lacking about the dryland farmers, their value systems, their willingness to take new risks, and their communication patterns, the production systems and the availability of credit.

A secondary objective is to increase Moroccan capabilities to conduct this type of research by providing U. S. assistance and training throughout the duration of the project.

One of the more detailed objectives is to identify and analyze the patterns of technical and economic decisions that farmers make under high risk situations. These decisions are influenced by a number of important factors which will be examined including the following:

a. present and former systems of farm production;
b. cultural practices and mechanization in relation to productivity;
c. value or priority systems held by farm operators based upon their consumption patterns;
d. availability and use of production units;
e. local market structure and farmer participation in it;
f. patterns of social organization in relation to product:

The study of these factors should lead to an understanding of the types of farm units and enable one to identify the potential alternatives among which each type of farmers can select. This will provide the basis on which the GOM can plan effective programs whereby farmers can benefit from the results of the agronomic research.

The task will be principally to: (1) identify the types of farming systems (2) develop a list of their most important characteristics; and (3) draw implications of decision-making behavior. The study will be organized along two main lines: - the social and economic history of the area in order to develop an understanding of the present systems and identify trends therein; and - the typical production systems and the farmers' perception of them.

The socio-economic research program will seek inshort to isolate the factors involved in determining the socio-economic behavior of the farmers, and their families including the role of women, their attitudes toward high-risk situations, productivity increases, and the use of modern techniques and innovation.

An examination of the value systems as reflected in the consumption patterns should reveal the nature of incentives which influence farm-level decisions. It should then be possible to draw conclusions regarding the farmers' receptivity to new production practices and the conditions necessary to encourage them to adopt these practices. The nutritional and family planning implications of consumption pat---- will also be studied.

A systematic study of the availability and use of purchased and home generated production inputs by farmers will be conducted in order to determine the patterns of use by each type of farmers.

Each type of farming system will be analyzed in order to determine the extent to which it is integrated in the local and international markets. Estimates of the nature, quantity, and value of the trade system will also be made in order to measure the flow of goods involved and the pressure exercised by such flow both on the economic pattern of the farming systems and on the attitude of farmers. The goods bought and sold will include both those for human consumption and those for other purposes, such as animal feed, fertilizers, pesticides, equipment, etc.---.

The study will analyze farming practices, technical knowledge, types of technology, mechanization and other items in relation to agricultural productivity.

IMPLEMENTATION PLAN

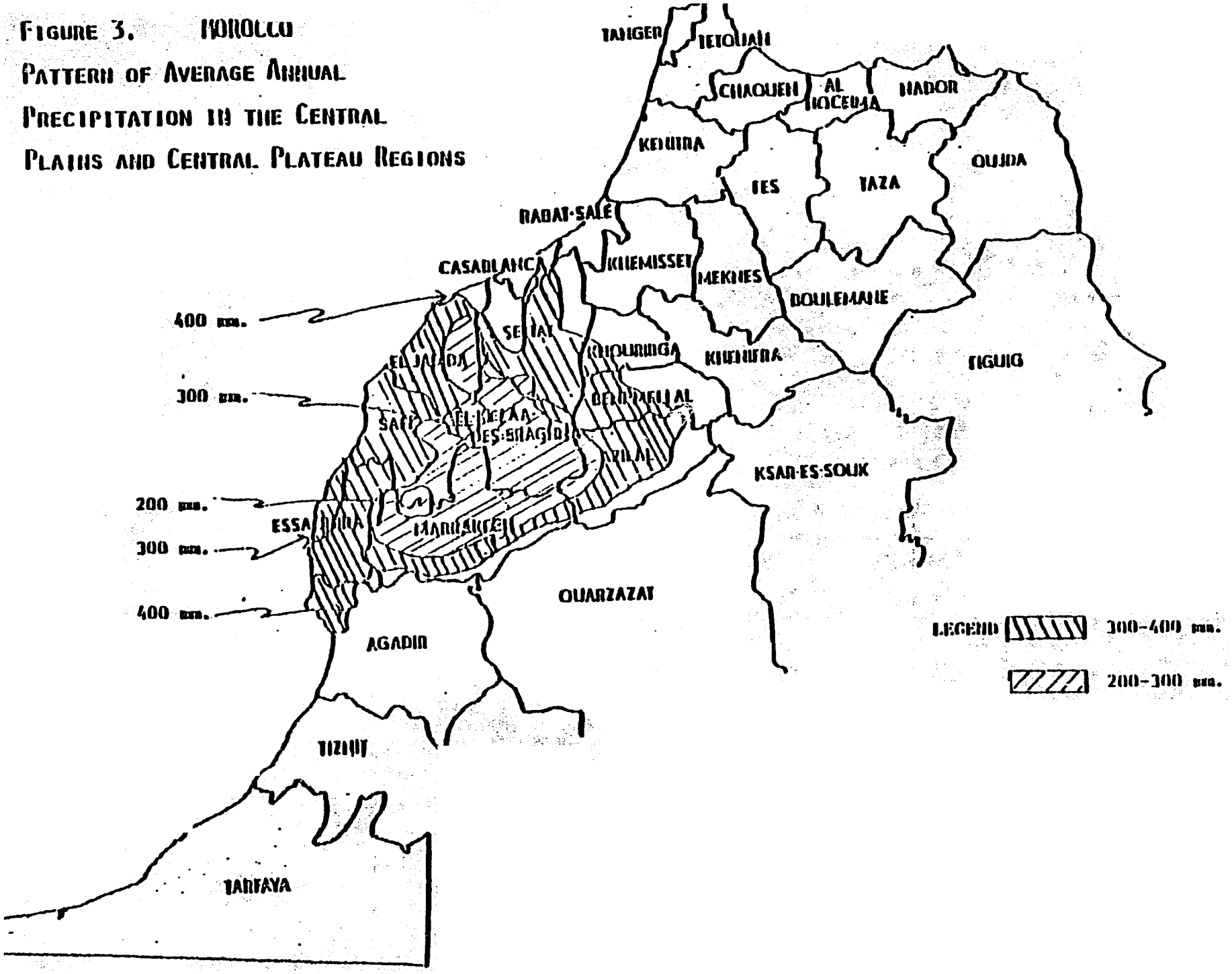
The following is a schedule of events planned for the study of the Chaouia region. A limited number of these events have already been started. USAID plans to provide some financial support for the study out of funds available under project 134, Dryland Farming, in order to permit the uninterrupted pursuit of this work.

- Study of the socio-economic history:	Nov. 77-June 79
- Collection of data on production practices:	Dec. 77-June 78
- Analysis of production practices data:	July 78-June 79
- Collection of data on value systems and consumption patterns	Oct. 78-June 79
- Types of farming units survey	Dec. 77-Mar. 78
- Analysis of farming units data	June 78
- Marketing Survey	Dec. 77-Sept. 78
- Analysis of marketing data	Dec. 79
- Technical Practices Survey	Nov. 77-June 78
- Analysis of data	July 78-Dec. 78
- Preparation of report on the Chaouia	

Staff:

Research:	2 socio-economists responsible for the study, half-time assignment from October 77 to June 7 (200 days of field work); 1 nutritionist, 200 days for survey; 1 agronomist, 200 days for survey; 1 livestock technician, 200 days for survey; 1 statistician, 100 days for the analysis.
Survey:	5 interviewers during 200 days of field work and 150 days for data processing.
Clerical work:	Typing, key-punching, etc.

FIGURE 3. MOROCCO
PATTERN OF AVERAGE ANNUAL
PRECIPITATION IN THE CENTRAL
PLAINS AND CENTRAL PLATEAU REGIONS



D. BUDGET PLAN AND ANALYSIS

1. The total (5-year) cost of the project is estimated at $7,400,000, including allowance for inflation and contingency. The U.S. contribution is $4,500,000 (61%); the Moroccan contribution is $2,900,000 (39%). The largest portion of the U.S. contribution is to cover the costs of contract services ($2,500,000) for the resident research team, equipment team, and short-term consultants. The vital element of long-term training is estimated at $855,000, a sum that will allow training to the required professional level of competence of more than the 22 Moroccans currently programmed. The Moroccan Government will pay for the international travel of all their participants.

2. It would be unrealistic at this time to attempt to determine a cost-per-beneficiary figure. As the socio-economic information begins to become available, we will be able to quantify the total project cost in terms of the estimated beneficiaries affected. In any case, given the potential benefit to cereal crop yields in particular and to Moroccan dryland agriculture in general, of an established research program, we believe the size of the budget is reasonable and justified.

3. The GOM has agreed, under the terms of the PL 480 Agreement, to allocate in 1978 to the project 6,000,000 dirhams ($1,333,000), of which 4,000,000 DH are for capital costs related to construction of the Main Research Center, and 2,000,000 DH are for operating expenses (or $90,000 per year for 5 years). However, this does not include salaries for technical and administrative personnel, vehicles for GOM project personnel, housing allowance, and other support costs which are provided from the GOM recurrent budget. To complete the Project Paper, we have made our own estimates of these costs in order to determine the total requirements for an Operating Budget (Table II). When the Project Paper is approved, we plan to negotiate a firm and comprehensive budget which will be included in the Project Agreement.

DRA has also pointed out that funds allocated to project activity are sometimes not available when needed due to a complex set of disbursement requirements. We therefore plan to negotiate a provision, also to be included in the Project Agreement, by which the GOM guarantees that operating funds will be made available when needed, preferably via the creation of a Special Account.

4. Apart from the budget presented herein, related U.S. financing of $105,000 was provided under the Dryland Farming Project, #131, to cover the costs of a) the MIAC feasibility study ($83,000) issued in January 1977* and b) the U.S. training ($22,000) of one Moroccan

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* "Applied Agronomic Research Program for Dryland Farming in 200-400 mm Rainfall Zone of Morocco". Prepared by the MidAmerica International Agriculture Consortium Dryland Farming Team under Contract No. AID/NE-C-1284 (University of Nebraska), January 1977.

agronomist who will be assigned to the project upon his return in the summer of 1978.

In future years, depending upon the outcome of the work undertaken by the Equipment Development Team under this project, there is the possibility of additional U.S. financing in the form of a loan (of up to $5 million) for the manufacture of equipment for the small farmer.

TABLE I. DRYLAND AGRICULTURE APPLIED RESEARCH BUDGET
($000)

Year	I	II	III	IV	V	Total
Salaries	270	193	214	212	227	1.125
Resident U.S. Staff 15 MY	100	114	120	126	132	600
Short-Term U.S. Staff 70 MM	36	42	45	45	42	210
Administrator-U.S. 30 MM	20	21	22	23	24	110
Secretary-U.S. 10 MM	15	16	17	18	19	85
Equipment Team 10 MM	100	-	-	-	-	100
Evaluation Team 6 MM	-	-	10	-	10	20
Indirect Costs	79	58	64	64	68	333
On campus 50%	18	19	20	21	22	100
Off campus 25%	61	39	44	43	46	233
Travel Per Diem & Transportation	129	65	70	62	92	418
U.S. travel	1	1	1	1	1	5
Arrival-home leave-departure	10	-	4	8	12	34
Visits International Centers	2	2	-	2	-	6
Short-Term Staff	25	32	34	35	32	158
Equipment Team	9	9	6	-	-	24
Evaluation Team	-	-	9	-	9	18
Inspection Visits	2	2	2	2	2	10
Shipping HHE & POV - Storage	24	1	2	2	28	57
In-Country travel	6	8	10	10	6	40
Shipping commodities	50	10	7	2	2	66
Other Direct Costs	160	107	112	121	164	664
Fringe benefits (20%)	36	39	41	42	43	201
On-campus supplies & expenses	5	6	6	7	7	31
In-country supplies & expense	1	1	1	1	1	5
Preparatory costs	2	-	-	-	-	2
Language training	25	-	-	-	-	25
Temporary lodging	36	-	-	-	40	76
Housing & utilities	40	42	44	46	48	220
Educational allowance	15	19	20	25	25	104
Commodities	330	60	5	5	5	405
Vehicles	75	-	-	-	-	75
Agricultural machinery & equipment	250	-	-	-	-	250
Laboratory equipment	-	55	-	-	-	55
Chemicals & pesticides	5	5	5	5	5	25
Training	210	60	30	100		900
Long term	210	45	15	85	-	855
Short term	-	15	15	15	-	45
Inflation (17%)		166	163	63	163	655
Contingency						
TOTAL	1,187	909	958	727	719	4,500

TABLE II. SUMMARY COST ESTIMATE AND FINANCIAL PLAN

Source	AID	GOM	Total
A. AID			
1. Contract Services:			
long-term	1,962		1,962
short-term	512		512
2. Commodities (including shipping	471		471
3. Training:			
long-term	855		855
short-term	45		45
4. Inflation (10%)	385		385
Contingency	270		270
GOM			
1. Operational budget		2,000	2,000
2. Investment budget		900	900
	4,500	2.900	7,400
	(61%)	(39%)	(100%)

TABLE III. COSTING OF PROJECT INPUTS/OUTPUTS
($000)

INPUTS	OUTPUTS: Research Program #1	Trained Staff #2	Farmer Equipment Activity #3	Socio-Economic Information #4	TOTAL
Contract Services					
long-term	1,246	'16			1,962
short-ter	222	00	110	80	512
Commodities	471				471
Training					
long-term		855			855
erm		45			45
	1,939	1,716	110	80	3,845
	(50%)	(45%)	(03%)	(02%)	(100%)

IV. IMPLEMENTATION

IV IMPLEMENTATION

A. Administrative Arrangements

1. GON

a. Implementing Agencies

The project will be i[illegible] by the Agronomic Research Directorate (DRA) and the National Agronomic and Veterinary Institute (INAV) in cooperation with the Development Directorate (DMV) of the Ministry of Agriculture and Agrarian Reform (MARA), and the National School of Agriculture (ENA) at Meknes. The DRA will be responsible for the agronomic research program with the support of the DMV and the ENA. The INAV will be responsible for the socio-economic research program.

b. Coordinating Committee

Project implementation will be guided and supervised by a Dryland Coordinating Committee that will be chaired by the Secretary General of MARA and will comprise the heads of the central directorates into which MARA is organized. (See organizational chart of MARA.)

c. Advisory Committee

A Dryland Regional Committee will be created as an advisory group to the agronomic research program. It will be composed of the Chief of the DRA Regional Center in Casablanca, the Provincial Directors of Agriculture in the semi-arid region, and farmer representatives. The committee will be chaired by the Agricultural Director of Settat Province where the main research center of Sidi El Aidi will be located.

d. Organization of the Main Research Center

The Sidi El Aidi research center will be organized into sections corresponding to the major areas of research, namely: Cereals, Grain Legumes, Forage Crops, Weed Control, Soil, Plant Pathology, Entomology, and Production Economics. Each section will be headed by an ingénieur d'etat who will be trained at the Ph.D. level in his field of specialization. One of the section chiefs will also serve as director of the center.

Three additional ingenieurs d'etat trained at the M.S. level--one each in Agronomy, Soil Science, and Forage Crops--will complement the senior research staff. The agronomist will also serve as manager of the center, and the other two will be in charge of the soil and forage analysis laboratories, respectively. The senior staff will be supported by technicians who will be assigned, as needed, to each section and to the laboratories.

To permit effective coordination of research and extension the Dryland Farming Bureau of the DMV will be relocated at Sidi El Aidi and its activities fully integrated with those of the research program. The staff of the Bureau which currently consists of two ingenieurs will be increased as the project evolves; it will participate actively in the research effort at the Main Center but will have primary responsibility for the outreach activities, including the training of the extension agents of the C.T.s.

In Meknes province, research activities will be carried out at the farm of the ENA and with the participation of the faculty in agronomy, soil, and plant pathology.

Finally, whenever necessary, the activities of the agronomic research program will be reinforced by the central DRA laboratories in Rabat --such as soil physics, soil microbiology, and other appropriate DRA units such as data processing and plant breeding.

e. The DRA as Implementing Agency

The DRA is one of the central directorates of the Ministry of Agriculture and Agrarian Reform and is responsible by law for all agricultural research in Morocco.

The DRA comprises five administrative units:

1. Research and Experimentation
2. Technical Control and Plant Sanitation
3. Documentation and Data Processing
4. Administration
5. Regional Centers

The Division of Research and Experimentation, which will be directly responsible for implementing the agronomic research program, is sub-divided into 3 services: Plant Production, Animal Production, and Ecology. These services in turn each contain a number of specialized sub-units called Central Stations or Laboratories. A total of 30 such sub-units exist of which 25 are located in Rabat and one each in Meknes, Kenitra, Casablanca, Beni Mellal, and Marrakech. In addition, there are 11 regional Sections which are branches of one of the Central Stations. These various units, their location, and the number of their staff are presented in Table IV.

The research staff of the Division numbers 92 ingenieurs, distributed as follows: Plant Production, 68; Animal Production, 10; Ecology, 14. Of this total, only 25 are stationed in the provinces; the other 67 are all in Rabat or nearby at the Koudia animal husbandry station.

Field research infrastructure consists of a 23-ha. station (Guich Station) and a 12-ha. field (Jardin d'Essais) in Rabat, 35 experiment stations, and 19 sub-stations which are widely scattered throughout the country.

The relationship just described between the size and location of the research staff on the one hand, and the number and location of the research stations on the other, makes the DRA an inherently unproductive an inefficient organization. Travel funds are never sufficient to permit adequate supervision of field experiments. As a result, the conduct of such experiments, although designed by the staff in Rabat, is largely left to adjoints techniques who run the provincial stations and whose training generally consists of two years at a secondary-level agricultural school. Under these circumstances, the validity of reported data is highly questionable.

According to information provided by DRA officials, the directorate is also plagued by a number of other problems: lack of competent staff, insufficient staff, and cumbersome operating procedures which are allegedly almost paralyzing. Therefore, if the agronomic research program is to succeed, it will be absolutely essential to ensure that the Moroccan ingenieurs who will make up its permanent staff will be assigned in sufficient numbers in the first three years to permit their advanced training in the U.S. It will be equally essential that the operating procedures, particularly with regard to disbursement of operating funds, be simplified and made efficient. Both points will be addressed explicitly in the Project Agreement.

Coordination of Agronomic and Socio-economic Research

Periodic meetings of the two research groups will be held to review the orientation and progress of the two research activities in terms of the problems confronting dryland farmers. It is believed that this arrangement will be beneficial to both the agricultural and the social scientists but will also enhance the probability of success of the project.

2. USAID and Contractor Roles

a. USAID

USAID's role will be to monitor the implementation of the project, schedule and arrange for the planned evaluation exercises, and otherwise assist in the resolution of major problems that may arise to threaten the success of the project. It is not expected that additional staff will be required.

Contractor

U.S. assistance will be provided through a contract with a land-grant university or a university consortium with expertise and experience in the conduct of applied dryland research. Since Arabic and French are the working languages in Morocco, the resident contract staff must have sufficient proficiency in one or the other in order to communicate effectively with their associates and other Moroccan officials. The contractor will be self-supporting and will perform called-for services in accordance with annual work plans which will be approved by both USAID and the GOM. The contractor will also report annually, and in writing, to the GOM and USAID on project activities. As already indicated, the role of the U.S. contract team will be that of senior but temporary associates in the establishment of the program. Under no circumstances will they be allowed to function as substitutes for Moroccan staff.

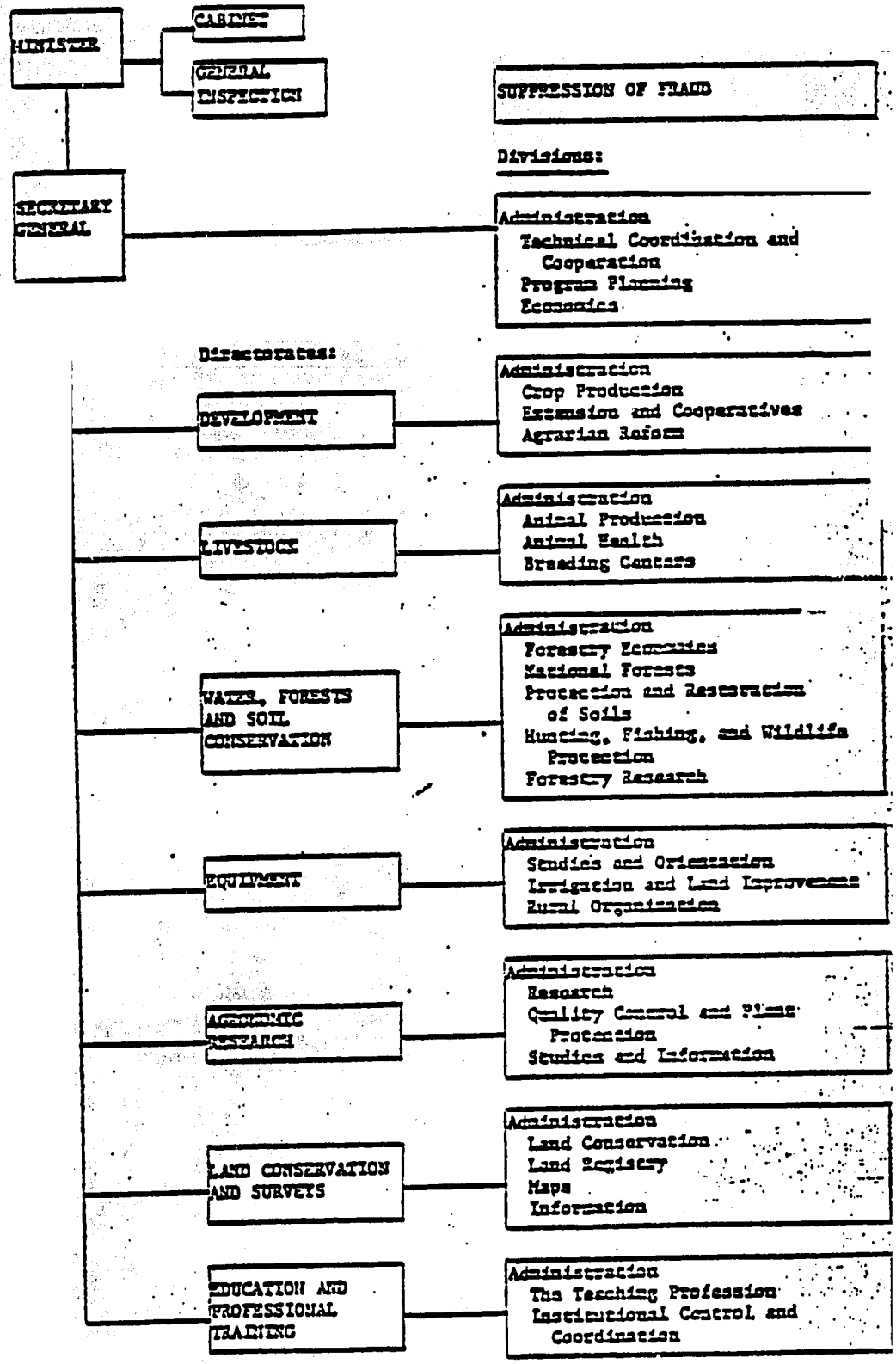
MINISTER
CABINET
GENERAL INSPECTION
SUPPRESSION OF FRAUD
Divisions:
SECRETARY GENERAL
Administration
Technical Coordination and Cooperation
Program Planning
Economics
Directorates:
DEVELOPMENT
Administration
Crop Production
Extension and Cooperatives
Agrarian Reform
LIVESTOCK
Administration
Animal Production
Animal Health
Breeding Centers
WATER, FORESTS AND SOIL CONSERVATION
Administration
Forestry Economics
National Forests
Protection and Restoration of Soils
Hunting, Fishing, and Wildlife Protection
Forestry Research
EQUIPMENT
Administration
Studies and Orientation
Irrigation and Land Improvement
Rural Organization
AGRONOMIC RESEARCH
Administration
Research
Quality Control and Plant Protection
Studies and Information
LAND CONSERVATION AND SURVEYS
Administration
Land Conservation
Land Registry
Maps
Information
EDUCATION AND PROFESSIONAL TRAINING
Administration
The Teaching Profession
Institutional Control and Coordination

TABLE IV. DIVISION OF RESEARCH AND EXPERIMENTATION

SUBDIVISIONS AND STAFF

Plant Production

	Central Stations/Staff	
1.	Winter Cereals	4
2.	Spring Cereals	1
3.	Food Legumes	1
4.	Forage Crops	1
5.	Oil Seed Crops	2
6.	Fiber Crops	1
7.	Sugar Crops	5
8.	Fruit Crops	1
9.	Olive	-
10.	Tea	-
11.	Cultural Practices	4
12.	Agr. Chemistry	9
13.	Plant Protection	21
14.	Vegetable Crops*	2
15.	Citrus Crops*	4
16.	Radio Elements*	2
17.	Saharian Agronomy*	6
		64

Animal Production

Central Stations/Staff	
Cattle	1
Sheep & Goat	2
Poultry	1
Bee Culture	2
Nutrition	1
Silkworm*	-

Ecology

Central Stations/Staff	
Plant Ecology	1
Bioclimatology	-
Soil Mineralogy	1
Soil Microbiology	2
Soil Physics	1
Soil Chemistry	3
Soil Mapping	2
	10

	Regional Stations/Staff	
1.	Horticulture	1
2	"	1
3	"	1
4.	Plant Protection	1
	"	1
		4

Regional Stations/Staff	
Livestock	1
	1
	1
	3

Regional Stations/Staff	
Soil Mapping	2
	1
	1
	4

- Technician
* Station located outside Rabat

B. Implementation Plan

he implementation steps listed in the following schedule reflect the major actions that need to be taken to produce the outputs expected of this project--a research program, trained Moroccan staff to carry it out, and suitable equipment for use by small farmers. It is essential, for example, that the Moroccan ingenieurs who will make up the permanent staff of the research program be able to complete their training in the U. S. early in the life of the project (See Training Schedule). Only in this way will they be able to participate effectively in the establishment of the program and prepare themselves for taking leadership and responsibility upon termination of Phase I of the project.

The major output--pertinent information on small farmer behavior resulting from the socio-economic research program--should follow fro the implementation schedule of surveys shown at the end of Part III (Socio-Economic Research Program).

Apart from building an applied research capability, the project is intended to increase, in th elong run (i.e., at the "Goal" level), basic food production and the income of small dryland farmers. There are several key assumptions underlying the full achievement of these goals. For example, the socio-economic research results must be useful and must be used by the Ministry of Agriculture in extending to the farmers the technology developed by the research team. Annual evaluations will nee to include this point on the Agenda. Another assumption, more basic to maximizing the benefits of this project to small farmers, is that the G will follow through with a comprehensive land reform program throughout the dryland area. In addition, the prices of production inputs--such as fertilizer, pesiticides, and agricultural chemicals, prices paid to farmers, and land taxation--are major areas in which policy changes may be necessary in order to ensure optimum diffusion of benefits under this project.

IMPLEMENTATION P[illegible]

1.	PP submitted to AID/W	March	1978
2.	PP approved	April	1978
3.	Selection of first group of 6 trainees	May	1978
4.	Project Agreement signed	May	1978
5.	Contract signed	July	1978
6.	Consultants arrive to design Main Research Cent	July	1978
7.	First group of 6 Moroccan resea[illegible] depart for U.S.	July	1978
8.	Project commodities ordered	August	1978
9.	Resident research team leader arrives at post	Sept	1978
10.	Work Plan for Year I (1978/79) completed	Oct/Nov	1978
11.	Field research work begins	Nov	1978
12.	Equipment team arrives	Nov	1978
13.	Construction of main research center begins	Jan	1979
14.	Balance of resident research team arrives	March	1979
15.	Selection of second group of trainees	March	1979
16.	Second group of 7 trainees depart for U.S	July	979
17.	Annual evaluation	August	979
18.	Work Plan for Year II (1[illegible]) approved	August	979
19.	Construction completed on buildings at main research center	Oct	979
20.	Equipment team report	March	980
21.	Selection of third (last) group of 9 trainee	March	980
22.	Third group of 9 trainees depart for U.S.	July	980
23.	Annual evaluation	August	980

Implementation Plan (continued)

24.	Work Plan for Year III (1980/81) approve	August	1980
25.	First group of trainees return	Sept.	1980
26.	Special evaluation	June/July	1981
27.	Work Plan for Year IV (1981/82) approved	Augus	1981
28.	Second group of trainees return	Sept.	1981
29.	Soil testing and forage laboratory becom operational	Nov.	1981
30.	Annual evaluation	August	1982
31.	Work Plan for Year V (1982/83)	August	1982
32.	Final evaluation	August	1983
33.	Third group of trainees returns	Sept.	1983
34.	Resident research team departs	Sept.	1983

Note: The scheduling of the socio-economic studies is included as a separate, though related, "implementation plan" at the end of Part III, C (Socio-Economic Research Program)

TRAINING SCHEDULE

1.	Agronomy	July 78---------- Sept 80
2.	"	July 78---------- Sept 80
3.	"	July 79---------- Sept 81
4.	"	July 79---------- Sept 81
5.	"	July 80---------- Sept 82
6.	"	July 80---------- Sept 82
7.	"	July 80---------- Sept 82
8.	Forage Crops	July 78---------- Sept 80
9.	"	July 79---------- Sept 81
10.	"	July 80---------- Sept 82
11.	"	July 80---------- Sept 82
12.	Soil Science	July 78---------- Sept 80
13.	"	July 79---------- Sept 81
14.	"	July 80---------- Sept 82
15.	Weed Science	July 78---------- Sept 80
16.	"	July 79---------- Sept 81
17.	Plant Pathology	July 78---------- Sept 80
18.	"	July 80---------- Sept 82
19.	Entomolog	July 79---------- Sept 81
20.	"	July 80---------- Sept 32
21.	Economics	July 79---------- Sept 81
22.	"	July 80---------- Sept 82

C. Evaluation Plan

Evaluation will be essential to the project's progress and will be carried out annually with the cooperation of USAID, GOM, and the contractor. Considerable baseline data are already available in the IHAC report, e.g., on the present status of the DRA research program, trained staff, and current crop yields. Socio-economic baseline information is not available, however, and it is for that reason that the socio-economic research component of the project was included. Evaluations have been scheduled annually in August, prior to approval of the Work Plans. In Year III (August 1981), a special evaluation is scheduled which will involve examination by an outside contractor. Likewise, at project termination in Year V (August 1983), an in-depth evaluation will be undertaken.

Individual factors which should be singled out for careful examination in the annual evaluations are the following:

1. Timely assignment of project personnel by the GOM
2. Timely allocation and disbursement of financial resources.
3. Timely assignment of contractor staff.
4. Adequacy of training program.
5. Timely arrival of commodities.
6. Usefulness of analytical reports on socio-economic status of small farmers.

After the formulation of the five year research program and stipulation of the institutional capabilities expected to be developed during the project, the evaluation plan shown above will be restructured to measure the achievement of project purposes as well as delivery of inputs and attainment of output objectives.

V. SUPPORTING ANALYSES

TECHNICAL ANALYSIS

Moroccan agriculture is dominated by the production of cereals and livestock which account for 40% and 27% respectively of the total agricultural production. Cereals constitute the main source of livelihood and livestock the main source of income for over 1 million rural families.

Livestock Production

Except for dairy cattle raised mostly in the irrigated areas, livestock production is almost stagnating. The rangelands - some 10 to 12 million ha - which support an estimated 13 million sheep and 8 million goats, are overstocked and producing well below their potentials. On the croplands, almost every farmer raises a few head of cattle which are generally underfed and malnourished. The main sources of cattle feed are straw from harvested cereals, volunteer plants and weeds that grow after crop harvest or in fallow fields, and some barley grain. Given the country's high growth rate of 3.0% and the changing consumption patterns, Morocco is likely to become a net importer of meat.

Crop Production

Morocco is already a cereal importer and in recent years imports of bread wheat have increased steadily to more than 1 million metric tons annually for the past three years. Projected imports for the current year are 1.7 million M.T. Analysis of the crop production situation suggests that this import trend is likely to continue unless a systematic and sustained effort is made to increase the productivity of the farmers.

Land utilization

Morocco's cropland area is about [illegible] million ha. Approximately 5-1/2 million ha. are cultivated annually and 1/2 million ha. are in fruit and nut crops. The remainder is left fallow. Table V presents the areas occupied by the major categories of crops during the five-year period 1971-2 - 1975-6.

Table V - Areas Occupied by the Major Crop Groups 1971-2 1975-76 in 000 ha.

Crops	1971-2	1972-3	1973-4	1974-5	1975-6	Average	% Total	% Annual
Cereal	4532	4600	4457	4112	4044	4470	57.5	83.7
Legume	472	545	572	562	557	544	7.1	10.2
Oil Seed	55	36	43	43	35	42	.5	.8
Vegetable	114	111	111	95	98	105	1.3	1.9
Industrial	80	72	87	90	93	78	1.1	1.6
Forage	60	62	61	84	85	74	1.0	1.4
Other	24	21	11	12	14	18	.2	.4
Annual	5342	5447	5370	5018	5519	5340	69.7	100.0
Fruits	557	511	511	541	547	533	7.0	
Fallow	1779	1593	1641	2097	1800	1752	23.3	
Total	7669	7551	7522	7650	7866	7657	100.0	

Cereals are by far the most important crops with 84% of the annually cultivated area, followed by the grain legumes with 10%, leaving 6% or 330,000 ha for all other annual crops. The major cereals produced are, in order of importance: barley, durum wheat, bread wheat and maize. While the major grain legumes are: broad beans, peas, chick peas, and lentils. Table VI presents the areas occupied by the major cereals and grain legumes.

Table VI - Areas of Major Cereals and Grain Legumes - in 000 Ha.

Cereals	1971-2	1972-3	1973-4	1974-5	1975-6	Average	%
Barley	1943	2016	1973	1619	2130	1974	44.2
Durum W.	1593	1478	1388	1236	1454	1412	31.5
Bread W.	495	562	528	453	463	501	11.2
Maize	431	446	447	490	432	460	10.3
Other	110	94	119	110	100	123	2.7
Total	4532	4600	4455	4118	4644	4470	100.0
Legumes							
Broad Beans	255	273	227	220	191	235	43.2
Peas	91	102	110	137	133	115	21.1
Chick Peas	53	84	150	99	100	99	18.2
Lentils	39	31	41	46	63	44	8.1
Other	36	58	46	60	67	51	9.4
Total	79	545	582	562	554	544	100.0

Rainfed Crop Production

Of the 8 million ha. of crop land, about 1 million ha. are irrigable and approximately 500,000 ha. have been brought under irrigation. The irrigated area produces primarily sugar beet, practically all of the cotton and rice, most of the vegetables and citrus which are grown largely for exports, and some cereals (mostly bread wheat).

Most of the crop production comes therefore from the rainfed areas and is conducted under high risk conditions. Over most of the country the rainy season extends from mid-October-November to April-May. Except in the mountainous regions, little if any rain falls between May and September, a period also marked by high temperatures. By contrast, during the rainy season mild temperatures generally prevail and sunshine is abundant. Thus the crop growing season coincides with the rainy season and, because the long and hot dry season virtually precludes the possibility of conservation of soil moisture through summer fallow, crop production depends essentially on the rains that occur each year.

Highly Variable Rainfall and Crop Production

Rainfall decreases in yearly amount as one moves south from the Rif mountains and east from the Atlantic coast. For example, average annual precipitation is 586 mm in Tangiers; Meknes 574 mm; Casablanca 404 mm, Settat 381 mm, Marrakech 242 mm and Agadir 226 mm. Accordingly, crop production decreases from the more humid regions to the semi-arid and arid areas (Table VII)

Table VII - Av rage Cereal Area and Production by Rainfall Region

Kenitra	465	11	605	14
Meknes	137	4	220	6
Fes	311	7	414	9
Taza	135	3	179	4
400 mm+	1126	25	1479	33
Settat	524	13	563	13
El Jadida	375	8	347	8
Safi	535	15	414	9
Khouribga	134	3	191	4
300-400 mm	1725	39	1520	34
Beni Mellal	245	5	267	6
Marrakech	702	16	562	13
Agadir	219	5	164	3
200-350 mm	1106	26	993	22
Other	448	10	473	11
Total	470	99.9	4464	100.0

Rainfall is high, variable in amount (up to 33%) from year to year and in distribution during the rainy season. This uncertainty is reflected in the wide variations in yearly crop production.

Table VIII - Production of Major Cereals and Grain Legumes-1971-2 1975-6
In 000 Tons

	Average	Highest	Lowest
Barley	2,106	2,360	1,354
Durum W.	1,410	1,632	1,199
Bread W.	460	537	371
Maize	368	492	217
Other	119	N.A.	N.A.
All Cereals	4,463	5,504	3,140
Broad Beans	251	343	109
Peas	86	164	37
Chick Peas	73	164	34
Lentils	27	42	11
Other	42	N.A.	N.A.
All Legumes	479	704	353

Highest and lowest yields do not occur in the same year for all crops.

Unstable and Low Yield

Wide variations in crop yields also occur throughout the country from year to year and although yields are generally higher in the more humid areas (Fes, Meknes, Kenitra) than in the semi arid (Settat-Safi), and arid areas (Marrakech-Beni Mellal), they are low when compared to those obtained under similar conditions in other countries (Table IX).

Table IX: Yields of the Major Cereals in Tons
1971/72 - 1975/76

Provinc	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.	Max.
[illegible]	.9	.5	1.1	1.1	.7	1.9	1.5	1.2	2.1	.9	.5	1.6
Fes	1.4	.5	2.0	1.3	1.0	1.7	1.4	1.2	1.9	.9	.7	1.3
[illegible]	1.8	1.3	2.2	1.4	1.2	1.8	1.5	1.2	1.7	1.2	.4	2.2
[illegible]	1.5	1.0	1.8	1.1	1.0	1.2	1.3	1.1	1.5	1.2	1.0	1.4
[illegible]	.8	.6	1.2	.9	.6	1.3	1.2	.8	1.4	1.0	.9	1.3
El Jadida	1.0	.7	1.3	.8	.4	1.2	1.0	.4	1.3	.8	.4	1.1
Safi	.5	.1	.8	.5	.2	.9	.8	.1	1.3	.2	.1	1.0
Khouribga	.8	.4	1.2	.8	.5	1.2	1.6	1.0	2.3	NA	NA	NA
Beni Mellal	1.0	.7	1.3	1.0	.8	1.2	1.2	.8	1.4	1.6	.9	2.4
Marrakech	.5	.1	.8	.5	.2	.8	.9	.4	1.2	1.1	.5	2.4
Agadir	.5	.2	.8	1.2	.8	1.6	.7	.3	1.2	.7	.3	1.1
[illegible]	.9	.4	1.4	.6	.3	.8	1.2	.8	1.5	NA	NA	NA
Nador	.6	.4	1.0	.5	.4	.8	1.1	.8	1.4	NA	NA	NA
Al Hoceima	.7	.5	.9	.9	.2	2.1	1.4	.9	2.0	1.1	1.0	1.3
Tetouan	1.2	.8	1.7	1.0	.7	1.3	1.1	1.0	1.4	1.4	.3	3.3

Inadequate Production Technolo

The erratic rainfall pattern that c
some effect on the variations in crop production and yields that occur f
year to year. However, it does not explain the low levels that are achieved.
Analysis of the production practices followed by the rainfed farmers suggests
that the low productivity of these farmers is probably due much more to inade-
quate technology than to insufficient rainfall.

Farmers in Morocco are commonly classified as modern or traditional. Yet
outside the irrigated areas where production is definitely market-oriented,
and judging by their strikingly similar production practices, the distinction
between the two groups is more apparent than real

... the rainfed areas, land preparation is generally carried out just
ahead of planting time after the first fall rains have softened the hard and
dry soil from the long and hot dry season. Modern farmers use mechanized equi-
ment, traditional farmers use the age-old animal drawn wooden plow or its steel
version. Modern farmers also tend to practice deep plowing on the mistaken
premise that the operation is necessary to save water. Actually, in addition
to being costly, deep tillage appears to cause important losses of soil mois-
ture without either providing a desirable seed bed or controlling weeds
effectively. Moreover, on sloping land, it tends to increase soil erosion
which is already a serious problem throughout the country.

Seed and fertilizer (when used) are normally broadcast and mixed with the
soil, using a tractor-drawn tandem disc (modern) or the animal drawn plow
(traditional). In either case, the results are the same. The planted seed
is unevenly distributed and buried, which makes for unsatisfactory germination.
This also results in poor stands and eventually poor yields. To overcome
this, farmers use high rates of seeding (40 KG/ha) which are twice the common
rates in the U.S., and often practice a second seeding. Considering that
2 million ha. are planted in barley and 1.9 million in bread wheat and durum
wheat, improving the seed method alone could save Morocco almost 30,000 MT
of barley and wheat annually. Broadcasting fertilizer is also inefficient and
wasteful, particularly in the case of phosphate which tends to become insoluble
and consequently unavailable to the seedling in its critical early growth
period. Moreover, broadcasting has the effect of fertilizing the weeds as well
as the planted crop, thus increasing their ability to compete for soil moisture

Although some farmers regularly use certified seed, most plant seed saved from their own previous harvests or purchased from other farmers at the local market. Some give attention to cleaning weeds from their seeds, many do not. The result is that often weeds are planted with the crop. Generally, the seed has not been tested for germination and its variety is unknown. However, given the cultural practices, seed variety is probably not a major factor in determining crop yield. Almost certainly the genetic potential of the seeds being used exceeds the yield potentials of the rest of the production system. Under such circumstances the major investment required for changing to certified seed of improved varieties would not be justified.

Harvesting of cereals and grain legumes is accomplished primarily with hand sickles. The grain is carried or hauled and temporarily piled near the threshing floor. Animals driven over the dry grain spread over the threshing floor accomplish the threshing. Winnowing is by wind from straw and grain being tossed into the air by pitchfork. Observation of volunteer cereal plants in fields indicates considerable shattering loss in the harvest process.

Modern farmers by contrast use self-propelled combines for harvest. Heavy stands of volunteer grain can be observed in many of the fields that are harvested with combines, particularly in the path of the combine separ This indicates improper adjustment of the machines.

Fallow Land

A substantial area (23%) of the arable land is used each year for so-called "fallow". Little, if any, of this fallow land is managed to prevent weed growth so as to conserve moisture and permit mineralization of available nutrients such as nitrogen. As practiced, fallow is more properly an annual crop of weeds and volunteer for livestock grazing.

The pressure for livestock feed is great. Throughout Morocco, little permanent perennial forage exists. Only 1.4% of the arable land is planted to forage crops and most of that is under irrigated conditions. In the rainfed areas, practically every hectare of even thin, marginal soil is planted quite regularly to barley or other cereal. From the time of harvest until the next crop is planted, livestock repeatedly graze the fields. Some of this land is not planted each year but is used for livestock grazing. This is not "fallow" as it is understood normally. As indicated earlier, it is an annual crop of weeds and volunteer that is grazed closely and continuously. This practice is not only inefficient in terms of forage production and animal nutrition, it is also a hazardous one in that it keeps the land nearly bare and subject to sheet-erosion.

Instead of a very unproductive crop of weeds, a much larger amount of quality forage could be produced on the fallow land if it were planted to annual forage crops, possibly grasses and/or legumes which would be cut for hay at timely intervals rather than being grazed. Admittedly this would involve a change in livestock management practices, but it would greatly increase the feed supply that so seriously limits livestock production.

Production Potentials under A1 Production System

To date, GOM programs to develop rainfed production have been directed essentially to larger farmers and in the more humid areas of the country (over 400 mm annual rainfall). Little has been done in the semi-arid and arid areas outside the irrigated perimeters. In these neglected areas most of the farmers are small, subsistence operators whose only tillage equipment is an animal-drawn wooden or steel plow with occasionally a small spike-tooth harrow.

Throughout these areas, soils are shallow, and the dry season is probably too long and hot to permit fallowing through one year in order to accumulate soil moisture for use in a two-year crop-fallow system that would increase yields and stabilize production.

Yet in the semi-arid areas (325 mm - 400 mm annual rainfall) there are clear potentials for markedly increasing crop yields and the productivity of the farmers. To achieve this, the production systems presently in use must be altered radically. However, although much progress has been made in countries such as Australia and the U.S. in improving the efficienty of farming in semi-arid areas existing technology is not directly applicable to Moroccan ecological conditions. Therefore a systematic research effort must be made to determine the alternative production practices and systems that farmers in the semi-arid areas can use without increasing the already high risks under which they operate.

Because the small farmers who are in the majority in these areas cannot ever do a satisfactory job with the equipment available to them presently, the research effort must give priority attention to the development of small, simple, low draft implements. Designing, testing, manufacturing and distributing such implements will take time and will require a major effort.

There is no evident, easy way to make major gains in agricultural production in the semi-arid areas. A vigorous applied research program is the right place to start in developing the technologies and information needed for sound decisions regarding programs that will take advantage of the substantial potentials that appear to exist in these areas.

B. ECONOMIC ANALYSIS

Since this project neither requires an infusion of capital (in the financial investment sense) nor generates direct revenue benefits (in the cash flow sense), it has not been the subject of a feasibility analysis for determination of internal rates of return, benefit-cost ratios or sensitivity analysis. The relevant questions related to technical and economic soundness and economic validity are, however, addressed below.

Population Expansion and Increased Food Requirements

With its present population, Morocco must import substantial amounts of cereals and other food products. With an annual population growth rate of about 3% and about 50% of its population under the age of 18, continuing rapid growth in population for the next twenty years seems certain. The need for added food will increase accordingly. The population will increase by three million in five years, the proposed duration of the first phase of the applied research project. If this increased food need is not generated by increased production within the country, it will have to be imported — will constitute a considerable burden on foreign exchange earnings.

Land Use in the Project Area (see Table X)

About 2 million ha. are cultivated annually in the project area. They represent 36% of the total cropland planted in Morocco. The project area accounts for 36% of the national barley area, 33% each of the durum and bread wheat, and 37% of the maize. Pulses are produced on only 152,000 hectares, or 7% of the cropland cultivated annually in this area, but they represent 29% of the total hectares devoted to pulses in Morocco. They are no doubt grown in the better land areas as well as on irrigated lands.

The number of hectares of irrigated lands in the traditional dryland area has been increasing. In April 1975, the Ministry of Agriculture reported two major projects in the area, the Doukkala in El Jadida province with 38,200 hectares, and the Haouz project in Marrakech province with 37,500 hectares—a total of 86,700 hectares under irrigation.

* During negotiations with the GOM, the project area proposed in the MIAC report was redefined to include only those regions where rainfall averages 325-425 mm per year. Since available data are generated by province, extrapolation of statistics from the MIAC proposal, or compilation of similar statistics, would compound errors already contained in collecting the original data. Accordingly, this section will use the information as given in the MIAC report.

Table X: Land Use in the Project Area [1]

Crop	Hectares	% of Country Total
Durum Wheat	459,000	32.5
Bread Wheat	164,000	32.7
Barley	707,000	35.8
Maize	300,000	82.5
Pulses	152,000	28.6
Other Crops	94,000	11.5
Total in Cultivation	1,756,000	34.3

1/ Provinces: Settat, Khouribga, El Jadida, Saf

Crop Yields

The average yield data for the three major cereal crops in Morocco during the five-year period 1969/70 through 1973/74 provide some observations that are significant in terms of future productivity (see Table XI). First, the severity of the 1972/73 drought is very apparent and indicates the production risks involved due to climatic conditions. Yields of wheat and barley, which dominate the cereal crops in the dryland arable area, dropped sharply. The yield per hectare in bread wheat was 25% below the five-year average, while barley yields declined 43%. Many observers believe the yields in 1972/73 were actually much lower than those reported.

Second, the relative stability of yields during the other four years plus the production levels obtained indicate that the combination of fall and winter rains plus the cool weather provide the right environment for maximizing production in the dryland arable areas. Plantings of annual crops are made in the fall and early winter and harvested in the spring. Because of this, production and harvest periods are identified as two years, 1969/70, indicating planting in 1969 and harvest in 1970.

TABLE XI. Yields of Cereal Grains and Pulses in Morocco 1969-70 & 1973-74 Harvests. (Quintals per hectare and bushels or pounds per acre)

Crop	1969-70	1970-71	1971-72	1972-73	1973-74	1969-70 & 1973-74 5-year average
	Q/Ha	Q/Ha	Q/Ha	Q/Ha	Q/Ha	Q/Ha
Wheat, durum	9.86	10.32	10.84	8.00	9.93	9.90
Wheat, bread	8.43	10.98	10.70	6.98	8.94	9.19
Barley	10.33	12.87	12.76	6.22	12.10	10.84
Pulses 1]	8.40	7.88	8.61	6.40	12.01	8.25
	Bu/A	Bu/A	Bu/A	Bu/A	Bu/A	Bu/A
Wheat, durum	14.7	16.1	16.1	11.9	14.8	14.7
Wheat, bread	12.5	16.3	15.9	10.4	13.3	13.7
Barley	19.2	23.9	23.7	11.6	22.5	20.1
Corn	10.0	13.7	12.2	7.3	13.9	11.5
	Lb/A	Lb/A	Lb/A	Lb/A	Lb/A	Lb/A
Pulses 1]	749	703	768	434	1071	781

1] Broadbeans, Chick and Green Peas, Lentils, and other pulses.

Livestock

The livestock production in the traditional dryland arable area is a significant part of the total livestock production of Morocco (Table XII). Fifty percent of the cattle are in this area, plus 48 percent of the sheep and 19 percent of the goats. In the northern, better rainfall area, cattle dominate with some sheep and practically no goats. Moving south and west, the annual rainfall declines, and the number of sheep and goats increases. Small herds dominate in the same manner that small farms dominate. Any comprehensive program to improve the well-being of farmers in the dryland arable area will have to include improving livestock production along with improving crop production.

TABLE XII. LIVESTOCK POPULATION IN MOROCCO, 1974

Type	Total Number in Morocco	Number in Project Area	% in Project Area
Cattle	3,400,000	1,704,000	50
Sheep	16,000,000	7,680,000	48
Goats	7,000,000	1,666,000	24
Hogs	11,000	N/A	
Donkeys	1,200,000	N/A	
Horses	320,000	N/A	
Camels	200,000	N/A	
Mules	360,000	N/A	

The Average Farm in the Project Area

There are an estimated 263,000 farm units in the project area, and great differences exist among them. Recognizing that the profile of an average farm does not describe either the typical farm or any specific farm unit, the following, nevertheless, provides a valuable perspective of the situation.

Information on crop production on the average farm in the area is presented in Table XIII. It has 6.68 hectares of cropland. Barley occupies 3.29 hectares, or 49% of the land, and accounts for 65% of the

value of the crops produced. Twenty-six percent (26%) of the land is in fallow. Total harvested crop production, based on 1969-74 average yields and 1975 prices, amounted to DH 2,208 ($492). The fallow area, plus stubble used after harvest for grazing livestock, make a real contribution to farm income. To obtain an overall gross income, one would need, therefore, to calculate the returns from livestock production. However, no value has been assigned to the fallow land and the stubble in developing the crop income. Although most farmers raise some cattle (1-3 heads), these are viewed by the farmers more as a form of savings than as income. No data are available to determine how much of the 6.68 hectares are owned and how much is rented, but it is safe to assume some of it will be rented and a share of the crop will be given to the owner. In addition, the farm will very often be fragmented.

Expense for production will be small. Tools will include a wooden plow with a steel point, hand sickles, wood forks, simple harnesses made mostly of twine plus a little wire and chain, and related items. In addition, there may be some years when seed is purchased, but most years the farmer will use his own seed. A few farmers use a small amount of purchased fertilizer, but most use none at all.

It is estimated that 1/3 of the barley raised is used for feeding the animals, 1/3 will be hauled to town for processing and returned for home use, and the balance will be marketed. Most of the meat animal production will be marketed at the weekly souk except for the sheep that are saved for the religious holidays. Wool will be used for home weaving or sold. The milk from cows, goats and sheep will be largely consumed along with a few chickens. The farmer's animals will usually appear thin and undernourished.

Some Assumed Results of Proposed Research Techniques

Mainly due to lack of available data, not all of the proposed research techniques were given quantifiable possible objectives. For purposes of this analysis, only proposals with quantifiable outcomes are taken into consideration.

I. The Potassium Situation

According to the TVA Report (1967), practically all soils in Morocco are calcareous and contain a pH level in excess of 7.0. This indicates that very little leaching of soluble minerals has occurred, especially on soils with a silt loam or heavier texture. Such soils should be relatively high in available potassium, yet in 1975 a total of 71,453 MT of potassium sulphate and potassium chloride were imported at a cost of about 8.8 million dollars. Much of this was probably not necessary. A properly oriented soil testing program could reduce considerably the potassium fertilizer imported. This analysis will assume that the proposed research program will reduce the import figure by 25%.

2. Yields

Yields of wheat, barley, and corn are very low (see Table XI). It is reasonable to assume that increases of 50 to 100% could be achieved with the use of fertilizers combined with proper cultural practices. Fertilizer demonstrations conducted by FAO have shown that such increases are possible. The analysis will assume an average increa of 50%.

3. Seeds

Drilling, rather than broadcasting, could save Morocco 40,000 M of barley and 39,000 MT of wheat annually in reduced seed requirements. Since the project area encompasses 36% of the land producing barley and 33% of total wheat land, this analysis assumes an annual savings of 14,400 MT of barley and 12,870 MT of wheat for the project-area farmers.

4. Changes in Farm Income by Utilizing Research

The anticipated effect on farm income of a 50% increase in yiel obtained by using improved cultivation practices is shown in Table XIV. The average farmer in the project area should increase his gross income by 1,104 DH. Assuming that production costs to generate the incremental product are about half the product value, the net increase in income to each farmer will be 552 DH per year.

By using a seed drill, rather than broadcast planting, he should reduce the amount of barley seed used by 0.66 quintals and wheat seed by 0.25 quintals per hectare. This would lower his production costs by 41 D A properly oriented soil testing program could reduce his fertilizer requirement by 0.31 quintals potassium. Using the 1975-76 price of 40.66 D per quintal for 60% granulated potassium chloride at Kenitra, the potential net saving in fertilizer outlay would be 21 DH per year. The implementation of improved cultural practices to increase yields and reduce costs could increase the net income of the farmer by 552 DH per year.

5. Other Feasibility Issues

a. There are no known price or marketing constraints for planning the development of the technology as such. For ultimate use of the technology, any such constraints would obviously have to be addressed. The GOM has several programs with respect to marketing, credit, and similar services. It is expected that these programs will continue to be carried out.

If bottlenecks occur in the follow-on project's testing and application of the innovations, such problems will be brought to the attention of responsible parties and project resources will then be introduced as necessary to address the problem.

b. The immediate employment effects of the project are nil with respect to total employment. The effect of the technology, when applied, should increase total employment substantially. The research design will stress the use of locally available resources whenever it is practical to use them. The net effect should therefore be increas labor use. It will stem from:

(1) Marketing of production inputs and farm products:

(2) Mixed, but increasing use of, capital and labor in tillage, spraying, fertilizing, and harvestin.

(3) Secondary effects resulting from increased net farm income

Conclusion

No accurate estimates can be made as to the net economic benefits that can derive from the project. In addition to the cost of the project itself, one would need to take into account the cost associated with translating the expected research results into practices utilized by the farmers in the area. These costs cannot be estimated in the absence of objective criteria. However, as shown in Table XV, sizable increases in the production of cereals and grain legumes could generate 200 million dirhams ($44.4 million) per year disposable income in the project area assuming added production costs will be about 50% of the increased product value. To this should be added the annual savings of 9.9 million dirhams ($2 million) accrued by lowered potassium requirements due to a properly oriented soil testing program and of 14 million dirhams ($3 million) by lowered seed requirements due to the use of seed drills.

Although the annual net increase in cereals available for non-farm consumption would be about 687,000 MT — 660,000 MT due to yield improvement and 27,000 MT from decreased seed requirements -- significant changes in prices would not be expected. The reason is that present internal production of cereals falls short of total demand by not less than one million metric tons yearly.

In view of the above, USAID concludes that the project is economically justified.

ABLE XIII. LAND USE AND PRODUCTION ON THE AVERAGE FARM

Crop	Hectares per farm	Q/Ha 1]	Total Prod. Q.	DH/Q 1975	Total Value Crops Produced DH 2]
Wheat, durum	.93	7.42	6.90	63	435
Wheat, bread	.30	6.89	2.07	60	124
Barley	3.29	10.84	35.66	40	1,426
Pulses	.41	6.12	2.51	89	223
Fallow	1.75				
Total Ha/Farm	6.68			Total Harvested Crops/Farm	2,208 DH

Crop	Acres/Farm	Bu or Lb/ Acre 1]	Total Prod. Bu or Lb	$/Bu 1975	Total Value Crops Produced
Wheat, durum	2.30	11.03	25.35	3.81	$ 98.37
Wheat, bread	0.74	10.38	7.68	3.62	27.80
Barley	8.13	20.14	163.73	1.93	316.01
Pulses	1.01	546.00 lbs.	551.46 lbs.	0.09 lb.	49.63
Fallow	4.33				
Total A/Farm	16.51			Total Harvested Crops/Farm	$491.82 2]

1] Estimates of crop yields are based on the reported natural 1969-70 to 1973-74 5-year averages. For wheat, 37% of the hectares of land in wheat in Morocco are in this region. Considering the rainfall level and soils, the yield for the dryland region is estimated at 75% of the national average. For barley, with 94% of the hectares in Morocco in this region, the estimated yield is assumed to be the same as the national average. For pulses, 40% of the total lands in pulses are in this area. Assuming that these crops would get a priority use of the better lands in the region, yields are estimated at 85% of the national average.

2] 4.5 DH per $1.00, approximate exchange rate.

TABLE XIV. NET RETURN FROM THE AVERAGE FARM

UTILIZING IMPROVED TECHNOLOGY

Crop	Hectares per Farm	Q/Ha 1]	Total Prod Q	DH/Q 1975	Total Value Crops Prod. DH	Increase in Value DH
Wheat, durum	.93	11.12	10.35	63	652	217
Wheat, bread	.30	10.28	3.08	60	185	61
Barley	3.29	16.26	53.50	40	2,140	714
Pulses	.41	9.18	3.76	89	335	112
Fallow	1.75		Total Harvested Crops/Farm:		3,312	1,104
Total H/Farm	6.68				Net Increase 2]:	552

Crop	Acres per Farm	Bu or lb per Acre	Total Prod Bu or Lb	$/Bu 1975	Total Value Crops Prod. $	Increase in Value $
Wheat, durum	2.30	16.55	38.07	3.81	145.05	46.68
Wheat, bread	.74	15.57	11.52	3.62	41.70	12.90
Barley	8.13	30.21	245.60	1.93	474.01	158.00
Pulses	1.01	819.00 lb.	827.19	0.09 lb	74.45	24.82
Fallow	4.33		Total Harvested Crops/Farm:		$735.21	$242.40
Total A/Farm	16.51				Net Increase 2]:	$121.20

1] Crop yields are 50% higher than the reported natural 1969-70 to 1973-74, 5-year averages.

2] Assuming production costs 50% of product value.

TABLE XI

EXPECTED EFFECTS OF IMPROVED TECHNOLOGY ON THE PROJECT A

Crop	Total Hectares	Current Average 1/ Yields/Ha	Unit Price 1975 2/ DH/q	Value Current Prod. 3/	Expected Yields q/Ha (1.5 x present)	Value Expected Prod.	Increase in value 3/
Wheat	623,000	9.90	63	388.6	14.85	582.9	194.2
Barley	707,000	10.84	40	306.6	16.26	459.8	153.2
Pulses	152,000	8.25	89	111.6	12.38	167.5	55.9
					Annual Total Increase		403.3
					Annual Net Benefit 4/		201.7

1/ Based on 5-year Average 1969-70 to 1973-7

2/ Based on 1975 farm-gate price

3/ Measured in million Dirhams

4/ Assuming production costs 50% of product value

C. SOCIAL ANALYSI

The social perspective of the program must give prominent consideration to the responses that farmers make as producers to the high risk conditions under which they operate, as well as the changing social and economic circumstances that prevail in the dryland areas.

The social environment in the project area appears to be very complex, with considerable variation. Very little current and well-documented information is available on the social milieu of the small farmers. Such a situation presents one with two choices: either to make a few sweeping generalizations which would have very little depth, or to limit the discussion to a few highly pertinent subjects utilizing the best available information. The latter is selected because it seems to make the greater contribution to this project proposal.

The topics to be discussed are: land tenancy, including arrangements for usage: the agricultural work force· the role of women; the role of livestock in farming operations.

1. A Brief History of the Evolution of Land Tenancy in Morocco

A true understanding of the present structures of rural Moroccan society cannot be adequately grasped without a consideration of their historical evolution. The use of the land and the patterns of land tenancy have played a very important role in the evolution of farming practices in the cereal-producing plains

a. Land Tenancy in the Past

Although it is difficult to ascertain exactly that relations previously existed between the land and its occupants, historians have characterized these as relatively loose ties, a state of affairs which corresponded to the preponderance of a pastoral orientation and a type of agriculture which featured long periods of fallow. Population density was low. The nomadic way of life and frequent shifts in the balance of tribal powers fostered geographic mobility.

Because of the overall abundance of land, uncultivated areas were common. It was available in seemingly unlimited quantities. Any individual or group could take possession of a field by marking it off and using it. The principle of "vivification" of "dead" land was the only recognized basis for establishing possession. Land was not considered to be held if active cultivation were terminated. Individual or private control of a plot was not dependent on the value of the land itself as much as on the amount of work and capital invested in it. At the end of the nineteenth century landed property was considered to be the land which an individual and the members of his social unit such as

the family or tribe (the distinction between the two being somewhat vague) could cultivate or use as pasturage for their livestock herds and which could be defended from the encroachments of others. The power of individuals or social units to control their domain was the important factor. Limits were not definite. The dimensions of such holdings around a central cultivated core could increase or diminish according to the strength of its "owner" or occupant. Beyond the limits of effective control, vast areas of uncultivated land and common pastureland existed which were very fluid in legal status and which offered room for unlimited expansion.

About the turn of the twentieth century, true private freehold property (juridically referred to as melk) made its appearance. Melk landholdings have their origin in lands that had previously been acquired through the "vivification" practice discussed previously. Use of the land was continued without interruption and held by the same individual or group. Subsequently, through a series of sales or other legal transactions, the land acquired the new legal status of melk (freehold) property. The total amount of melk land was still quite small at this time. Most of it was centered in the vicinity of permanently established villages or tribal groups that were relatively sedentary and who repeatedly used the same land. The familial or patriarchal aspect of landholding was reflected in the concept of indivisibility as regards inheritance. This indicated the cohesion of the patriarchal plan on the one hand and a relative weakness of the concept of individual possession on the other. The practice of indivision occurs in a limited fashion today with more than one descendant inheriting joint title to a parcel of land. This is done to prevent further fragmentation of parcels of land.

A category of land to be distinguished from melk land is bled jemaa, or collective lands. These are "lands of cultivation and pasturage used by tribes, villages or other indigenous groups under collective title, following traditional modes of production and use", as defined by a dahir (decree) of 1919. Some have argued that there was no such collective land with a special legal status before the intrusion of European influence, and that bled jemaa was in fact a creation of the Protectorate that gave the state, an entity that did not exist previously, ultimate guardianship of this land.

b. Changes in the Land Tenure System following European Penetration

The intrusion of European colonials into Morocco was accompanied by a great increase in melkisation, the conversion of untitled land into privately held property with legal title. Early accounts attributed this increase in titled land to a reduction of internal strife brought about by the Protectorate, a necessary condition for the development of a private landholding system. More recent studies, however, have attributed much of the movement toward melkisation to a defensive reaction on the part of the Moroccan peasants who quickly saw that land without clear

title was subject to appropriation by Europeans as well as by other Moroccans who possessed both the means and the power necessary for enlarging their holdings. The notion of an "establishment of order" may have expressed the viewpoint of the colonizer, but for the Moroccan peasant the insecurity associated with tribal quarrels and shifts in power was replaced by an insecurity that was due to colonial manipulations.

Melkisation rapidly accelerated the division of former common lands into privately held fragments. The distribution and configuration of plots reflected the location and relative power of families and individuals at the particular time of this development. This occurred between World War I and World War II. It was by no means the result of a gradual evolution of land ownership.

The period between the two world wars was also marked by an increasing differentiation between large and small landowners. A process of increasing fragmentation continued among small landowners resulting from Islamic laws requiring equal inheritance and from demographic growth in limited space. This fragmentation contributed to a growing disparity between large and small landowners. Farms that fell below a minimum size for viability were often purchased by the larger proprietors, especially during periods of drought. The larger proprietor then became the most important source of land for sharecropping. This source is now beginning to decline as the larger farmers can afford to mechanize and move toward owner operation.

By the time of World War II, the picture of immense amounts of untilled land, which characterized the situation at the turn of the century had changed drastically. The limits of potentially arable land had been reached. By the end of the Protectorate, Europeans had acquired about a million hectares of the best land which is about one-fourth of the total arable land in Morocco. The amount of land available for the Moroccan peasant had diminished considerably. In addition, rapid demographic growth began to be acutely felt just at the time when horizontal expansion was no longer possible. The average amount of land surface per person was decreasing rapidly.

2. The Agricultural Work Force in Morocco

The problem presented by the increased number of workers is perhaps more complex in agricultural areas than in the urban areas in Morocco. The rapid growth in manpower tends not only to create problems in employment but also to multiply the number of individual farming operations, creating a serious regressive evolutionary pattern in size of operation. A fuller understanding of the effects of this demographic pressure requires a closer examination of the patterns of employment. Attention will first be given to a brief general description of various employment categories, followed by a more detailed review of prevailing forms of work contracts found in the traditional Moroccan agricultural sector.

a. Types of Employment - a brief description.

The farmer-worker (fellah) is a man, using the help of his immediate family, who works the land which belongs to him or which he is entitled to use according to contractual agreements (rent or association) The farmer-worker has more control of his own activities than do those in other forms of farming, participates directly in production, and is rewarded with benefits from his own labor. These farmers make their own decisions in attempting to achieve the oftentimes precarious balance among the various production sub-systems of their farming operations which are necessary to maintain their level of living.

The associated-employee (khammes) executes the order of his patron, and is reimbursed for his labor with one-fifth of the harvest that he has directly participated in producing. This form of relationship is an old one and bears a strong resemblance to patronage relationships found in feudal societies. The khammes is not provided with a salary but often enjoys some benefits accruing from the patronage relationship that the salaried employee lacks such as greater employment security. Now that the traditional agricultural sector is increasingly being drawn into a money economy, however, the khammesat relationship is on the wane as an increasing number of agricultural workers choose salaried positions, even though they may be less secure.

The salaried agricultural worker first appeared during the period of colonization when European forms of production organization were introduced and quickly assumed a great importance. Salaried workers can be considered as consisting of two basic categories: permanent workers and occasional or seasonal workers.

A major characteristic of work in the traditional sector is the amount of time that is devoted to finding and setting up working arrangements. The large numbers of men who appear to be idle along the roads or at the souks (markets) are often engaged in this sort of unproductive but essential activity. Such negotiations are often of a subtle and delicate, time-consuming nature.

It is interesting to note that a farmer and his family will often refrain from harvesting activity so long as the employed harvesters are working in his fields, although the farmer and his family may do some harvesting in the afternoon after the workers have left. Social rank plays an important role even here.

b. Types of Contractual Arrangements in the Traditional Sector

Agricultural household heads who have at their disposal the total means for accomplishing their farming work are rare. Almost all farming households must enter into contracts in order to procure the means they are lacking as well as to commit those that they have in excess. A landowner can either rent his land to someone who wants to work

it or cultivate it himself by acquiring that which he lacks, such as labor or additional tillage equipment. The farmer who possesses no land or other means of production can either enter into a khammesat contract with a landowner or sell his labor as an agricultural worker. He might also be able to obtain land, work, or livestock to tend through a rental or sharecropping arrangement. These are simplified examples; there are innumerable variations in relation to the different aspects of rural productive activity.

Contracts of Association (Bel Khobza): As has been noted previously, farming associations play an important role in traditional Moroccan agriculture. Under the general title of the bel khobza, or cultivation association, there is great diversity ranging from sharecropping contracts with large landowners to more cooperative agreements between small farmers of more or less equal stature in relation to the means of production they contribute to the association.

Formally, the duration of such associations is limited to only one growing season, although in practice they can be repeated between the same partners for several successive years. The contract is always renewed in a formal manner, however, and never continued in a tacit and informal way. The contracts of association are considered terminated when the grain from the harvest has been divided on the threshing floor into the respective shares of the landowner and the associate(s).

Recent developments indicate that the total amount of land let out in association or to sharecroppers by big landowners has diminished as the larger landowners adopt more modernized management practices and mechanization. The large landowners, although the least numerous, are those who have let out most of the acreage to smaller sharecropping farmers in the past. Over the past several years an increasing number of large landowners have purchased tractors and now cultivate the land themselves. This development has had the effect of either depriving former sharecroppers of adequate land to till or of changing their status to one of salaried employees. An overall effect has been to provoke disequilibrium in the traditional agricultural system. The small farmer who needs to supplement his agricultural base to maintain a subsistence level is the victim of this change. The present situation suggests that associations are more exclusively contracted among small peasant farmers, while the larger fellahs are operating all the land they own. Mechanization greatly changes the relations which formerly existed between the large and small landed farmers. It increases the social distance between the two groups.

3. The Role of Women

The importance of the work done by women in agriculture must be given greater attention in the future. Available comments on women's work activities usually cite the complementary nature of their work to that of men. In farm operations women commonly tend livestock, weed the crops, and assume responsibility for getting firewood and water

Considerable time is taken for the performance of domestic activities associated with rearing children, cooking, etc., all of which must be accomplished through very labor-intensive techniques

The care of animals is the most demanding work for women. For an hour or more every evening women must cut grass, weeds or lucerne to feed the livestock. Some of the forage must be dried and stored to feed the animals during the dry summer and barren, early winter period.

The processing of plant and animal products involves the weeding of wheat fields from March to May and feeding the tares to the animals. Women may be employed winnowing wheat in June and stripping maize cobs in October. Women are also responsible for milking goats and cows.

Morocco is a Moslem state characterized by considerable variation in behavior and values, both among and within different sectors of the society. Some urban areas have adopted many features of European culture in life-style and attitudes. Much of the rural population continues to respect and adhere to those values which have developed from the contact and intermingling of different Islamic and, more specifically, Moroccan cultures. These sets of values are rich in tradition. Variable contributions of European, Islamic, and Moroccan cultural features are reflected in cultural differences that exist among the several regions.

Variation in behavior and values can be observed in the role of women in various sectors of the society. They range from an educated, professional role to a minimally (formally) educated, secluded and highly restricted role. The overall configuration of roles appears to be changing rapidly, especially in the urban areas. Differences between generations in dress and other outward manifestations are sometimes quite striking. It is not unusual to see a veiled mother accompanied by her teen-aged daughter dressed in the latest European style.

In rural areas, tradition remains strong. There is a high degree of differentiation between the roles of men and women which is articulated throughout many aspects of rural life. There are symbolically significant differences in dress and sexually differentiated kinds of social organizations for men and women. According to Moslem tradition, women are confined to the home and domestic activities: cooking, childrearing, and helping to tend livestock (see the section on Women's Work Activities under The Agricultural Work Force in Morocco). The proportion of women engaged in labor-intensive work, some of which may be outside the home, is much higher in lower socio-economic conditions than among middle-income groups. The seclusion of women may be an ideal which can be adhered to by those with an adequate income, but economic conditions necessitate compromises with the ideal. An interesting result

4. The Role of Livestock in Farming Operations

The System of Livestock Production: Livestock production has always been of importance in Moroccan traditional agriculture. In fact many of the contradictions or tensions which today characterize the traditional agricultural sector originated through the adaptation of agricultural production practices to a nomadic, pastoral way of life. The relative tenuousness of ties between man and the land is one example.

Today most small farming households own some livestock, perhaps one or two draft animals and a small herd of cattle, sheep or goats. These animals play a very important and integral role in the small farmer's attempt to balance the various components of production in his total farming operation.

Problems arise from traditional livestock production practices because of the many functions that these animals serve. Livestock serve as capital, a savings account, and a source of income. They also supply power for land tillage provide milk, wool and meat, and finally function as a primary criterion of social prestige.

The combination of economic and social functions prevents the adoption of more specialized animal husbandry techniques. Livestock which satisfy the greatest number of functions are usually the ones acquired, even though each of these functions may be poorly accomplished. It is essential to gain a thorough knowledge of the various functions livestock perform in the maintenance of the economic equilibrium of the farming operation if there is to be an attempt to change the behavior of the farmer in the direction of more rational livestock management. Suppose, for example, one wanted to introduce pure-breed cattle into a small farming operation, such as cattle bred for mil production. The farmer would have to add the purchase cost of additional animals for draft power to the credit and new costs involved in the care and maintenance of pure-bred cows. The replacing of a "traditional" cow with a more specialized one is not a perfect substitution. The former will assure, even if poorly, the accomplishment of the functions which the latter one won't, especially if it is forbidden because of credit agreements to sell the pure-bred cattle at harvest time.

Livestock as a Source of Power: Less than 15% of the cultivated land in Morocco is tilled with tractor-drawn implements. Tilling, weeding, harvesting, threshing, and transporting are mostly done by means of manual and animal power, an adaptation to the low level of capital accumulation and technology of traditional farmers

Rather than complete mechanization which would replace animals with machines, it seems necessary to follow a more modest route by improving the productivity of draft animals. The improvement of animal-drawn tillage equipment, the gradual selection of stronger animals, the elimination of milk cows as a source of power (although this is not too extensively practiced), and castration practices would all lead to increased efficiency and productivity. Such new equipment and practices would require distribution of additional credit.

Livestock as a Source of Income: Cattle and sheep are the primary income producing livestock. Not all of this livestock is sold. A portion is consumed by the farm household itself. Except in suburban areas, milk production is a non-market product. Milk and butter are almost entirely consumed by the family. This is not surprising when one considers that an average milk cow produces only two to four liters of milk daily during lactation, and the average size of a family is five

Both meat and wool are marketed products from sheep. Formerly wool was almost entirely used or processed by the family. Today it is increasingly sold in raw form destined for urban centers. A very significant amount of wool however, is still accumulated and saved by the family and used to stuff mattresses and other furniture in the home. This collected wool constitutes a form of savings and an insurance against variations in the purchasing power of money

Livestock as a Savings Account: Decisions on the sale of livestock are determined by the financial needs of the farming operation rather than market prices. In traditional agriculture an animal is sold to meet an urgent need for liquid assets. The traditional herd is sometimes referred to as a kind of bank. It is in fact a savings account that is very well adapted to the rudimentary level of capitalization in the traditional agricultural sector. Replacing this function of the herd would certainly be among the first requirements in instituting a more rationalized pattern of livestock management. This would necessitate profound changes in the current system of banking and credit at the level of the small farmer. An entire banking network would have to be created along with a whole host of banking personnel, etc. Thus the herd for better or for worse, satisfies many of the functions of a banking system when complemented by the local moneylender who provides some intermediate term credit.

Livestock as a Source of Prestige: The ownership of livestock plays a very important role in determining the social status of a farmer. The number of head of sheep and cattle is an index of available capital. It is a bank acc visible to all. This has important psychological, social and political consequences in regard to social ranking, alliances and marriage, etc. Thus the peasant has reasons for increasing the number of livestock in his farming operation that are not strictly economic. The prestige afforded by livestock in traditional society is a basis for influence and power at the local community level. Livestock is a form of social as well as financial capital that is not subject to the same fluctuations in value as money.

Conclusion

The information presented above represents what is available to the USAID at the present time. There are definite gaps in this information relating particularly to the need for a comprehensive description of the farmers in the target area. The Moroccan Government itself has little research material which would throw light on small farmer practices and life style in the semi-arid areas. It is intended that these gaps be filled during implementation as a result of the socio-economic research component of the project. The socio-economic research will not only help to clarify our understanding of the Moroccan small farmer, but will also serve as a basis for determining that direction the agro-economic research should take.

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of this situation is that the role of the woman and the amount of productive work done by her may very well decrease as a family's socio-economic situation improves and as the ideal of seclusion becomes more economically attainable.

Past development plans have devoted considerable attention to the mechanization of agriculture, irrigation projects, banking, etc., but only a few pages to the family and the condition of women. A development proposal must thoroughly examine all the potentials already present in the society or social group concerned as well as all forms of work being done, including those for which there may be no remuneration and much of which appears unproductive. Such a thorough examination must devote attention to the condition of women in the society, their roles and the work they do as well as patterns of social organization in which they participate. This increase in comprehensiveness could well reveal important potential alternatives that are already present within the society and upon which aspects of a development program can be based. Approaches should be used which seek to discover and then build upon existing potentials rather than those which impose formulas from above that may be in serious disjuncture with existing social relations and values. They will have much greater chances for success in achieving the overall goal of improved living conditions and greater productivity in the social group concerned.

ANNEX 1

KINGDOM OF MOROCCO
Ministry of State in charge
of Cooperation and Training

USAID Mission Director
Embassy of the United States of America
Rabat

Through: The Minister of State in Charge
of Foreign Affairs

Subject: - Agricultural Research and Training Projec
606-11-110-122

Evaluation Reports for Three New Projects

Dear Mr. Director:

Enclosed herein please find the Agricultural Research and Training Project - 606-11-110-122. As required, the Project was concurred to by all of the authorities concerned. I would therefore appreciate it greatly if you could see to its implementation within the time limits a scheduled in the Project Agreement.

In addition, you will find enclosed three requests for assistance which are submitted for your consideration. Your support of these requests and your recommendations for their approval to the authorities responsible within your Agency will be highly appreciated. The requests relate to: (a) the establishment of a dryland farming operation; (b) the setting up of a range seed production nursery; and (c) the methodology and evaluation of extensio impacts in the rural areas.

Sincerely yours,

Dr. Benhima
Minister of Cooperation and Training

ANNEX 2

EQUIPMENT LIST

(in Dollars)

Tandem Disk	500	Tractors -	16,000
Moldboard Plow	1,500	Tractors -	10,000
Chisel Plow	2,800	Plot Planter - 2	10,000
Spiketooth Harrow	500	Nursery Planter	5,000
Springtooth Harro	800	Plot Tillage Equipment - 2	6,000
Sweep Machine	2,500	Plot Fertilizer Applicators	2,500
Rodweeder	1,200	Plot Sprayer	4,500
Rotary Hoe	600	Plot Combines - 2	5,000
Four-Row Planter	5,000	Nursery Harvester	2,000
Grain Drill & Attachment	1,800	Plot Threshers - 2	2,500
Grain Drill - 2	5,000	Grain Threshers - 2	0,000
Small Seed Drill - 2	7,000	Seed Separators - 2	3,000
Fertilizer Drills - 2	3,000	Seed Cleaners	3,000
Four-Row Cultivator	1,800	Neutron Soil Probes -	8,000
Sprayer	2,000	Power Soil Probe	9,000
Rotary Mower	1,400	Soil Probes & Misc	3,000
Sickle Mower	1,200	Moisture Meter	4,000
Misc. Tools & Scales	5,000	Balances - 3	4,500
Mill-Seed Cleaner	1,000	Calculators - 3	4,500
Equipment Trailer - 2	10,000	Drying Ovens -	6,000
Truck	25,000	Pick-Up Trucks - 3	25,000
Shop Equipment	30,000	Laboratory Equipmer	80,000
Herbicides & Pesticides	20,000	Fertilizer	5,000
	130,600		258,500

Total = 389,100

AID 1020-28 (1-72) "ANNEX 3"

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

_to FY_____

Project Title & Number: DRYLAND AGRICULTURE APPLIED RESEARCH

Date Prepared: April 18, 1978

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 foood 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 targets: The GOM will: - effect program and price policy changes so as to encourage greater farmer productivity.
Project Purpose: To develop a permanent applied research program aimed at increasing farmer productiv	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 purpose: - MARA is committed to establishin a permanent applied dryland research program. - MARA and AID will provide adequa human, material, and financial resources on a timely basis. - MARA will implement programs to transmit to farmers the results the research program.
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 U. S. 18 Technicians trained on-the-job 8 Socio-economic study reports 1 Report on mechanization	- Annual Project Evaluations - Special Evaluations	Assumptions for achieving outputs: - MARA will assign qualified ingenieurs and adjoints techniqu in agreed-upon numbers and on a timely basis. - Adequate resources--funds, equipment and land--will be provided on a timely basis.
Inputs: U. 1. Research Teas 2. Consultants 3. Commodities 4. Training GOM Land, buildings, equipment and machinery, agricultural and social scientists and technicians, laborer and administrative personnel. Operating budget.	Implementation Target (Type and Quantity) U. S. $4.5 million Man-Years 15 3 Research Scientists 6½ 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: $ 300,000 Operating budget: $2,000,000	- USAID and GOM records - On-site visits	Assumptions for providing inputs: - AID inputs will be provided on a timely basis. - Contractor staff will have proficiency in French and Arabic. - GOM will provide inputs on a timely basis. - GOM will provide adequate budget for operating costs.

INITIAL ENVIRONMENTAL EXAMINATION

Project Loca	:	Morocco
Project Titl	:	Dryland Agriculture - Applied Researc
Funding	:	FY 1978 through 1982; total project cost is estimated at $7,400,000, of which $2,900.000 is to be provided by the Government of Morocco.
Life of Project	:	Five years
IEE Prepared by	:	J. Gerard Neptune, Agricultural Development Officer. USAID/Rabat
Date		March, 1978

mental Action Recommended: This project will have no adverse impact on the physical environment. In fact, improved cultural practices in the dryland areas should improve the environment by reducing soil erosion. Moreover, if crop yields can be increased in the rainfed areas marginal land now cultivated may be returned to its original use as grazing land and this will further protect the land resource of Morocco. Finally, if higher yield and production levels are achieved, the socio-economic status of smal farmers should improve. Therefore, we recommend that an environmental assessment not be done.

Concurrence:

Albert G. Drake — 7/13/78

Mission Director — Date

Deputy Director — Date

Dryland Agriculture - Applied Researc

Project Description

The project will establish (1) an applied agronomic research program through which existing production technology will be adapted to Moroccan conditions; Moroccan staff will be trained to carry out the research on a permanent basis and transmit the results to farmers; and various alternatives will be determined whereby small farmers can gain access to suitable equipment for their farming operations.

(2) a socio-economic research program which will develop a better understanding of the behavior of dryland farmers and thus provide a basis for extending the results to farmers.

The project is planned for a period of five years during which activities will be carried out primarily in the areas where annual rainfall averages 325 mm to 450 mm.

U.S. assistance will be provided through a contract and will consist of technical services - resident research staff, short term staff and consultants, - training, some agricultural machinery and equipment, and small amounts of fertilizers and agricultural chemicals for research purposes only.

MPACT IDENTIFICATION AND EVALUATION FORM

Impact Areas and Sub-Areas*	Impact Identification and Evaluation**
A. LAND USE	
1. Changing the character of the land throug	
a. Increasing the population	N
b. Extracting natural resourc	N
c. Land clearing	N
d. Changing soil character	N
2. Altering natural defenses	N
3. Foreclosing important use	N
4. Jeopardizing man or his works	N
5. Other factors	None
B. Water Quality	
1. Physical state of wate	N
2. Chemical and biological state	N
3. Ecological balance	N
Other factors	None

* See Explanatory Notes for this form

** Use the following symbols:
N - No environmental impact
L - Little environmental impact
M - Moderate environmental impact
H - High environmental impact
U - Unknown environmental impact

Impact Identification and Evaluation Form (continued)

C. ATMOSPHERE	
1. Air additives	N
2. Air pollution	N
3. Noise pollution	N
4. Other factors	None
D. NATURAL RESOURCES	
1. Diversion, altered use of water (irrigatio	N
2. Irreversible, inefficient commitments	N
3. Other factors	None
E. CULTURAL	
1. Altering physical symbols	N
2. Dilution of cultural traditions	N
3. Other factors	None
SOCIO-ECONOMIC	
1 Changes in economic/employment patterns	N
2 Changes in population	N
3 Changes in cultural patterns	N
4 Other factors	None

Impact Identification and Evaluation Form (continued)

G. HEALTH

1. Changing a natural environment	N
2. Eliminating an ecosystem element	N
3. Other factors - Small quantities of fertilizers and plant protection materials	N

H. GENERAL

1. International impacts	N
2. Controversial impacts	N
3. Larger program impacts	N
4. Other factors	None

I. OTHER POSSIBLE IMPACTS (n[illegible]

None

Morocco - Dryland Applied Research (Phase I)
Certification PUrsuant to Section 611 (e) of the Foreign Assistance Act of 1961, as Amended

I, Albert P. Disdier, principal officer of the Agency for International Development in Morocco, having taken into account among other things the maintenance and utilization of projects in Morocco previously financed or assisted by the U. S. and the commitment of the Kingdom of Morocco to carry out an effective Dryland Applied Research project (Phase I), do hereby certify that in my judgement Morocco has the financial and human resources capability to implement, maintain, and utilize effectively the subject project.

4/18/78
Date

Albert P. Disdier
Albert P. Disdier, Director
USAID/Morocco

Amplified Project Description
Annex I
of the Grant Agreement

A. PROJECT DESCRIPTION

The purpose of the project is to develop an applied research program in order to increase cereal, legume and forage crop production in the rainfed areas:

- Project activities will be concentrated in those areas where annual rainfall averages 325 mm to 450 mm and will be concerned essentially with the establishment of the research program and the training of staff to operate the program.

- The project will comprise two coordinated components:

  1. An Agronomic research program which will

     (a) adapt existing technology to local conditions in order to increase farmers' productivity;

     (b) train adequate staff to operate the program and transmit the results to farmers; and

     (c) determine the optional ways whereby small farmers may gain access to equipment suitable for their operations.

  2. A Socio-economic research program which will develop a better understanding of the behavior of farmers in response to the high risk conditions under which they operate.

B. PROJECT IMPLEMENTATION

Agronomic Research Activities

The agronomic research program will address all aspects of the production systems used by the dryland farmers. However, priority will be given in the beginning to those factors which are most critical to increasing yield, namely: tillage practices, including seed bed preparation, method rate and date of planting, weed control, and soil fertility. Next will come crop varieties, sequences and rotations, disease and insect control, harvesting, handling and storage. A special study will be undertaken to determine the optional ways whereby suitable farming equipment can be made accessible to small farmers.

Principal Research Station

Project activities will be centered at the Sidi-El-Aidi Experiment Station which will be developed and equipped to serve as project headquarters. However, as soon as staff and other required inputs permit, research activities will also be conducted at off-station locations, which will provide a greater variety of environmental conditions than can be found at the Sidi El Aidi. These outreach activities will constitute an essential component of the research program and will provide an effective linkage among researchers, extension workers, and farmers. Some experiments will also be conducted at the ENA in Meknes province. In all cases the activities will be organized and carried out under the direct and personal supervision of the research staff.

Facilities at the Sidi-El-Aidi Station will include:

1. a seed house for drying, processing, handling and storage of seeds and experimental plant materials:

2. a laboratory for soil and forage analysis;

3. a shop for maintenance and repair of machinery and equipment;

4. a shed for storage of machinery and equipment;

5. storage for fertilizers and agricultural chemicals; and

6. offices for the project staff.

Agronomic Research Staff

The permanent staff of the agronomic research program will comprise a minimum of 22 specialists in the following fields:

Cereal Crops	Soil Science	Entomology
Legumes	Weed Science	Economics
Forage Crops	Plant Pathology	Agriculture Extension

This staff will be supported by appropriate technical and administrative personnel and by colleagues from the central DRA laboratories and stations.

Socio-Economic Research

The socio-economic research program will identify and analyze the patterns of technical and economic decisions that dryland farmers make under high risk situations. These decisions are influenced by a number of factors which will be examined, including the following:

a. present and former farm production systems;

b. cultural practices and mechanization in relation to productivity;

c. value of priority systems held by farmers and their families, based upon their consumption patterns;

d. availability and use of production units:

e. local market structure and farmer participation in it; and

f. patterns of social organization in relation to farmer's productivity.

The study of these factors should lead to an understanding of the types of farming units and enable one to dientify the potential alternatives among which each type of farmers can select. This in turn will provide the basis on which effective program can be planned whereby farmers can benefit from the results of the agronomic research.

Implementing Agencies

Under the guidance and supervision of a Dryland Coordinating Committee which will be chaired by the Secretary General of the Ministry of Agriculture, the Agronomic Research Directorate (DRA) will be responsible for the agronomic research program with the participation and support of the Development Directorate (DMV). The Department of Social Sciences of the Hassan II Agronomic Institute (INAV) will be responsible for the socio-economic research program with the support of the DMV.

To insure effective and adequate linkage between the two programs, periodic joint staff meetings will be held to review their progress and orientation in terms of the problems confronting dyrland farmers. Also, to permit effective coordination of research and extension the Dryland Farming Bureau of the DMV will be fully integrated with those of the Sidi-El-Aidi Center. The staff of the Bureau will participate actively in the research effort but will have primary responsibility for the outreach activities, indlucing special training programs for extension agents.

Training

At lease eleven (11) members of the permanent staff of the agronomic research program will receive Ph.D level training in the U. S., three in Production Agronomy, two each in Soil Science, and Forage Crops, and one each in Weed Science, Plant Pathology, Entomology and Production Economics. At least 11 others will receive M.S. level training in the same disciplines. All of them will be expected to do their thesis research in Morocco. It is anticipated that each trainee will spend 2 to 2½ years in the U. S. (see Training Schedule).

In addition to the above 22 ingenieurs, up to ten may be selected for specialized study or for short-term training in agricultural extension, plant breeding, sociology, economics, and other dryland related fields.

U. S. Assistance

Subject to availability of funds, and the mutual agreement of the parties, the Government of the United States through A.I.D. expects to provide a total of $4.5 million which will finance the following:

1. consultant services to assist the MARA in the planning and design of the Sidi-El-Aidi research facilities;

2. the mechanization and equipment study;

3. a resident research team comprising two agronomists specialized in Cereal and Forage Crops respectively, and one soil scientist;

4. short-term research staff in various fields of specialization;

5. some agricultural machinery and equipment, a modest amount of fertilizers and agricultural chemicals, some laboratory equipment, and some vehicles; and

6. the training of Moroccan staff.

It is expected that U. S. assistance will be provided through a contract between the Kingdom of Morocco and a qualified U. S. contractor.

Role of the U. S. Contract Staff

The role of U. S. scientists will be that of temporary associates in the establishment and operation of the research programs. They will actively participate in all phases of the activities, as needed, but under no circumstances will they be allowed to function merely as substitutes for Moroccan staff.

Contribution of the Government of Morocco (GOM)

The GOM will:

1. finance the costs of developing and constructing the facilities needed at the Sidi-El-Aidi Research Station;

2. provide adequate funds for purchasing needed equipment that is not granted by the USG;

3. provide annually and make readily available adequate funds to cover the operating costs of the research programs; and

4 assign a minimum of 22 ingenieurs to the agronomic researc
p program at such a rate as to permit their training during Phase I of the project.

First Years Operations

During the first year of the project the implementing agencies, together with the U.S. contractor will, among other organizational a tivities, carry out the following specific tasks:

A. Formulate a detailed set of measurable, end of project institutional objectives with respect to structure, location, staffing, research capabilities and coordinating mechanisms for the socio-economic and agronomic research.

B. Lay out a five year research program with respect to various research topics, objectives of each effort, methodologies, timetables and budget estimates.

Project Evaluation

The first evaluation would consist primarily of measuring the adequacy of total project planning and of the organizational structures required to implement the project. The evaluation would be conducted jointly by MARA, USAID, and the contractor. The outcome of the evaluation will serve as a basis for programming subsequent incremental funding of the project and the extension of the technical assistance contract.

Thereafter, an annual evaluation will be undertaken jointly by the three parties concerned. Two special evaluation exercises, one in year 3, the other at the end of the project, will also be carried out by an independent team. The following factors will be singled out for careful examination during the annual evaluations:

1. timely assignment of contractor staff

2. timely arrival of U. S. funded commodities:

3. adequacy of the training program,

4. timely assignments of project personnel by the MARA;

5. adequacy and timely allocation and disbursement of financial resources

TRAINING SCHEDULE

1.	Agronomy	July 78 — Sept 80
2.	"	July 78 — Sept.80
3.	"	July 79 — Sept 81
4.	"	July 79 — Sept 81
5.	"	July 80 — Sept 82
6.	"	July 80 — Sept 82
7.	"	July 80 — Sept 82
8.	Forage Crops	July 78 — Sept 80
9.	"	July 79 — Sept 81
10.	"	July 80 — Sept 82
11.	"	July 80 — Sept 82
12.	Soil Science	July 78 — Sept 80
13.	"	July 79 — Sept 81
14.	"	July 80 — Sept 82
15.	Weed Science	July 78 — Sept 80
16.	"	July 79 — Sept 81
17.	Plant Pathology	July 78 — Sept 80
18.	"	July 80 — Sept 82
19.	Entomology	July 79 — Sept 81
20.	"	July 80 — Sept 82
21.	Economics	July 79 — Sept 81
22.	"	July 80 — Sept 82

FINANCIAL PLAN ($000)

MARYLAND APPLIED RESEARCH

	First Year		Future Years		Totals	
	USAID	GOM	USAID	GOM	USAID	GOM
U. S. Contractor Services	1566		974		2540	
Commodities	320		85		405	
Training	210		690		900	
Other			655		655	
Station Development	-	900		-		900
Operating Expenses	-	400		1600		2000
Totals	2096	1,300	2404	1,600	4,500	2,900