ISN-31931 UNCLASSIFIED App 12A-1, Chp 12, HB 3
CLASSIFICATION (TM 3:43) 9-30-82

PROJECT EVALUATION SUMMARY (PES) — PART I

Report Symbol U-447

1. PROJECT TITLE	2. PROJECT NUMBER	3. MISSION/AID/W OFFICE
Central Tunisia Rural Development - Dry and Farming Systems Research Subproject (664-0312.2) - Small Holder Irrigation Subproject (664-0312.3)	664-0312.2 and 3	66403/202/15 PD-AAB-357

4. EVALUATION NUMBER (Enter the number maintained by the reporting unit e.g., Country or AID/W Administrative Code, Fiscal Year, Serial No. beginning with No. 1 each FY)

☐ REGULAR EVALUATION ☐ SPECIAL EVALUATION

5. KEY PROJECT IMPLEMENTATION DATES	6. ESTIMATED PROJECT FUNDING	7. PERIOD COVERED BY EVALUATION
A. First PRO-AG or Equivalent FY 79 B. Final Obligation Expected FY 79 C. Final Input Delivery FY 84	A. Total $ 5,140,000 B. U.S. $ 7,600,000	From (month/yr.) 11/12/78 To (month/yr.) 3/83 Date of Evaluation Review

8. ACTION DECISIONS APPROVED BY MISSION OR AID/W OFFICE DIRECTOR

A. List decisions and/or unresolved issues; cite those items needing further study. (NOTE: Mission decisions which anticipate AID/W or regional office action should specify type of document, e.g., airgram, SPAR, PIO, which will present detailed request.)	B. NAME OF OFFICER RESPONSIBLE FOR ACTION	C. DATE ACTION TO BE COMPLETED	
(Numbering and Lettering refer to Joint Report)	GOT	U.S.	Compl. Date
II. Small Holder Irrigation			
a. Summarize ground water situation	CTDA/CRGR	F&A	8/83
b. Prepare an integrated land and water use plan	CTDA/DRES/CRGR	F&A	3/85
c. Expand water management program	CTDA/CRGR/DRES	F&A	10/83
- Assign a Tunisian specialist	MOA		
d. Institution building	CTDA (EPU)		
- 2 Master of Engineering trainees selected	MOA	F&A	9/83
e. Delay new PPIs	CDTA	-	6/84
f. Marketing improvement (also suggested use of	DPV	F&A	9/83
Private Enterprise Resources)	Min. of Fin.	PROG	9/83
g. Credit (revise loan procedures)	BNT/ CTDA	F&A	6/84
h. Analyses of costs and benefits of irrigation	CTDA/CRGR	F&A	6/84
i. More attention to dryland farming	CTDA	F&A	1/84
j. Social economic study of constraints	CTDA/INAT	F&A	8/84
k. Change farm size qualifications for loans	BNT	F&A (credit)	6/83
l. Use of increased local currency from devaluation	MOA	F&A	6/83
m. Use of OSU personnel	CTDA	OSU	
n. Schedule changes	CTDA	F&A	
- New draft schedule for irrigation works	CTDA	F&A	30/6/83
- Extend PACD for water management	MOA	F&A	7/83
o. Participation of other agencies	CTDA	F&A	8/83

9. INVENTORY OF DOCUMENTS TO BE REVISED PER ABOVE DECISIONS

- ☐ Project Paper
- ☐ Financial Plan
- ☐ Logical Framework
- ☐ Project Agreement
- ☒ Implementation Plan e.g., CPI Network
- ☐ PIO/T
- ☐ PIO/C
- ☐ PIO/P
- ☐ Other (Specify)
- ☐ Other (Specify)

10. ALTERNATIVE DECISIONS ON FUTURE OF PROJECT

- A. ☐ Continue Project Without Change
- B. ☐ Change Project Design and/or ☒ Change Implementation Plan
- C. ☐ Discontinue Project

11. PROJECT OFFICER AND HOST COUNTRY OR OTHER RANKING PARTICIPANTS AS APPROPRIATE (Names and Titles)

SAID/Tunis, HLDickherber
MOA/ESAK, Mohamed Ben Senia
MOA/CTDA, Mosbah Hadji
Evaluation Team: RNewberg, WFurtick, JAlfaro, HKetata

12. Mission/AID/W Office Director Approval

Signature

Typed Name: James R. Phippard

Date: 8/13/83

AID 1-20-18 (2-78)

Clearances: D/DIR ___, PROG ___, RD ___, F&A ___

PROJECT EVALUATION SUMMARY - PART I. 8. (continued)

	Name of Officer Responsible for Action		Date of Action to be Completed
	GOT	U.S.	
III. Dryland Farming Systems Research			
a. Administration and Organization	CTDA		
- Better research and extension coordination	ESAK/CTDA	OSU	6/83
- Research at Sers and Tadjerouine	ESAK	OSU	7/83
- Involve other institutions in research and related activities	CTDA/ESAK	OSU	10/83
- Create a coordinating committee for research and related activities	CTDA	OSU	10/83
b. Substantive priorities:			
- Socio-economic research on farmer constraints	DERV/ESAK	OSU	8/84
- Development of a long range research and demonstration plan	CTDA/ESAK	OSU	8/83
- Develop soils lab program	ESAK	OSU	8/83
- Research on tillage and rotations	ESAK	OSU	6/84
- Evaluate straw value	ESAK	OSU	6/84
- Research-Extension joint activity	CTDA/ESAK	OSU	8/83
c. Rescheduling			
- Add 1 year to senior advisor time	MOA	OSU/F&A	5/83
d. Use of equipment	ESAK	F&A	1/84

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13. SUMMARY

This evaluation focuses on two of the seven separate subprojects combined under the Central Tunisia Rural Devevelopment umbrella project. These two are Small Holder Irrigation and Dryland Farming Systems Research subprojects. Both subprojects have progressed as satisfactorily as realistically could be expected though not as rapidly as the original optimistic implementation plan. The Project Paper was submitted 11/17/78 and called for authorization and signature of the agreement in March 1979. The project was authorized March 28 and the agreement signed May 18, 1979 providing $4.8 million for the Irrigation Subproject and $2.8 million for the Dryland Farming Systems Subproject. However, the senior advisor arrived in February 1981 instead of February 1980; participants are 2 years behind schedule as are commodity imports, some irrigation construction and water management. It is proposed that irrigation perimeter completion date be maintained at the old PACD of June 1984 but other activities under the two subprojects be assigned a PACD of September 30, 1986 corresponding with other subprojects.

Progress in lending for improvement of existing old shallow wells has been satisfactory with over 323 loans as of Feb. 1983 but lending for new wells reached only 17 of 200 planned.

Spring improvement for irrigation is similarly behind schedule and results for irrigation on those completed less than expected. Irrigation resources should be shifted from spring improvement to shallow wells. Spring improvements for household use were generally viewed favorably by benefitting families. They provided more water under more sanitary conditions but the arrangements for withdrawal of water often were difficult to use[1/].

1/ Dr. Raymond B. Isely, WASH Project, prepared a separate report on the household use of water from springs supported under CTRD project, USAID/Tunisia, February 1983.

Well loan repayments have fallen in arrears. It is proposed that the repayment schedules and recovery procedures be reviewed and necessary measures be taken to insure the integrity of the loan fund is not jeopardized by unrealistic schedules of loan repayment.

Because dryland research and demonstrations as well as return of participants are about 2 years behind schedule, it will be necessary to change the senior advisor position from 3 years to 4 years total and to recruit a replacement for the second two-year assignment. Marketing problems for fruits and vegetables grown under the expanded irrigated areas are likely to require greater effort than has been planned. Among other actions, special efforts should be made to encourage more private enterprise and farmer cooperation.

14. Evaluation Methodology

In Section 6.1., the Central Tunisia Rural Development Project Agreement states

"Except as the Parties otherwise agree in writing, the program will include during the implementation of the Project and at one or more points thereafter: (a) evaluation of progress toward attainment of the objectives of the Project; (b) identification and evaluation of problem areas or constraints which may inhibit such attainments; (c) recommendations as to how such problems or constraints should be addressed; and (d) evaluation, to the degree feasible, of the overall development impact of the Project."

This interim evaluation was carried out pursuant to that section with a joint team composed of

Mr. Mohsen Chaari[1/], Resident Advisor, ODTC

Mr. Hassan Hamadi[1/], Director, Agriculture, ODTC

Dr. Habib Ketata, Professor, INAT

Dr. Jose Alfaro, Irrigation Consultant, USAID

Dr. William Furtick, Agronomic Consultant, USAID

Dr. Richard Newberg, Agric. Economic Consultant, USAID

The scope of work for the team included the evaluation of

1. The effectiveness and proper utilization of the surface well credit fund and its impact on farmer income, efficiency of the banking services provided by the BNT including management and accountability of loan funds, disbursements and collection.

2. The cost effectiveness of the spring development program and extent to which this investment is being utilized by target farmers in increasing production. With regard to spring development, the evaluation team will be assisted by a consultant under the WASH project to evaluate the impact of spring development for irrigation on improvement of access to potable water for families in the area.

3. The efficiency and expected impact of irrigated perimeters developed under the project. (This will include both AID and GOT financed project perimeters.)

4. The effectiveness of AID financed technical assistance, training, and commodities in developing a program to test and make recommendations to institionalize and diffuse improvements in on-farm water management.

1/ Mr. Hassan replaced Mr. Mohamed Sakri on the team; the first two team members participated only during the time the team made field visits in the Central Tunisia area.

5. The extent to which trials conducted and planned are focussed on production constraints of Central Tunisia's small farmers and the extent to which the ESAK research team is aware of and adapting known semi-arid agriculture technology.

6. The extent to which research results of ongoing research may be expected to be adopted in the production environment(s) of Central Tunisia.

7. The extent to which training, technical assistance, and commodities are being utilized by CTDA and ESAK to develop and institutionalize an applied cropping systems research program for Central Tunisia.

8. The appropriateness of trials conducted, local training, staffing and organization to develop the farming systems (pilot study and demonstration) activities planned to be carried out by a multi-disciplinary joint CTDA and ESAK team after year 3 of the project.

9. The cost effectiveness of the various types of irrigation infrastructure financed.

10. The banking/credit procedure used in the shallow well component.

11. Analysis of the extent to which the dryland research program has taken into consideration financial constraints and attitudes toward risk of Central Tunisian farmers.

The team started its work in Tunis January 26, 1983 and met January 27-29 with officials of the Ministry of Agriculture, Planning, International Cooperation, ODTC and USAID. January 30 through February 5 was spent in Central Tunisia project area observing and collecting data at shallow well, spring and PPI sites and dryland field plots and farming areas. Meetings were held with the President Director General of ODTC and his headquarter and field staff, with CRDA staff and personnel of other development agencies, the BNT and with farmers. One day was spent with the Director and staff of

ESAK, Le Kef. February 7-13 was spent reviewing reports, discussing results with MOA and AID officials and one repeat visit to ODTC and ESAK. The preliminary draft report was completed February 15, 1982.

Comments were assembled during the period February 15 - April 11 at which time the leader of the U.S. part of the team and Mr. Ketata prepared the final draft.

Time does not permit listing of all the documents reviewed and people with whom project activities were discussed. Suffice to say, principal officials of CTDA, BNT, CRDA, INRAT, CRGR, DERV, INAT, GR, DRES, ESAK, DARME and other related offices of the Ministry of Agriculture including Planning and International Cooperation, and USAID were contacted and many met with the team several times.

Relevant background studies, pre-project and project program documents (PIDs, PPs, Grant-Loan agreements, contracts, quarterly, contractor and other project reports) as well as reports of cooperating Tunisian agencies were reviewed.

The A.I.D. IQC-contracted team members spent a total of 64 person days on the evaluation effort. Approximately 24 person days were spent in full-time travel, site visits and discussions involving several CTDA officials; full time.

15. EXTERNAL FACTORS

Social, political, economic factors and other aspects of the project setting have changed little during the period since the umbrella project and the two subprojects that are the focus of this evaluation were approved (11/17/78). The GOT continues to accord this set of activities high (perhaps now higher priority and to meet its funding commitments. In general, the goal, purpose, output and input assumptions continue to be valid as in 1978. The linkage assumptions are weak in places and in some cases assumptions for one level

seem more appropriate to another, but these are not sufficiently important to suggest redesign of the log frame.

The umbrella log frame appears to involve some confusion among goals and purposes, e.g. the No. 1 listed goal is really more of a purpose. The first nine EOPs and measures related to sector goals seem more appropriate as outputs. No.10 seems to be an input assumption. Some goal assumptions are more appropriate to purpose and lower operational levels. Assumption 5 under output appears more a goal assumption.

16. INPUTS

Considerable problems and delays were encountered in providing inputs on schedule and consequently in achieving scheduled outputs. In part, the problem appears to have been overly optimistic initial scheduling. The technical assistance and participants were delayed considerably, e.g. the senior advisor at ESAK arrived only in February 1981 and departed in February 1983, not agreeing to a third year. Most of the participants who were to have returned to work with the senior advisor have not yet returned. As a result, a replacement senior advisor at ESAK is planned for another two years starting about June 1, 1983.

Some key equipment items were delayed, e.g. the Johnson electric pumps for deep wells cleared customs nearly 4 years after the project authorization. Eight months of that delay was on customs clearance after arrival. GOT staff assignments also have been late. All in all, however, delays have not caused really serious timing incompatibilities - in part, because they tended to be similar. The extension from 3 years to 4 years for the senior advisor is more an adjustment for an unrealistic initial time allowed. Four to five years should have been an original minimum period for the senior resident advisor for the dryland research activities.

No serious qualitative problems were encountered with inputs. They were on average above realistic expectations. However, time and level of inputs required to achieve the planned level of outputs for both dryland research and water management appear substantially underestimated. In addition to more time for the dryland research advisor, the evaluation team is recommending extension of the PACD for the water management activity and that AID provide additional resources, including TA, for that activity. The additional year for the dryland advisor can be accomodated within existing resources in long and short-term TA.

17. OUTPUTS

In general, outputs are about 2 years behind the original PP schedule, but for some outputs prospects for achieving targets are dim. Irrigation perimeters (target of 4) and shallow well improvement (300) are near or in excess of targets. New shallow wells (17) and spring improvement (20) are now about 10% of targets. Resources from these latter should be shifted to shallow well improvement. Irrigation perimeters involve such high subsidies and continued government operational costs that use of additional resources to increase the number of irrigated perimeters appears to be unwise unless major improvement is made in cost recovery from beneficiaries. Water management and dryland farming systems problems and needs were underestimated and will require more time and resources. Outputs for these now are about at levels expected 2 - 2 1/2 years earlier in the project life. Major causes of output difficiencies are over-optimism on input deployment and on input/output relationships (what could be accomplished with given amounts of input), and in the case of springs and new wells over-estimation of numbers of sites suitable for development. Delays in granting of some form of conditional land title also has been a factor in shallow well program shortfalls.

Some inconsistencies exist in planned outputs for the Irrigation Subproject.

Item	Project Paper		Grant-Loan Agreement
	Pages 3 & 9 text	Log Frame	Annex 2 C, pages 2 & 3
Shallow Wells			
improved	300	600	about 300
new	205	225	about 200
Natural Springs	99	250	no figure
Irrigation Perimeters			
AID funded (new)	3	210 households	210 hectares
Improve existing (GOT)	4		
New Irrigation	1000-1500 ha		
Improved Irrigation	2000 ha		
Families benefited	3000		
Water Mgt Improvement			
Existing private wells		1500 families	
Public Irrigation		2200 families	
Income Improvement		3500 families	

Procedures in issuing of certificates of possession now appear to be proceeding at an adequate pace. The problems of improving water management and dryland farming are more intractable than was originally anticipated. In addition, there have been some administrative problems within Tunisia, and CTDA has tended to put more effort into physical (irrigation) structures (which can be seen) than into research on improvement in water management and dryland farming.

18. PURPOSE

The Irrigation Subproject purpose is:

Optimize small farmer access to and income derived from agricultural groundwater in the CTRD region primarily through infrastructural expansion and secondarily, through diffusion and institutionalization of relevant water management practices.

The Dryland Research Subproject purpose is:

Development and adaptation of tested systems of dryland farming practices and inputs useable by and extendable to the small farmers of the Central Tunisia Rural Developmentzone.

In addition, the umbrella project cites the following as its primary Goal (The evaluation team considered this to be more appropriately a Purpose-level objective than a Goal):

To develop cost-effective, managerially efficient, and resource-mobilizing project interventions for a portion of Central Tunisia so that, ultimately, those that are proven to be the best can be replicated in other geographic areas of Tunisia where conditions of similar marginality obtain in:

- Agriculture
- Natural resource endowments
- Transport and communication

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- Preventive and Curative Health Services
- Human Resources Development
- Industrial and Marketing Development
- Housing
- Credit and Banking, and
- Local Participation

As of February, 323 loans had been approved against a target of 300 (or 600) improved shallow wells but only 17 loans had been approved against a target of 225 (or 200) new shallow wells. Twenty of the target of 99 (or 250) natural springs have been improved. Further, results with improved springs have been discouraging for irrigation but the results for potable water have been generally satisfactory.

Four out of four irrigation petimeters are near completion.

As yet, little progress has been made in producing higher incomes as a result of the expanded water supply or better water management.

Under dryland farming, four production environments have been defined as targeted but none of the targeted dryland farming practices or the cereal, forage and legume crops have been fully tested and adpated, nor has the package of practices designed for rapid transfer been completed. The second year of testing was in progress in February-April 1983. Eight of eight extension agents have been assigned but only 5 remain on the job and 8 of 160 farmers planned have participated in trials/demonstrations.

No new agriculture interventions of the type anticipated in the Goal statement can as yet be classified as having been "proven", but that could not realistically have been expected in less than 2 years of field work.

19. GOAL/SUB GOAL

1. Goal No. 1; as stated above, the reviewers considered this more appropriately a purpose-level objective and have discussed it under item 18.

2. To increase income, labor productivity, and improve the quality of life for the 200,000 rural Tunisians residing in the CTRD zone.

3. To reduce regional disparities in income levels, quality of life, and access to basic services in Tunisia.

4. To reduce intra-regional disparities in income, quality of life, and access to basic services.

The most relevant EOP indicator appears to be No. 7 which states:

- Rate of growth of income for lowest 40% of population in CTRD areal equal to or greater than average rate for whole of CTRD region.

- % of improvement in quality of life indicators for the lowest 40% equal to or greater than % of improvement in region as a whole.

A few farmers have started to use increased water from improved shallow wells to increase vegetable production, but the project can not yet be said to have produced production increases sufficient to be noted by crop estimators. The only significant income and employment impacts are on workers, contractors and vendors involved in physical irrigation improvement work and a few people employed in dryland research.

20. BENEFICIARIES

As of the time of this evaluation, the beneficiaries in the agriculture activities are restricted to those directly involved in the construction, research and other improvement work itself plus a very few farmers who have completed well improvements. In the longer run there should be 1,000-1,500 farm families directly benefiting from improved irrigation water and a substantially larger number benefiting from better water management.

Additional new jobs will be available for 500 - 1000 workers in irrigated areas. Probably 100 farmers will participate directly in testing and demonstrations under the drylands subproject, but the results should spread to several thousand more over a period of 4-5 years. Potable water benefits from spring improvements have come more quickly and are more broadly distributed. Practically all families drawing from improved springs found water supply more adequate, but some complained that drawing water was more difficult with the new concrete enclosures.

21. UNPLANNED EFFECTS

As yet no unplanned effects can be noted and none are foreseen.

22. LESSONS LEARNED

1. The project paper was unrealistically optimistic regarding the rate of progress, the time until results can be obtained, and the inputs required, especially with regard to dryland research and water management improvement. The magnitude of problems involved in carrying out 7 different interventions in Central Tunisia which cut across many agency lines was underestimated, and the simplification introduced by working primarily through the Central Tunisia Development Authority has not resolved the problem of needing to cooperate with and obtain the support of a multitude of centrally-directed development entities.

The overall project encounters some of the difficulty of integrated rural development programs in trying to do many things at one time. A smaller number of subprojects with more time for implementation and more resources for each would probably have better served the area and put less of a management burden on CTDA and USAID. Some of the activities might have been combined or more closely coordinated. The four major AID assisted activities in agriculture in Central Tunisia include extension, range

management, irrigation and dryland farming. These do involve fairly close coordination with a single U.S. contractor. National line agencies should have been more closely involved, especially in the irrigation subproject. More time is needed for dryland research and water management improvement. A separate follow-on water management project may be necessary. Research to increase efficiency in use of available irrigation water appears to merit higher priority than development of new irrigation systems.

23. SPECIAL COMMENTS AND REMARKS

The team had as its assignment the evaluation of only two of the seven Central Tunisia subprojects. Nevertheless, it observed enough to lead it to conclude that the overall program might have benefited from fewer activities and greater coordination among those included and more realism in planning implementation schedules and input/output relationships. Seven disparate subprojects from one donor for an area with only 200,000 population, albeit a poor area, seems to impose a heavy burden on host country management.

The Government's decision to create the Central Tunisia Development Authori was influenced by the expected availability of AID resources for the area. Undoubtedly the creation of CTDA has helped focus GOT interest on the area and probably helped to manage AID's inputs. Whether the addition of another resource-consuming level of bureaucracy will contribute positively in the long run is not yet clear. It might have been better to spend similar effort working through existing central and provincial line organizations with assigned development responsibility in agriculture and other sectors. This is being done to a greater extent in the Range Management subproject which is implemented through OEP.

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A separate report in English and French covering the observations and recommendations of the team is being distributed (60 pages).

Evaluation Report:
Small Holder Irrigation and Dryland Farming
Systems Research Subprojects of the
Central Tunisia Rural Development Project
USAID/Tunisia
April 1983

XD-AAN-357-A
ISN-31933
6640312.2 and.3 /17

Project Evaluation

DRYLAND FARMING SYSTEMS RESEARCH SUBPROJECT

and

SMALL HOLDER IRRIGATION DEVELOPMENT SUBPROJECT

of the

CENTRAL TUNISIA RURAL DEVELOPMENT PROJECT

April, 1983

USAID/Tunisia

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SUMMARY

This evaluation focuses on two of the seven separate subprojects combined under the Central Tunisia Rural Development umbrella project. These two are Small Holder Irrigation and Dryland Farming Systems Research subprojects. Both subprojects have progressed as satisfactorily as realistically could be expected though not as rapidly as the original optimistic implementation plan. The Project Paper was submitted 11/17/78 and called for authorization and signature of the agreement signed May 18, 1979 providing $4.8 million for the Irrigation Subproject and $2.8 million for the Dryland Farming Systems Subproject. However, the senior advisor arrived in February 1981 instead of February 1980; participants are 2 years behind schedule as are commodity imports, irrigation construction and water management. It is proposed that irrigation perimeter completion date be maintained at the old PACD of June 1984 but other activities under the two subprojects be assigned a PACD of September 30, 1986 corresponding with other subprojects.

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1/ Dr. Raymond B. Isely, WASH Project, prepared a separate report on the household use of water from springs supported under CTRD project, USAID/Tunisia, February 1983.

Preface:

In Section 6.1. of the Project Agreement on Central Tunisia Rural Development the Parties agree to establish an evaluation program which states

"Except as the Parties otherwise agree in writing, the program will include, during the implementation of the Project and at one or more points thereafter: (a) Evaluation of progress toward attainment of the objectives of the Project; (b) Identification and evaluation of problem areas or constraints which may inhibit such attainments; (c) Recommendations as to how such problems or constraints should be addressed; and (d) Evaluation, to the degree feasible, of the overall development impact of the Project."

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5. The extent to which trials conducted and planned are focussed on production constraints of Central Tunisia's small farmers and the extent to which the ESAK research team is aware of and adapting known semi-arid agriculture technology.

6. The extent to which research results of ongoing research may be expected to be adopted in the production environment(s) of Central Tunisia.

7. The extent to which training, technical assistance, and commodities are being utilized by CTDA and ESAK to develop and institutionalize an applied cropping systems research program for Central Tunisia.

8. The appropriateness of trials conducted, local training, staffing and organization to develop the farming systems (pilot study and demonstration) activities planned to be carried out by a multi-disciplinary joint CTDA and ESAK team after year 3 of the project.

9. Collecting data and analysis of the cost effectiveness of the various types of irrigation infrastructure financed.

10. The banking/credit procedure used in the shallow well component.

11. Analysis of the extent to which the dryland research program has taken into consideration financial constraints and attitudes toward risk of Central Tunisian farmers.

The team started its work in Tunis January 26, 1983 and met January 27-29 with officials of the Ministry of Agriculture, Planning, International Cooperation, ODTC and USAID. January 30 through February 5 was spent in Central Tunisia project area observing and collecting data at shallow well, spring and PPI sites and dryland field plots and farming areas. Meetings were held with the President Director General of ODTC and his headquarter and field staff, with CRDA staff and personnel of other development agencies, the BNT and with farmers. One day was spent with the Director and staff of ESAK, Le Kef. February 7-13 was spent reviewing reports, discussing results with MOA and AID officials and one repeat visit to ODTC and ESAK.

The preliminary draft report was completed February 15, 1983. Government of Tunisia comments were received April 17 and reviews completed April 15, 1983.

The team wishes to acknowledge especially the support and assistance provided by ODTC and USAID during its period of work January 26 to February 15, 1983. The team particularly benefited from the large amount

of time devoted by the ODTC staff in accompanying and responding to data requests of the team and to Mohamed Ali Hassairi of USAID who accompanied the team on its first visit and supplied information and reports for the team's use.

The team concluded that the overall progress in implementation by agencies involved was satisfactory. The four members of the team not involved in implementation consider progress by the implementing agencies in some aspects, such as in execution of irrigation works (PPI's), to be rapid. Others have moved more slowly.

Chapter I of the report provides background on the program. Chapters II and III report and analyze progress to date on the Small Holder Irrigation and Dryland Farming Systems Research subprojects, respectively, and summarize recommendations of the team.

I. BACKGROUND

A. Characteristics of the Project Area

The project area included under Central Tunisia Development includes 11 delegations located in 4 governorates. The central region has a climate that is a mixture of both Mediterranean and desert climates. Its annual average rainfall varies between 200 mm (7.7 inches) in its interior and south, and 320 mm (12.5 inches) in the north and along the coast. The project area is located inland from the coast where lower and variable rainfall is the rule. It is a plateau criss-crossed by steep hills and valleys where dryland farming plays a secondary role to livestock grazing. Crops include durum wheat, barley, olives, fruit trees, and some bread wheat and vegetables. Cattle, sheep and goats are the principal livestock raised for market or home use. Tractors are fairly common in use on the large government controlled agro-combinats, cooperatives, and on larger private holdings. Others who can gain access and can afford it may use tractors on a rental basis. Although much of the central region is best suited to grazing, tree crops are grown extensively. The irregularity in rainfall makes dryland farming for annual crops precarious. However, there are some substantial areas in annual cultivation (mainly cereal crops) in the project area. Irrigation facilities are not well developed in this region, and the surface and ground water resources in general have high mineral content which requires attention to salinity problems in their use for irrigation depending, of course, on salt content and the nature of minerals which needs to be determined. Total available irrigable area is about 3% of the farm land.

The area includes an estimated 40,000 farm units which are expected to benefit. Most now practice a mixed system of dryland farming and grazing which yields a bare subsistence. Though most farms are 5 hectares or less, totally landless families are rare. Almost all have at least enough land for a home and garden and a few trees. Land tenure represents somewhat of a problem in the area. Over half the land area is in the hands of individual farmers with an average of about 14 hectares each (in 1974). However, legal title to land adequate to obtain loans frequently is not available. A major effort has been required to provide farmers with a substitute "certificate of possession" to obtain farm improvement loans.

Per capita income of most rural families is between $40 and $100 per year which puts this area in the income category of some of the lowest income countries. Other indices of deprivation include lack of potable water, substandard housing, scarcity of health facilities. A large percentage of the farm families have very recently shifted from nomadic herding to sedentary farming and herding.

Population density is not high relative to surface area though it is relative to current output and the resource base. Low rainfall is a major factor in low incomes but soil characteristics, lack of suitable dryland technology and lack of inputs also are important factors.

AID is supporting GOT efforts to address the low income and deprivation by introducing irrigation and better water use where adequate water resources exist, by increasing supplies of potable water, by introduction and dissemination of higher yielding technology for dryland crops and by rangeland management.

B. Political and Institutional Organization

Tunisia is divided into 3 regions based on physical conditions - mainly rainfall, surface features and native vegetation. This division has no political significance except in so far as development priorities and activities are varied to reflect needs and opportunities in the different areas.

The country is divided into 20 political areas called "Gouvernorats" (each headed by a governor who represents the GOT). Each governorat is further divided into a number of subdivisions called "delegations" (each headed by a delegue). This is the lowest level of principal functioning political divisons. Central Tunisia comprises 24 delegations from the governorats of Kasserine, Siliana, Kairouan, Sidi Bouzid and Gafsa which have several common features: high geographical dispersal of a highly rural population, low income level, and poor living conditions (lack of potable water, health centers, electricity, etc.).

To solve major economic problems and improve living conditions in Central Tunisia, in August 1978 the GOT created the "Office de Developpement de la Tunisie Centrale" or ODTC hereafter referred to as Central Tunisia Development Authority or CTDA which has a general mission, the promotion of integrated development in the following delegations from the governorats of Kasserine, Siliana, Sidi Bouzid and Gafsa: Kasserine, Feriana, Foussana, Sbeitla, Thala, Hejdra, Jedliane, Sbiba, Gafsa Nord, Sned, El Guetar, Sidi Bouzid, Ben Aoun, Meknassi, Mezouna, Regueb, Jilma, Cebbala, Hajeb El Ayoun, Nasrallah, Bou Hajla, El Ala, Haffouz, Rohia, Makthar and Kessra.

The principal assigned role of ODTC is to:

- improve living conditions in rural areas,
- improve alfa production through rational exploitation,
- help in land reform and provide credits and technical assistance to farmers,
- help non agricultural institutions by providing technical assistance in management and access to financial sources.

Agreements have been signed between ODTC on one hand and other institutions or agencies on the other to implement a number of activities to meet the assigned objectives. May 18, 1979, USAID signed a Project Agreement with the GOT to support the following ODTC subprojects:

- Dryland Farming Systems Research
- Small Holder Irrigation
- Extension and Outreach
- Rangeland Improvement
- Rural Potable Water
- Area Development (Experimental Fund)

All of those USAID/ODTC activities concern 11 delegations within the ODTC area which are: Makthar, Kessra, Thala, Rohia, Haidra, Jedliane, Foussana, Jilma, Sbiba, Sbeitla and Cebbala.

Although only the "Dryland Farming" and the "Small Holder Irrigation" subprojects are presently being evaluated, all USAID/CTDA subprojects are interrelated as shown below in more detail. Their assigned activities focus on different aspects of rural development in a common region. Although ODTC has a predominant role in rural development of Central Tunisia, other institutions have been assigned direct or indirect responsibilities for development in the area as outlined below:

Institution	Major Role
ODTC	Integrated Development in Central Tunisia
ESAK	Training and Research (dryland farming)
CRDA	Contribution to, coordination and control of regional agricultural development activities
DRES	Inventory and study of variation, conservation and means of development of water and soil resources
GR	Study, control or/and implementation of infrastructure works (irrigation, drainage, roads) and other civil or agricultural engineering activities in rural areas
CRGR	Research on water use will emphasis on salinity. Farm machinery is also included as another research activity.
DERV	Planning, management and coordination of activities, dealing with agricultural training, research and extension (including INRAT and INAT)
OEP	Promotion of livestock sector in Tunisia including all aspects of inputs as well as rangeland management
OC	Promotion of cereal sector in Tunisia including supply of inputs and marketing
CGDR	Newly created institution responsible for developing and implementing a general regional development strategy for the various regions of Tunisia
DAPME	Encouragement of farmers' associations, organizing commodity procurement study of marketing and contribution to management and oversight of credit
BNT	A national bank that manages farmers' loans and credit in Tunisia
UNA	Tunisian Farmers Union. Helping all types of (affiliated) farmers for technical, economical, social and political matters.

This listing is not exhaustive; it suggests the number and variety of major institutions or agencies that need to work together harmoniously to meet development objectives. DRES, CRGR and GR should cooperate with and help ODTC in carrying out studies and/or implementing activities dealing with irrigation and water use in private and public perimeters. ESAK, INAT, INRAT

and OC particularly need to cooperate with ODTC to help solve technological problems related to improved dryland farming and farming systems. Extension personnel from DERV, CRDA (or DPV), OC and OEP should cooperate closer with those of ODTC to motivate the farmers to adopt new and efficient agricultural technological packages for crops, livestock and forage under both rainfed and irrigated conditions. Coordination among the governorat (through the Rural Development Program), DAPME, UNA, BNT, CRDA and ODTC is a prerequisite for a sound loan and credit program that will insure more expeditious and sound lending, realistic repayment scheduling and procedures that maximize loan repayment. BNT has primary responsibility for lending and for maintenance of up to date loan records.

Similar cooperation is necessary among institutions in other areas of rural development such as rangeland management and soil and water conservation which require collaborative efforts of OEP, the Forestry Directorate, DRES, GR, and ODTC and the potable water program which would involve "services" from Ministry of Health, GR, Governorat and ODTC.

Other rural development activities are being implemented or planned, include the irrigation program of OTD aimed at providing sprinkler (800 ha) and drip irrigation (800) at Oued Derb. This program does not directly involve ODTC but can have direct effects on potential adoption of drip irrigation in the region once preliminary results are obtained.

C. AID Activities in Central Tunisia

AID supports Central Tunisia development through several activities. The Rural Development Project is the umbrella project under which seven subproject activities are supported with a total commitment of U.S. resources as shown below:

	Amounts Obligated by the Agreement as Amended to Date (in millions of Dollars)		
	Loan	Grant	Total
Area Development	0	3,200*	3,200*
Dryland Farming Systems Research	0,350	2,800	3,150
Small Holder Irrigation Development	4,400	0,400	4,800
Potable Water System (urban)	0,750	0	0,750
Rural Extension and Outreach	2,805	0	2,805
Rural Potable Water	1,500	0,690	2,190
Range Development and Management	2,300	0,300	2,600
	12,105	7,390	19,495

*of which $1.5 million is allocated to the Experimental Fund.

In addition to the above, one other AID project is closely related to the Central Tunisia Development support. This is the Agriculture Technology Transfer Project which supports a wide range of agricultural training in the U.S. including provision for 12 trainees who were specifically to be assigned to the Central Tunisia sub-project activities working through ESAK (the Dryland Research Subproject). Additional training is provided under the Rural Development subproject activities[1/]. The 1982 funded Agriculture Research Project will provide some indirect support, as does the PL 480 Program. Additional AID supported activities operating in the AID/CTDA project area include:

(a) CARE assisted project with $491,000 (50 potable water sites)

(b) CARE (Operational Program Grant) $1,050,000 for 100 potable water sites.

1/ Rural Extension provides training for 4 M.S. candidates, and Range Management for 10 M.S. and B.S. candidates. The Area Development subproject provides short-term training mainly in planning and management.

The Dryland Farming Systems Research and Small Holder Irrigation subprojects are the principal focus of this evaluation. However, the evaluation team was also asked to consider implications of its observations for other activities, particularly Rural Extension and Range Development and Management.

The Range Management and Extension obviously are closely related to the irrigation and research. In addition, the rural potable water subproject in some cases involves shared use of common water sources with irrigation development (e.g. springs). The Area Development includes the Experimental Fund designed to stimulate small scale economic development activities which could inlcude agricultural related activities such as renewable energy and agribusiness. In addition, AID is supporting a private enterprise development program of a national scope which could be drawn upon to stimulate and help finance marketing and other agribusiness development in Central Tunisia (e.g. marketing fruits and vegetables form land irrigated under the project).

D. Major Other Donor Projects in Central Tunisia

Central Tunisia has received relatively little donor attention. There currently are two major projects of other donors underway or planned of particular relevance to the CTDA area. One is the Austrian financed irrigation and livestock project (Oued Derb) on the edge of Kasserine which will develop 1,600 has. for irrigation, split 50/50 between forage for the dairy herd and tree crops. The forage is to be sprinkler irrigated and tree crops drip irrigation. The equipment is already on site and to be installed and started up over 2 years with the help of 12 Austrian technicians.

The other project is IBRD-financed - a part of the Kasserine-Kairouan project for which IBRD will provide $16.5 million. The total activities for CTDA area will cost about 7.7 MD split between IBRD and the GOT. It will include the following elements:

1. Rehabilitation of 9 old PPI's with 1,502 has and 531 farms (817,000 D);
2. Creation of 4 new PPI's with 246 has (1,944,000 D);
3. Research and extension (873,500 D);
4. Infrastructure (roads, etc.) (1,499,000 D);
5. Institutional Development (782,000 D);
6. Other (support to PS) (84,000 D)

Contingency allowances are:

Physical contingency	(704,000 D)
Monetary (inflation) contingency	(962,300 D)
Total	(7,666,000 D)

Institutional Development includes marketing 310,600 D; provision for forage, etc. 246,000 D; repair services for shallow wells 126,400 D; motor service 158,100 D. Artificial insemination, veterinarian medicine center, a sheep dipping tank, and equipping and staffing of a mechanized farm unit are included. Financing is also provided for feasibility studies for future investment. Research and extension includes 11 new extension personnel, offices, housing, commodities, training, research trials and demonstrations, creation of a monitoring and evaluation unit. The marketing activity will equip 3 centers and train ODTC and farmers. Repair of pumps includes spare parts and training of 11 people.

In general, the Austrian and IBRD projects are complementary to the AID supported CTDA project. The IBRD program in particular attempts to address some of the longer term problems in implementation of activities supported by AID - shallow well and other irrigation maintenance, research and extension, marketing, livestock feed and health, improved extension evaluation and planning. However, the marketing inputs appear to be only a fraction of levels of support and investment needed. Additional needs could and should be identified and planned for possibly using the IBRD feasibility study funds. The monitoring and planning inputs though listed under extension and research may duplicate somewhat the AID EPU. This should be reviewed by AID and CTDA officials.

The Austrian supported agro-combinat adjacent to Kasserine is not so clearly consistent with the AID-CTDA plans though it has complementary CT production and regional income objectives. It will for example concentrate on sprinkler and drip irrigation, both of which had previously been considered excessively costly and in the case of sprinklers, inefficient in use of water because of high winds and low humidity. Such experimentation

seems desirable, if that is planned, to answer questions of economics. However, it is not clear that the project will be devoted to answering such questions objectively rather than simply farming. AID should discuss with CTDA the possibility of obtaining reliable data on costs and benefits of these two approaches from that project.

II. SMALL HOLDER IRRIGATION SUBPROJECT

A. SUMMARY

a. Situation at the Outset

Prior to organization of CTDA and provision of support through the Central Tunisian Development (CTDA) Project, irrigation was already quite widely practiced with water supplied by Public Irrigation Perimeters (PPI's), private shallow wells and some use of springs. Prior to initiation of the project, PPI systems provided irrigation water for some 2,000 hectares of land in delegations of Sbiba, Sbeitla, and Thala (Table 1). Principal crops irrigated were fruit trees (apples, pears, almonds), vegetables, forage crops and some cereal area. Technical assistance was provided to farmers by the Office for the Development of the Madjerda Valley (OMVVM) through extension agents assigned in the area. The number of extension agents is shown in Table 1 by delegations. Shallow well development was carried out largely through individual efforts. A total of 600 shallow wells were reported in four (4) delegations as follows:

Delegation	No. of Wells
Foussana	272
Djedeliane	53
Thala	167
Rohia	108
Total	600

Delegation	Area Has.	Water Supply Wells/ Dams	L/S	Reservoirs No.	Volume m3	Beneficiaries No.	Extension Agents Available
Sbiba	1,667	5/1	246/190	2	1000/1500	730	5
Sbeitla	400	3/0	118	1	1000	150	3
Thala	120	1/0	50	0	0	45	1

1/ Information furnished by Mr.Hadji Mosbah, Chief of the Irrigation Program of the CTDA.

The University of Missouri project development team reported 1,080 wells in 5 delegations and used this as a basis for project costing[1] The CTDA project area appeared to have substantial potential for additiona irrigation development. Data assembled by the University of Missouri team from Tunisia studies of major aquifers in the project area indicated a minimum of ground water available for development of 250 liters per second of continuous flow (about 7 million m3 or 700 hectare meters[2]) and the ma: mum was estimated to be 27 million m3[2]. The study noted further that onl: additional ground water development and aquifer monitoring would provide needed data concerning the true sustained yield capacity of the aquifers. The above refers to main river valley aquifers and excludes Djilma for which essentially all the ground water is earmarked for Sfax. It also excludes small and shallow aquifers and underground flows of water available to shallow wells. It was noted that shallow well irrigation is "probably the most effective means to improve small holder income".

Four already existing deep wells in the Delegation of Foussana were to be developed. These wells (designated as SF3, SF4, SF5 and SF6) were drilled in 1974 and capped in expectation of additional funds for their development. The water quality in the area was reported to be generally satisfactory for both shallow and deep well developments[3]

Surface wells existed in various stages of development -- from a shallow unlined surface well reaching just below the water surface to lined wells sometimes equipped with small above surface reservoirs. The usual depth of

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1/ Hagan, A.R., I.E. Asmon, F.E. Bolton, and C.F. Cromwell, Jr. (University of Missouri-Columbia Consulting Team) Agricultural Development in Centra Tunisia, Recommendations for Irrigation, Erosion Control, and Dryland Farming Interventions. July 1978, p. 110

2/ University of Missouri, Op. Cit. p. 109

3/ Ibid.

these wells was between 7 and 10 meters and seldom more than a maximum of 12 meters. The average water depth in these wells was reported to be 1 to 2 meters. A typical surface well supplied enough water to irrigate 2-3 has. in the winter and 1 ha. in the summer. Crops irrigated commonly included vegetables (tomatoes, peppers, carrots, lettuce, etc.) and fruit trees. The average net income was reported to be 300 TD per hectare. Pump breakdowns and malfunctioning occurred frequently. In many cases the motor and pump were reported to have been selected without adequate consideration of the well characteristics.

At the outset of the project, most of the existing natural springs were used mainly as a source of potable water. A few farmers constructed small rudimentary earth reservoirs to collect water and to irrigate a few mainly ubsistance crops.

b. Problems to be Addressed

Rural people in Central Tunisia have incomes that average only in small fraction of the country average. Causes include: low levels of rainfall and use of low risk but low yield practices in dryland cropping and range management; low levels of investment in irrigation development; inefficient use of water resources already developed. The Small Holder Irrigation Subproject addresses this latter set of constraints.

The problems of low levels of investment in development and utilization of ground water potentially available for irrigation and low levels of use of improved practices. It is directed at (a) existing farmers owned shallow wells that are underused because they lack small essential improvements such as deepening, lining, adequate pumping facilities, and temporary water storage, (b) unused shallow water aquifers that farmers lack resources to develop, (c) springs which go underused or unused for irrigation, (d) existing deep wells lacking pumps and other development, (e) some existing

public irrigation perimeters requiring rehabilitation, and (f) cutting across these and other existing irrigation systems, the inefficient and wasteful delivery and on-farm use of irrigation water. Together these factors resulted in productivity that was much below the potential of the ground water resources.

c. Subproject Description

The stated purpose of the Small Holder Irrigation Subproject is to "optimize small farmer access to and income derived from agricultural ground water in the CTRD zone primarily through on-farm irrigation infrastructure expansion and secondarily through the diffusion and institutionalization of appropriate on-farm water management practices"[1/].

The project involves a combination of capital and technical inputs comprising a number of discrete but interrelated types of intervention, some of which are predominantly U.S.-financed and others predominantly GOT-financed. An AID loan of $4.4 million was to be used to finance selected irrigation facilities including:

- Development of 3 irrigation perimeters based on 4 existing but capped deep wells;
- Improvement of existing private shallow wells;
- Development of springs for irrigation (and potable water);
- Development of new shallow wells where water resources are ample.

In addition, a $400,000 grant is provided to finance water management improvement to reduce wastage and improve field efficiency of use.

1/ "Small Holder Irrigation Development Sub-Project Paper" USAID Project No. 664-0312.3 (Nov. 17, 1978 (Log Frame, Annex A, p. 1)

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GOT funds were to be used to make grants to cover part of the shallow wells program, for development of at least one irrigation perimeter and to cover administration, locally available technical assistance inputs and related costs of operation.

- Improvement of Existing Shallow Wells

USAID-financed shallow well improvement was to cover about 300 wells and consist of (a) deepening to about 3 meters below the ground water table, (b) lining to ground level, and (c) installing either electric or diesel pump sets, if needed, and other minor improvements.

- Installation of New Shallow Wells

Approximately 200 new shallow wells were to be developed financed by AID funds. The installation of wells required the participation of the farmers involved by undertaking excavation to at least the ground water level. The well deepening and lining required specialized equipment and involved considerable material costs. The AID-funded credit, finances the farmer to hire local entrepreneurs to execute work related to well deepening and finances additional development cost such as pumps.

- Development of Natural Springs

Approximately 100 springs were to be developed with AID funds. The development of the natural springs consists of: (a) construction of a concrete tank to hold the overnight flow and provide a strong irrigation stream flow when used; (b) provision of portable outlet pipes to reduce seepage losses. At the outset the area irrigated by a spring was expected to be comparable to that irrigated by a shallow well but the investment per site much smaller. Thus, economic benefits of spring development were expected to higher relative costs.

Development of Three New Irrigation Perimeters

Three irrigation perimeters were to be developed, with AID funds, by exploiting four existing and unutilized deep wells in the delegation of Foussana. A fourth perimeter was to be developed by the GOT with an existing well in the Thala delegation.

- On-Farm Water Management

Technical assistance was to be provided by Oregon State University under a contract with the GOT financed by an AID grant[1/]. The specific objectives of this TA are

"a. On the basis of the consultants' reports, the Contractor will formulate, in cooperation with CTDA staff, a program for the next twenty-four (24) months. This program will center on controlled field testing of alternative water management and cropping systems.

b. Specify minimum cost/minimum maintenance recommendations for most beneficial use of existing water resources in irrigated agriculture.

c. Determine economic benefits of varying levels of supplemental irrigation.

d. Determine optimum level of exploitation of ground and surface water resources based on regional and national net economic benefits, social objectives, and physical constraints of the hydrologic system.

e. Establish experimental test sites for irrigation and soil and water conservation in the project area delegations.

f. Develop and initiate training of personnel in irrigation and soil and water conservation in cooperation with CTDA."

1/ Contract between Government of Tunisia represented by the Ministry of Agriculture and the State of Oregon acting by and through the State Board of Higher Education on behalf of Oregon State University. (See p. 20 of contract signed in July 1980.)

d. Status of Implementaiton Plans Relative to Schedule

Input Deployment

Development of three new Irrigation Perimeters.

Three irrigation perimeters were to be developed based on four existing wells. These four wells were retested (June 1980) by the CTDA prior to beginning of construction of the civil works. The test results were:

Well	Static Level m	Drawdown m	Flow l/s	Specific Yield l/s/m
SF3	6.1	53	20	0.4
SF4	26.1	25	50	2.1
SF5	14.2	30	50	1.7
SF6	24.2	30	20	0.1

Perimeter 1 - Wells SF4 and SF5 are being used in developing perimeter 1. Inputs deployed:

- Installation of water distribution system. This includes 9,260 meters of PVC pipe (160,200 and 250 mm in diameter) and 44 water hydrants.
- One water reservoir of 1,500 cubic meters.
- One third of the total area has been planted with fruit trees (apples and pears).

Capital deployments to date are as follows (in dinars):

- Deep wells (Tunisian contribution): 68,000 TD (both wells)
- Total civil works: 185,000 TD
- Equipment (pumps): 25,200 TD

Perimeter 2 - The well SF3 with 20 l/s is the source of water for perimeter 2.

Inputs are:

- Water distribution system: 4.0 km of PVC pipe (160 mm diameter) and 20 hydrants.
- A 300 m3 reservoir
- One Johnston deep well pump

The capital deployed is:

- Deep well: 34,000 TD (Tunisian contribution)
- Civil works: 68,000 TD
- Equipment: 12600 TD

Perimeter 3 - The source of water for this perimeter is the SF6 well.

Inputs deployed to date are:

- Water distribution system: 2.5 km of 160 mm PVC pipe and 9 hydrants.
- A 300 m3 reservoir
- One Johnston deep well pump
- About 80% of the total area (30 ha) is planted with fruit trees.

Shallow Wells

Deployment of inputs:

- Construction of 17 new wells
- 323 existing wells improved or in process (equipped with diesel or electric driven pumps, other needs)
- Capital loan through the BNT approved for 1. 346,000 TD.

Development of Natural Springs (AID-financed)

- 20 springs improved
- Capital deployment - 34,800 TD (about)

On-Farm Water Management Technical Assistance

The inputs for TA on on-farm water management were provided by the following short term consulting:

Dr. Cuenca	27 March	-	24 April, 1981
Prof. Shearer	27 March	-	17 April, 1981
Dr. Cuenca	22 June	-	14 July, 1981
Dr. English	23 June	-	20 July, 1981
Prof. Shearer	20 September	-	9 October, 1981
Prof. Shearer	6 March	-	29 March, 1982
Mr. Baker	6 March	-	4 April, 1982
Dr. Cuenca	14 April	-	7 May, 1982
Dr. English	23 May	-	11 June, 1982
Dr. Cuenca	8 January	-	2 February, 1983

Improvement of Functioning Irrigation Perimeters (GOT Contribution)

Inputs to date:

At Sbiba

- Construction of a flood protection reservoir at a cost of 28,315 TD
- Introduction of 5 additional extension agents.

At Sbeitla

- No additional construction was necessary.
- Introduction of 3 additional extension agents.
- Planted fruit trees.
- Introduction of greenhouse technology.

At Thala

- Added 70 new hectares: 20 has. of apples and about 45 has. in irrigated pastures and vegetables.

- Drilled one new well in 1981 producing 45 l/s.
- Construction of water distribution system and hydrants
- A 600 m3 reservoir

Capital costs:

- Reservoir: 28,000 TD
- Well and Pump: 34,000 TD
- Pipe and hydrants: 18,500 TD

At Jelma

- Construction of one surface reservoir
- Total Surface: 318 hectares
- Beneficiaries: 80 families
- No cost information was given.

Outputs Achieved

Practically all the civil works in the three new irrigation perimeters are completed. Some of the land has been planted and irrigation has started.

Seventeen new surface wells have been approved for loans and started. About 40 hectares of land is to be put into production. The land used per well is about 2.0 hectares. The expected gross yields per hectare are vegetables, 12 tons and fruit, 10 tons. Each well benefits one family of about 5 members.

The natural springs development program has finished the improvement of 20 springs. Each spring serves a minimum of 3 households and a maximum of 42 (5 members for household). The number of irrigable hectares for the 20 springs is about 60. The springs' main use is at present to provide drinking water.

The improvement of existing irrigation perimeters (Tunisian contribution) has increased the irrigated area and introduced fruit trees, vegetables and irrigated pastures. In addition, some farmers are beginning to use greenhouses for the production of winter vegetables.

The ultimate output, of course, is the irrigation of the entire area within the perimeters and that feasible within the shallow wells and developed natural springs. The productivity of the land thus utilized will depend on the efficiency of irrigation water use and other on-farm water management and cropping practices employed.

The on-farm water management technical assistance produced consultant reports for every assignment containing pertinent recommendations. In addition, a total of 37 recommendations were made in a "Recommendation Report" submitted the 11th of May, 1982.

e. Problems Encountered in Deployment of Inputs and Achievement of Outputs

The main problems encountered in the implementation of the irrigation perimeters have been customs clearance and land tenure problems. The pumps arrived in Tunis by April 1982, but were not cleared through customs until January 1983.

Shallow well development and improvements have been slow because of banking (BNT) regulations, lack of ownership title for the land in question and consequently release of funds to pay for subsidized work. Apparently, the initial number of springs for development was on the optimistic side. Project personnel have had difficulty in locating springs to improve.

The consulting assignments were too short and some of the recommendations difficul to implement considering the technical, logistic and political constraints. The CTDA has selected six of the 37 recommendations

given in the "Recommendation Report" for implementation.

f. Appraisal of Results Attained to Date

Spring Development

The main purpose for development of natural springs was to furnish two or more families with a water supply capable of irrigating small plots of land comparable to that irrigated by a shallow well. Because of the small investment involved, as compared with shallow wells, it was expected to provide a significantly higher benefit/cost ratio (see Project Paper). Despite its apparent low cost relative to expected benefits this water resource has produced little results. The developed natural springs shown to the evaluating team were not being efficiently used.

The team was informed that the multi-family use of the natural springs was one of the causes of serious maintenance problems encountered. Generally, the springs constitute the main source (and sometimes the only source) of drinking water for families living nearby. The irrigated agriculture practices around the developed springs was not comparable to that practiced in the shallow well areas. This, of course, does not mean that supervision of these springs can not achieve better results, but better results would probably require more technical guidance and more cooperation among those served by the spring than was evident.

Shallow Wells

The improvement of shallow wells and the construction of new ones permit the incorporation of about two hectares of irrigated land per well.

The average loan value per well can be estimated as follows:[1/]

Pumping equipment	1,200 TD
Well lining	1,100 TD
Irrigation piping	800 TD
Total loan	3,100 TD

The loan cost for irrigated hectare is, therefore, 1,550 TD. The average operation cost was estimated to be 0.023 TD per cubic meter of pumped water[2/]

By mid February 1983, 340 loans were approved for equipment, well improvements, and construction of new wells. Only 17 of these loans were for the construction of new wells. The main reasons for the slow rate of well improvement and construction were banking procedures and delay in granting some form of land title (e.g. Certificate of Possession).

The efficiency of irrigation apparently is low. Farmers seem to be hard working individuals, eager to learn and to practice improved irrigation and agronomic methods. Many of the farmers in Central Tunisia are one generation or less from nomadic herdsman. The transition from nomadic herdsman to farmer, to successful and efficient irrigation farmer is a long one. Intensive technical assistance by Tunisian specialist is needed to train most of these new irrigation practitioners to use efficient irrigation practices. The consultants from Oregon State University have suggested some areas for emphasis in this regard in their reports.

1/ "Prets Accordes Jusqu'au 5/82". Republique Tunisienne, Ministere de l'Agriculture, Office de Developpement de la Tunisie Centrale, Kasserine.

2/ Information provided by the CTDA in Kasserine.

Irrigation Perimeters

The surface "effectively irrigated"[1/] to date is as follows:

Foussana	210 hectares
Thala	150 hectares
Hajeb	318 hectares
Sbiba	1,667 hectares
Sbeitla	300 hectares

To date, there are 10 technical personnel available for the CTDA irrigation activities[1/]. Information regarding technical qualifications and specific responsibilities of the irrigation personnel were not supplied to the team.

The civil works targetted for the irrigation perimeters are practically concluded, with the exception of finishing the installation of three new Johnston pumps.

A detailed Operation and Management Program for the irrigation perimeters was not available to the team. Such a program should include irrigation scheduling; maintenance of well and pumping equipment; and maintenance of water distribution systems and related structures. Plans for provision of irrigation practice extension services to the farmers also should be included.

Farmers in the perimeters irrigate when water is made available to them. Deciding when to irrigate and how much water to apply in each perimeter falls into the responsibility of the technician in charge of the perimeter's operation. This is a difficult task to perform properly under any circumstances. It is complicated in the PPI's by the diversity of crops and cropping patterns among the many farmers served. Since most, in some cases,

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1/ Information furnished on February 10, 1983 by Mr. Hadji Mosbah, Chief of the Irrigation Program of the CTDA.

all of the support of the families living in and supplied with water in irrigation perimeters depends on irrigation, the irrigation scheduling must be carefully planned, implemented and continuously monitored. A properly maintained and operated perimeter would greatly help the farmer in achieving more efficient irrigation.

The efficiency of water conveyance after it leaves the closed distribution system appeared to be low, and water application efficiencies also appeared to be low. A survey on the present irrigation practices by perimeter and by crops should be made, with actual measurement, to determine water losses, depth of water application per irrigation, scheduling of irrigation, soil water-retention capacities, salinity hazards, etc. The initiative for such study and monitoring should be undertaken by CTDA, but it should seek assistance from Tunisian agencies already involved with such activities, who have trained and experienced staff.

In some cases not enough water will be available to irrigate the desired area. For example, twenty liters per second for 24 hours for 60 hectares of land, at an overall efficiency of 50% (which is high for the present practices) would give a maximum net of water available daily for evapotranspiration of only 1.4 mm.

On-Farm Water Management Technical Assistance

Oregon State has provided a total of 11 short-term consultant assignments over the period March 1981 to February 1983 with individual consultant visits ranging from 20 to 30 days in length and a total of 270 person days. Some of the consultants made several visits (e.g. Cuenca 4 for a total of 104 days, and Shearer 3 for 68 days).

In general, the in-country time spent on individual consultant assignments was too short and coordination apparently inadequate. Numerous valid recommendations were made by the OSU consultants, a large part of which have not been implemented and are not likely to be implemented. The magnitude and variety of recommendations appear to be overwhelming for a new institution (CTDA) with insufficient trained personnel in irrigation and on-farm water management, and with many logistic and organizational constraints. This should have been evident to OSU advisors early in the game. More emphasis should have been given to formulation of on-farm water management activities, for which major contributions could be made and results could be achieved during visits of the consultants and for which specific follow-up could have been managed with a high degree of certainty within Central Tunisia institutional limitations. Certainly more contact should have occurred between the OSU personnel and national agencies with competency to deal with problems identified (e.g. CRGR, DRES, ESH). This program should:

(a) Include active participation of other institutions and expertise available in Tunisia in formulation of plans and their implementation.

(b) Be based on the present and future needs of the CTRD project in adaptive research, extension activities, operation and maintenance of irrigation perimeters, shallow wells and natural springs; and

(c) Include a well designed training program (mainly in Tunisia) for personnel from different agencies working on the program.

Up to now, the training component of the technical assistance has been minimal. Visits to the USA provided for a few CTDA technicians were too short. Such short visits allow the participants to observe some of the irrigation practices followed in the areas visited, but <u>do not train</u> the

observers to implement such practices. Short training abroad should have a minimum effective duration of one month and should be specifically designed as an intensive and practical short course covering some of the irrigation problems encountered in the CTRD project area.

g. Appropriateness of the Approach Taken

The 3 1/2 years' experience, since the rural development project was signed, and specific experience with the irrigation activity raise some questions about the approach initially taken.

Marketing and credit in irrigation perimeters already showed indications of possibly serious problems. Some are mentioned in the Hopkins background report. These might have been more specifically addressed in the project, or assurance provided that they were being addressed outside the project by GOT agencies. Credit repayment was identified as a major problem prior to approval of AID support to APMANE, and might have been addressed more specifically in the irrigation credit sub-activity.

The experience from earlier spring improvements which were visited indicate that serious problems with beneficiary participation and satisfaction with the approach predated the AID start-up. These problems do not appear to have been addressed under the project. In a similar manner, conflicts among beneficiaries and minimal beneficiary participation in financing and operation of PP''s were not addressed. Another aspect not addressed is the wide disparity in beneficiary cost sharing between irrigation perimeters, where beneficiaries share none of the water development costs and pay only nominal water use rates, and the shallow wells where they receive a grant of up to 25%, but are to pay full costs of the remainder including future operations. Such disparities are bound to be widely known

to borrowers. A more equitable arrangement should be sought which recoups more of the cost of PPI investment and operation from the beneficiaries.

Closer coordination between irrigation and water management improvement, and extension and dryland cropping systems research subprojects would be beneficial especially to the water management improvement subactivity. An extension specialist on on-farm water management should have been included in the extension subproject.

h. Implication for Future Programming

This Subproject

The delay and difficulty in spring development for irrigation is already recognized; the team supports plans to discontinue spring improvement for irrigation purposes. Development of new shallow wells has proceeded slowly. Increased emphasis and assignment of additional resources on improvement of existing shallow wells would be desirable at this point.

Increased resources should be devoted to initiation of a major effort to improve irrigation efficiencies within irrigated areas. This should include: (a) Measurement of water delivery losses and efficiency of field use, and identification of the causes of losses and major inefficiencies in use; (b) Research on better delivery methods and more efficient on-farm use, and, (c) A major extension effort to teach farmers how to get maximum returns from available water. The team recommends in particular that resources gained by more favorable than projected dollar conversion be devoted to this high priority area, and the activity completion date be extended to permit implementation of such a program. While CTDA should exercise coordinating responsibility, it should seek major professional and operational support from line agencies with proven experience with these types of activities.

Related Activities

A closer working relationship should be developed between water management research and extension and other related activities, particularly Dryland Research, Extension and Range Management.

B. RECOMMENDATIONS

a. Summarize Ground Water Situation

Assemble and review current information on ground water supplies and utilization in the project area. Based on available data, assess probable effects of present irrigation development in the CTDA area: make these results available to agencies involved in Central Tunisia development. This should be a collaborative effort of DRES, CRGR and CTDA. DRES has staff experienced in such data collection and mathematical modeling.

b. Prepare an Integrated Land and Water Use Plan

Assemble and review data on climate, topography and soils, vegetation and water resources. Prepare an integrated plan for long term sustained yield use of these resources including management of watersheds affecting the CTDA area. This should include among others:

1. Ground water investigation and monitoring to identify changes in quantity and quality of ground water aquifers, identification of ground water movements, recharge rates and factors affecting changes and suggest alternatives for water exploitation in the short, medium and long term.

2. Climatic data and evapotranspiration estimates including water use by natural and cultivated flora under alternative circumstances.

3. Development of a soil and water conservation program.

Select and study a sample of watershed areas to identify and extensively test soil and water conservation practices for subsequent widespread application in the CTDA area. Such developments should be designed to improve

ground water recharge and regrowth of natural vegetation and consequently should benefit both dryland and irrigated agriculture.

4. Supply maps and related material for planning. CTDA should request that the appropriate MOA agencies, particularly DRES and CRGR, take major responsibility in reviewing needs and, as appropriate and consistent with regulations, supply soils, topographic, hydrologic and geologic maps and aerial photographs and interpretation data to implementing agencies. Project funds should be made available to cooperating agencies for this purpose.

c. Expand Water Management Program

A plan should be prepared and implemented for improving the management of irrigation water both on public irrigation perimeters and in private shallow well systems.

1. Measure losses in water delivery from well or reservoir to individual fields and measure field utilization of water (effective up-take by economic plants) and estimate losses due to evaporation and leaching to derive overall water use efficiency estimates.

This should include measurement of water use efficiency under different delivery methods, rates and timing of application, and different crops and cropping systems to identify and define optimal methods for various physical conditions encountered. It should cover both physical and economic aspects. In this connection CTDA should seek to obtain detailed data from the Austrian project at Oued Derb on water use efficiency and costs and benefits of drip and sprinkler irrigation.

2. Prepare specific recommendations for improving water management in both shallow wells and public perimeters taking into consideration the rates at which capacity of managers of the systems and farmers can adopt

improved methods and the technical guidance required for adoption of more efficient methods. Recommendations should include:

(1) Best estimates of optimal water delivery schedules and application rates for different crops, soils and weather conditions;

(2) Technically and economically feasible methods for reducing delivery losses between the wellhead or reservoir and the lowest level of field application area.

3. Procedures for monitoring and evaluation of efforts to improve water management with appropriate in-process redesign of plans.

4. Preparation of operation manuals for each irrigation perimeter- and, as experience indicates, revise the manuals. These manuals should provide guidance on water delivery schedules based on individual crop requirements and guidance on maintenance of equipment, conveyance structures and fields.

The addition of at least one trained Tunisian professional will be needed to assist in planning and implementation of the water management activities.

Professional personnel from Oregon State University can be drawn upon to assist in implementation of recommendations a, b, and c.

d. Institution Building

Systematic development of Central Tunisia requires that all institutions involved continue to grow in their planning and implementation capacity. Institutional development should focus on strengthening of CTDA as a planning and coordinating agency with some direct implementation responsiblity and strengthening of other agencies that are or should be collaborating in the Central Tunisia development efforts within their assigned roles and capacity. Adequate and stable budgets properly balanced between capital and operating

funds consistent with roles should be sought for all institutions involved. Assigned responsibilities and accomplishments should be reviewed regularly to avoid duplication and gaps and to assure coordination of efforts. Specific provisions should be made where needed for training of personnel in the various agencies including post graduate studies, on the job training, special courses and increased assignment of professional and leadership responsibilities. EPU should take leadership on these institution building efforts. An important part of these assignments would be review of tasks to be performed by different agencies, staff required and preparation of a staffing and personnel development plan reflecting priority needs. It should also examine the adequacy of technical materials and, as necessary, prepare plans for improvement which might include organization of a small shared library and documentation center.

With respect to professional staff, the team believes that there is a priority need for improvement in level of engineering skills and suggests that the MOA select one or two candidates for Masters of Engineering degree training (with emphasis on ground water hydrology and on-farm water management) for assignment in Central Tunisia upon completion of their training. This training should be financed under the project, provided there is adequate assurance that the trainees will be assigned to work in Central Tunisia after graduation.

e. New Irrigation Perimeters

The drilling of deep wells for new irrigation perimeters should be considered only after careful examination of the findings obtained in the preliminary ground water data and analysis recommended in a) and b).

f. Marketing

Marketing efforts planned for Central Tunisia appear to be substantially less than needed to assemble, store, process and market profitably the increased output of fruits and vegetables the expanded irrigation system is expected to produce. The following are recommended:

(1) Implement principal recommendations made in Waldstein report.[1/]

(2) Initiate careful studies of future production and potential market demand for apples in Tunisia and nearby countries.

(3) Appraise the apple varieties being planted in Central Tunisia and as needed take steps to expand the harvest season and storability by shifts in the varietal mix.

(4) Initiate studies of processing of fruits and vegetables in Central Tunisia.

(5) As appropriate, arrange technical and financial assistance for private marketing ventures, especially Central Tunisia processing facilities for fruits and vegetables. The AID Private Sector Development Project should be explored as one possible source of funding for this purpose.

(6) Encourage farmers to utilize some water on forage crops and on supplemental irrigation of typical dryland crops such as barley and durum where marketing is not a problem and returns are likely to be favorable.

Some of the IBRD feasibility funds might be used for the studies suggested above.

1/ Particular attention should be given to the following in Waldstein's report: Provision of 2-3 consultants, if possible from Tunisia, to (a) analyze costs, benefits and operational feasibility of alternative market strategies; (b) analyze feasibility and develop plans for processing plants for CT: (c) advise on cooperative development. Under Waldstein report paragraph VI, particular attention should be given to 1. c, d, g, h, and i; 2., 3. a (for both vegetables and apples), b, c, d; and paragraph VII 1, 5, 6.

g. Credit Management

The team was very favorably impressed by the approach taken on the shallow wells wherein most of the funds would be made available as loans which, as paid, would be available for future development. Further, under this approach, the Government would incur no future financial obligation for operation of the system. This is in sharp contrast with the PPI's which, with low water charges provide no such mechanism for recoupment of the investment by the Government and do incur a continuing financial obligation for operation. The former has the advantage also of providing a greater stimulus to water conservation. As far as shallow well lending is concerned, however, the lack of loan repayment discipline encountered in many Tunisian credit activities also may jeopardize the viability of this loan fund. Preliminary results of payments coming due indicate that the project may suffer such lack of repayment discipline. It is recommended that the MOA, CTDA, BNT and AID review this problem carefully, and until they are assured that the agencies principally involved, BNT and CTDA, have put in place a mechanism which will bring about acceptable levels of repayment, further loan approvals be delayed. It is essential, of course, that initial farm plans and repayment schedules reflect realistic expectation on the rate at which farmers can prepare their land for irrigation and establish, harvest and market crops based on the expanded productivity resulting from the irrigation. Schedules also must reflect the increased costs the farmer must bear the first year in preparing his land for irrigation and in planting and harvesting his first irrigated crops. Loan discipline inevitably will suffer if original repayment schedules are not realistic. Thus an important part of the review should be a determination

of whether loan repayment schedules are realistic, along with implementation of a procedures that insures adherence to the repayment schedule.

h. Analysis of Costs and Benefits of Irrigation

The team found very little systematic data being collected and analyzed on costs and benefits of irrigation and alternative approaches to irrigation. The team recommends that CTDA, in collaboration with CRGR, INAT and INRAT, initiate a systematic program of data collection and analysis to appraise costs and benefits from alternative investments in irrigaion systems (shallow well pumps, spring improvement, public irrigation perimeters) and means of improving benefits relative to costs.[1/] Particular attention should be paid to means of reducing unreimbursed public investment and reducing continuing public obligations for deficit funding of future operations. Such study should establish criteria for upper limits of individual project investment per well or hectare irrigated.

i. Irrigation Versus Dryland Priorities

Current estimates put irrigation area at about 3% of the total area with 97% in one type or another of dryland use. The portion of the total population which will be able to benefit from irrigation will be more than 3%, but still include only a small percentage of the total. It is recommended, therefore, that CTDA intensify its efforts to introduce dryland technology and establish conditions which make improvement feasible for small farmers. The team was left with the clear impression that up to now this has received substantially lower priority in CTDA than completion of irrigation work. The team recommends that the three subproject activities dryland research, extension and range management - along with measures to

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1/ This should be closely coordinated with IBRD financing of studies of PPI's.

insure wider availability of production increasing inputs (improved cereals, legumes and forage seed, fertilizer, pesticides and planting equipment) receive high priority among CTDA activities.

j. Socio-Economic Study of Constraints to Improved Irrigation Farming

A study similar to that outlined under the Dryland recommendations, should be undertaken on irrigated agriculture and include study of marketing practices, especially of fruits and vegetables.

k. Farm Size Qualifications for Loans

The present agreement specifies that the farmers shall not exceed the APMANE small and medium size farm criteria for loans. The definition of smalland medium size has been redefined at the upper limits by proclamation No. 5 of January 14, 1983 which establishes new upper limits and defines coefficients for combination of diverse enterprises to arrive at a maximum. The team recommends that these new criteria be incorporated into the new limits for project financing. This would raise the single enterprise limit but generally lower the overall limit and improve equity.

l. Use of Increased LC from Dinar Devaluation

Additional dinar funds resulting from the more favorable dollar conversion rate should be allocated first to water monitoring and on-farm water management, and include the assignment of one additional Tunisian irrigation specialist hopefully from CRGR to work in Central Tunisia in water management research and extension.

m. Use of Oregon State University Personnel

In general, greater efforts are needed to use personnel available from Tunisian organizations before calling on OSU consultants and to coordinate consultant visits with other Tunisian institutional inputs.

Short-term technical assistance should be provided only for specific well defined tasks which can be accomplished during the assigned period. No short-term consultancy should be for less than a month; preferably assignments should be for 2-3 months.

Need for a resident technical advisor for the irrigation subproject should be reviewed after well defined programs for the on-farm water management and watershed management recommended in (b) and (c) are prepared.

n. Scheduling Changes

It is recommended that:

1. The PACD for physical works under the Irrigation Subproject be maintained as June 30, 1984.

2. A draft schedule be prepared by June 30, 1983 for implementation of the remaining irrigation works specifying shallow wells to be improved, new wells to be funded, and works to be completed on the agreed three PPI's with schedules for each. Funding shifts between springs and shallow wells should be planned. Project officials plan to discontinue the spring improvement program for irrigation. The team, based on its very limited observations of spring improvement, believes this is the correct decision to take. This schedule should be sent to AID along with a request for an appropriate shift in funds.

3. The PACD for the water monitoring and water management activities should be extended to September 30, 1986 to correspond to the Drylands, Extension and Range Management activities.

o. Participation of other Agencies

In concluding its recommendations on irrigation, the team wishes to emphasize the importance it attaches to CTDA taking the lead in obtaining participation of national agencies such as DRES, CRGR and others, and in coordinating inputs into the CTRD project.

III. - DRYLAND FARMING SYSTEMS RESEARCH SUBPROJECT

A. SUMMARY

a. Situation at the Outset

The dryland farming areas of Central Tunisia are characterized by predominantly shallow soils, often sandy and underlain by calcarious subsoils with frequent rock outcroppings or interspersed stones. Annual rainfal ranges between 250 and 400 millimeters, most of which occurs between October and April in heavy showers that can result in rapid runoff and erosion. Rainfall lacks dependability, both in amount and distribution. The summers are relatively long with extended periods of high temperatures. Winters are mild with occasional light freezes and infrequent snowfall. Extended periods of high wind velocity cause high evaporation potential and wind erosion.

The farming pattern is predominately fall or winter sown barley and wheat with some pulses such as chickpeas and broadbeans. Most farms are ten hectares or less and are tilled by animal power, mostly donkey and oxen or occasionally camels. When rainfall is timely andabundant, annual cropping is practiced. If fall rains are late or sparse, the shallower soil areas in particular will be left fallow. Yields are low, usually less than 1,000 kg/hectare, and average about half this amount. If yields fall below 200-300 kg/hectare the crop is usually harvested for animal fodder. Nearly all farmers keep livestock, predominantly sheep and goats that are a primary source of income. The non tillable areas are used as livestock range and are utilized either on an individual ownership basis or as a communal grazing area. The straw and other crop residues are fed to the livestock. As s result, the region may be classified as a mixed farming area of livestock and dryland cereals and pulses. Most of the farmers have limited resources, and low incomes.

Although these limited resource farmers predominate, much of the land is owned and farmed with machinery by better endowed farmers. Although most

crops are broadcast seeded by hand after plowing and covered by harrowing, some of the larger farmers are beginning to use drills, fertilizer and chemical weed control. This represents a small portion of the total area farmed. Because of the large number of low-income farmers in the central region compared to other parts of Tunisia, the Government of Tunisia has given special priority to improving the dryland farm productivity in this region through the activities of the Central Tunisian Development Authority. This subproject was implemented to conduct adaptive research on moisture conservation farming techniques and dryland cropping procedures to develop production packages of proven value based on known technology developed in similar dryland farming areas of the world.

This subproject is headquartered as part of the Ecole Superieure d'Agriculture d'El Kef; a two-year agricultural college soon to become a four-year school serving the north and central drylands areas, but is a subproject of the Central Tunisian Development Project.

b. Problems to be addressed.

The problems may be divided into two broad categories, one related to tillage practices designed to minimize erosion and maximize water conservation, and the other to crop production practices designed to increase the amount and dependability of crop yields. Although closely interrelated, these two problems require somewhat different research approaches and thus can be treated as separate segments of the overall problem of overcoming low crop productivity and environmental degradation.

The current tillage methods consist of animal draft plowing once fall rains have produced adequate moisture. This is followed by broadcast seeding and harrowing for coverage of the seed. The same basic methods are used where tractor power is available with the plow and disc harrow as primary implements. Where land is left fallow, it is not plowed but left untilled

and the weeds and volunteer grain kept down by grazing.

These current tillage practices are contrary to those that have been developed and introduced in many similar dryland cropping areas of other countries. The current methods produce a poor seed bed that dries out more readily than those produced by improved methods, is less resistant to erosion and fails to adequately kill established weeds, particularly grasses. The untilled summer fallow is largely ineffective in building soil moisture reserves and has the sole advantage of providing some grazing and not requiring the expense of tillage.

Crop yields are low, not only because of the inefficient moisture conservation practices, but because heavy uncontrolled weed growth competes for both moisture and nutrients. The soils are generally deficient in phosphorous, and where inadequate phosphorous or moisture is not limiting, nitrogen becomes inadequate. Variety improvement or even adequate testing of existing varieties developed for similar areas of the world has not been carried out in the past. The evaluations of optimum seeding rate, seeding methods, time of seeding and related cultural practices have not been done in a systematic way.

In countries where highly efficient dryland farming has been developed, it is associated with adequate soil testing facilities in which crop production correlations have been worked out between soil moisture and nutrients contents and crop yields for the primary soil types. This has not been done in the Central Tunisian region. Soil testing facilities were not available in the region for this type of work at the time the subproject was developed.

c. Subproject Description: Purpose, Goals, Plan, etc.

The purpose of this subproject is to develop extendable packages of dryland farming technology through adaptive research and field trials designed to tailor known semi-arid agricultural technology to the small farmer environment

of Central Tunisia.

This is to be carried out by utilizing land leased from farmers in the various governorates covered by the Central Tunisian Development Authority as sites to test various moisture conserving tillage practices and crop production techniques. These are to be developed into improved packages of technology that can be extended to the farmers of the regions by the Extension Services of CTDA and other agencies.

The basic problems to be addressed by this subproject are improved moisture conservation tillage methods, optimum rate and date of seeding, identification of the best adapted crop varieties, the most cost-effective use of fertilizers and the most appropriate means of weed control and other crop protection practices.

The overall goal is to improve the productivity of the dryland farming areas in order to raise the income of the limited resource farmers and introduce improved tillage practices that will reduce erosion and as a consequence the various types of environmental degradation that result.

To accomplish this, an AID supported subproject was established and Oregon State University contracted to provide technical assistance. The Tunisian instrument chosen to establish the necessary soils laboratory and provide the headquarters location for the equipment and the staff required to conduct the field research and demonstration activities was the Ecole Superieured'Agriculture d'El Kef. This required the expansion of this instructional institution to accommodate the research and support facilities and staff required. Under the contract with Oregon State University, AID provided the funds to equip a soils laboratory, and provide the field and laboratory equipment required for field research and demonstration activities and the vehicles and trailers required to transport the equipment and staff. A senior resident advisor and consultant services were budgeted over a three-year funding period to be provided by Oregon State University. The total project duration is five years. A total of eleven post graduate Tunisian

technicians with MS and PhD training along with the necessary support staff at the four-year past secondary and lower levels of training represent the Tunisian staff contribution. The Ecole Superieure also agreed to provide the necessary renovation and construction to house the soils laboratory and agronomy laboratories required to support the program. In addition, an equipment area was provided for the housing and maintenance of field equipment. These were done under a subcontract with CTDA.

The end result of the project is to provide a range of field-proven varieties and practices suitable for extension to the small farmers of the region that have taken into consideration the constraints of limited resources and tillage options available to these farmers.

Although the subproject has no direct responsibility for extending to the farmers the technology developed, it is forseen that it will have close linkage with the extension activities of CTDA and other agencies that will have this responsibility and will conduct a farmer demonstration program to prove the usefullness of the technology.

It is recognized that any type of research program is long term, and thus initial activity will focus on adapting already known technology that adequate momentum would have been attained to permit continuity and momentum to provide necessary long term research activities. This is particularly important due to the need for the new technologies and interventions to be combined and coordinated into a complete farming system which suits the needs and resources of the small farmers of the region.

The technical interventions to develop the basis for improved farming systems will initially focus on cereal breeding to improve the barley and wheat varieties and later legumes and forage varieties adapted to dryland conditions. Continual testing of existing varieties will form the basis for future breeding activities. Agronomic practices will focus on soil fertility and fertilizer trials, date and

rate of seeding, seeding methods, weed control and crop rotation. The soil management and moisture conservation trials are to test tillage techniques, fallow-crop rotations, seedbed preparation and erosion control methods.

All trials are to be designed around the real operating situation of the Central Tunisia small farmer rather than "experiment station maxima", but should establish the actual yield potential for dryland areas under farmer conditions.

The integration of these improved technologies into the farming systems in the various governorates is to be carried out through the establishment of pilot study and demonstration areas by the rural extension subproject also contracted with Oregon State University.

In order for these plans to be implemented, the major responsibility of the senior resident advisor and consultants provided under the Oregon State contract is to determine the most likely existing technologies that should be utilized in the testing programs and to train the Tunisian staff in the specific methodologies and use of the equipment and laboratory facilities required to implement the plans.

d. Status of Implementation Planned Relative to Schedule.

(a) Input Deployment: Use of TA, training and commodities to achieve project purpose.

The implementation can be divided between the inputs to be provided by Oregon State University under the Technical Assistance contract, and by MIAC for graduate training under the Technology Transfer project, and those provided by the Tunisian Government. The technical assistance provided by Oregon State has been hampered in effectiveness by delays in both the MIAC contract and the inputs to be provided by Tunisia. The nine month start-up delay in the MIAC contract has delayed the deployment of the senior counterparts by the Government. There have also been less serious delays in the provision of renovated facilities

for the soils laboratory, research laboratories and farm machinery.

Although both the field and laboratory equipment were acquired in a timely manner by Oregon State, there were minor delays in its shipment and customs clearance. A more serious delay was in the registration and licensing of the vehicles and trailers. The first year field program was implemented with the use of the trailers without proper licensing which could have created difficulties, but these potential problems were not encountered.

The delay in the completion of the soils laboratory caused some inefficiency in the use of the consultant provided by Oregon State for the installation and testing of the equipment. This was compensated at least in part by help received from two qualified Peace Corps volunteers who contributed spare time to complete needed installation and testing. The delay in the completion of the soils lab and the selection of technicians and their training to operate the laboratory prevented the desired analyses in support of the first year field plot work. Although the advanced degree holder being trained in the USA for director of the soil laboratory program is yet to return from his degree program, short term training of the two key laboratory technicians at Oregon State has been completed and should permit the laboratory to start operations in support of the current season field programs.

By February 1983, only three of the scheduled eleven advanced degree holders slated for the subproject have returned from training so far. The names, specialities and estimated completion date for these advanced degree holders is provided in table form.

Of the three returnees so far, only two have taken up posting in El Kef. The economist chose to become an extension specialist under the rural extension subproject at CTDA headquarters. Of the other two, the seed specialist has chosen to work on forage crops instead and the legume breeder will handle the work on pulses as programmed.

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As a result of the delayed return of advanced degree candidates, the in-service training in cereals and dryland cropping that could have been provided by Dr. Floyd Bolton, the Senior Resident Advisor provided by Oregon State, has not occurred and will be prevented by his imminent departure after completion of his two year contract. Because Dr. Bolton is an internationally recognized authority in dryland cereal production and improvement, this is very unfortunate. This is partially offset by the quality and dedication of the junior technicians with four year degrees or two year certificates that have taken up posts in support of the various program components implemented so far. They have made possible the implementation of most of the components of the field program other than tillage and moisture conservation. They are not in a position to provide the leadership necessary for continuity without the presence of either the graduate degree holder or a resident advisor. Once the new graduate degree returnees take up post, they will need time and guidance to translate their academic studies into an effective applied research effort. Little of their thesis research training is directly relevant to the research needs of Central Tunisia.

(b) Output Achievement

During the 1981-82 crop season eight sites were selected and dryland cropping trials established with one in each delegation. These included cereal breeding and variety trials; weed control tests using various herbicides; fertility trials using various rates of nitrogen and phosphorous; and seeding rate and row spacing trials. All of these various tests were conducted on barley, durum wheat and bread wheat. Yields were taken on each of the treatments and compared with the yield obtained by the farmer outside the plot area using his normal production procedures. In general the various fertilizer and weed control practices all gave considerably higher yields than those obtained by the farmers. A number of varieties and breeding lines showed superior yield potential.

MIAC Contract Participants Expected to Return to ESAK

Name	Degree Sought	Field	Thesis Topic	University Attended	Arrived in U.S.	Began Ac. Studies	Projected Completion Date
Aloui, Tahar	Ph.D.	Soil Science (Agronomy)	Chemical and Physical Effects of Cations upon Soil Structures & Fertility Status	Univ. of Missouri, Columbia	8-79	1-80	8-83
Ben Hammouda, Moncef	M.S.	Soil & Water Conservation (Agronomy)	----	Undetermined	8-82	6-83	8-85
Ben Younes, Mongi	M.S.	Plant Improvement (Agronomy)	Interspecific Hybridization between Lotus Conniculatus (4X) and Lotus tennuis (2X)	Univ. of Missouri, Columbia	8-80	1-81	3-83
Boubaker, Mohsen	M.S. and	Plant Improvement (Agronomy)	K interacting with N and P to reduce disease and lodging in some wheat genotypes	Univ. of Missouri, Columbia	8-80	1-81	11-82
	Ph.D.		--		--	--	6-86
Bouchandira, Mokhtar	M.S.	Ag. Engin.	--	Iowa State Univ. Ames	1-82	6-82	12-84
Bouslama, Mohamed	Ph.D.	Plant Improvement (Agronomy)	Genetics of drought resistance in soybeans	Kansas State Univ. Manhattan	8-79	8-79	7-82 (returned)
Cherif, Raouf	M.S.	Weed Science (Agronomy)	--	Colorado State Univ.(?)	6-82	--	8-85
Limam, Mohamed	M.S. and	Statistics	No thesis	Oregon State Univ.	8-79	8-79	12-81
	Ph.D.	Statistics	--	Corvallis	--	--	6-85
Marouani, Ahmed	M.S.	Seed Production (Agronomy)	A study of Factors Influencing Seed Quality and Seed Yield in Carrots Grown for Seed	Washington State Univ. Pullman	1-80	6-80	6-82 (returned)

Name	Degree Sought	Field	Thesis Topic	University Attended	Arrived in U.S.	Began Ac. Studies	Projected Completion Date
Yahyaoui, Amor	Ph.D	Plant Pathology and Genetics	(Topic related to the disease of barley: *Puccinia hordei*)	Montana State Univ. Bozeman	8-82	8-82	8-86
Khelifi, Bechir	M.S.	Ag. Economics	Factors influencing Cereal Production in Tunisia	Univ. of Missouri, Columbia.	6-80	8-80	8-82 (returned to Extension sup-project CTDA Kaserine)

In 1982-83 the same trials are being repeated in greater detail on each of five sites. In addition, trials have been initiated on broad beans, chickpeas, oat and vetch forage production and forage trials testing annual ryegrass and various selections of berseem clover and annual medic.

e. Problems encountered in deployment of inputs and achievement of outputs

Most of the problems encountered have already been alluded to, but their consequences have not been detailed. The delays in the construction, installation of equipment, training of laboratory staff and return of the advanced degree holder to head the soils laboratory has prevented its utilization in support of the field program. To date a comprehensive program to utilize the soils laboratory to develop the necessary response curves for fertility and soil moisture on the primary soil types has not been developed or implemented. This requires careful collaboration between the field program and the soils laboratory. Until these data are obtained, the laboratory is of limited use as the basis for farmer recommendations or in support of the research program.

The baseline data that is needed to determine in more detail the various aspects of the current farm practices, their variation between farmers and the level of constraints on the adoption of technological innovation is yet to be collected. The program to obtain the data essential for refining the research program to insure that the technological packages are within the capacity of the small farmer to utilize is only in the advanced planning stage. It needs early implementation and amplification of data collected for maximum benefit.

The lack of counterpart technicians due to delayed return from graduate training in the U.S. has prevented implementation of the soil management,

tillage, moisture conservation and crop rotation portions of the anticipated research program. Other programs already implemented are severely handicapped by lack of trained leadership. This has placed an undue burden on the OSU resident advisor.

f. Appraisal of the Results Attained to Date

(a) Research and demonstrations carried out.

The first year results from the cereal production trials gave strong indications that all the key innovations have the potential for major improvements in crop yields. These include improved varieties, proper seeding rate, timely weed control and improved fertility. It would appear that at least doubling the current farmer yield is readily feasible at reasonable cost.

It is too early in the current season to appraise results. These will include added work with annual forages and pulses. The trials appear to be in good order and offer the potential for a wide variety of useful information. Because 1981-82 was an abnormally dry year and 1982-83 abnormally wet, the trials will give useful comparisons at the two extremes. This information when used with the results obtained in future years that may be more nearly average will give maximum predictive capability to data interpretation.

(b) Their relevance to small farmer constraints.

This is yet to be determined as the approach being taken is to determine the technological innovations that prove successful and then adapt them to fit farmer constraints. The study of farmer constraints is yet to be carried out, so the relevance cannot yet be readily determined.

(c) Adequacy of consideration of financial and farmer attitude toward risk.

Because these have not yet been studied, they cannot be determined. The only indication on farmer attitude gained so far is circumstantial evidence from experience gained through the contracts negotiated with the farmers for

plot sites. The first year, farmers were insistant that only their poor quality areas be used. The second year they have encouraged use of their better sites.

(d) Incorporation of the results in research and extension activities; actual and probable.

The Rural Extension Education subproject has already incorporated some of the most promising results into farmer demonstrations. The breeding and variety testing trials have provided evaluation of varieties and breeding lines, both introduced and developed by the Institut National de la Recherche Agronomique de Tunisie. These results will be useful to the dryland cereal breeding station institute which is developing at El Kef and in their national cereal improvement program.

It is highly probable that after yields are obtained during the summer of 1983, certain improved innovations can be identified for widespread testing through farmer demonstrations based on two years of field testing data.

(e) Utilization of training, TA and commodities.

This subproject provides for only short term training abroad in its program. This has been utilized so far for two technicians to operate the soils testing program and one in field research techniques. In-service training is to be carried out by the senior resident advisor and timely consultancies. So far a specific plan for use of the consultant component for this purpose has not been developed. The use of the senior technical advisor for in-service training has been limited by staffing delays.

The technical assistance component has been utilized as the primary element in implementation of the applied research program to date. The future schedule for staff taking up their post after completion of training abroad would indicate heavy reliance will need to be made on the Oregon State technical assistance component for some time yet.

The needed commodities have been procured, delivered and made ready for utilization in a timely manner. The equipment for the soils laboratory and the tillage and moisture conservation programs are all ready for these programs to be implemented once the required staffing and supervision is available. Commodity procurement and availability have not been a limiting factor in project implementation.

g. Appropriateness of the Approach Taken

The approach taken has been influenced by the circumstances of staffing delays and lack of farming systems base line information. Under these constraints, the approach taken would appear appropriate. It will provide a substantial amount of information needed as the basis for refining technological packages that can be designed to fit farmers' constraints and requirements once more fully evaluated and understood.

h. Implications for Future Programming of This Subproject; of related Activities

So far the subproject activities have focussed on the crop production improvement portion of the research program. The results have indicated that by utilizing widely practiced improved cereal production technology, yields in Central Tunisia can be at least doubled compared with current farmer practices. These indications are based on measured yields under abnormally dry conditions where some farmers had inadequate yields to justify grain harvest, yet yields in the improved technology plots were far above normal year farm yields.

This second year of research, plot work has been conducted under higher than normal rainfall conditions. Yields by the farmers should be at maximum levels as should those in the plots testing improved technology. Careful analysis of the data from these two climatic extremes should give

clear indication of the relative potential contributions under average conditions and extremes for the various improvements, i.e. improved varieties, fertilizer and weed control.

These three innovations are easily adapted to farmer conditions and readily demonstrated by tested extension demonstration techniques. They, therefore, should form the basis of a standard improved package for each of the three cereal types: barley, durum wheat and bread wheat. These can be used as a standard by which future variety improvement, fertilizer technology and weed control practices can be compared in the research program. The same package can be taken directly to the farmers through a carefully structured extension demonstration program. This should be a joint effort of this subproject and the Rural Extension subproject.

Other technical innovations not yet tested can add substantially to yield potential, income, risk aversion, and are basic to stopping serious soil erosion losses. They require major changes in current farming practices that will be more difficult and time consuming to develop in the research program, to package for the farmer, and become readily accepted by the farmer. The major innovations will each be outlined and discussed.

(a) Improved seedbed, proper seeding rate, and seeding method.

The current practice of plow, broadcast seed and harrow to cover gives good stands where moisture conditions are favorable, but under these conditions grass species and various perennial and biennial broadleaf weeds established prior to plowing are only partially killed and those not completely turned under by the plow or torn out by the harrow reestablish quickly and provide maximum competition for moisture and nutrients and are hard to kill. They compete with the cereals prior to the normal weed

control treatments that are based on weeds coming from seed that germinate at the same time as the cereal crop.

During unfavorable moisture conditions, this type of loose, rough seedbed dries out quickly and may kill most of the weeds, but the stand of grain may be inadequate to provide acceptable yield potential. Measures to overcome this problem would include use of implements to more fully break up the soil in the plow furrows and use of drills with packer wheels to provide a firm seedbed for germination. Where drilling is practiced, switching to chisel or sweep plows should be compared to the current system. Small farmer equipment fitting a common tool bar for animal or small tractor traction has been developed for this purpose, but not introduced into Tunisia.

Under improved seedbed and seeding methods, the dependability of stand at an optimum seeding rate would be greatly increased, thus reducing farmer risk and seed cost. This will require added capital investment to achieve, but should have a short recovery period.

(b) Improved summer fallow, moisture conservation and erosion control

The primary advantages of a fallow year in low rainfall cropping areas is to accumulate moisture and available nitrogen which can produce more crop production every other year than two annual crops that each suffer from insufficient moisture. In lower rainfall areas of the world this alternate year crop-fallow practice is standard. Where rainfall is higher, the use of soil moisture tests prior to sowing time can lead to annual cropping in years where the analysis shows the reserve moisture in the soil, when added to that which can be expected with a high probability

from rainfall, will produce an adequate corp. In years below this amount in the soil test, the land will be fallowed.

The current fallow system provides far below the potential level of moisture accumulation. Because the area is left untilled and unplanted, weeds and volunteer grain use up most of the available moisture and nitrogen. The weeds provide poor quality forage for livestock that keep the fallow area grazed, and there is no tillage expense.

Improved fallow requires the fallow fields to be kept free of vegetation starting with the time of diminishing rainfall in the early spring. This is done with sweep or chisel plows followed as necessary by a rod weeder. This provides a surface mulch that is resistant to erosion, prevents loss of stored moisture and is too dry for weed germination. Any time rain disturbs the mulch it is reestablished with a rod weeder or sweep tillage. Under the abundant moisture conditions below the mulch nitrifying bacteria fix atmospheric nitrogen which will substitute for the fertilizer needs of the next crop. The amount of nitrogen accumulated and the available moisture can be determined by soil test and, if the fertility is inadequate for the crop expected, it can be supplemented with fertilizer.

Because soil moisture is readily available under the mulch regardless of rainfall, seeding can be done at the optimum time rather than waiting for rainfall because the seedbed is prepared and moisture available. This is m .t efficiently done with a chisel or shovel type (deep furrow) drill that leaves the soil ridged to prevent erosion and channels rainfall into the bottom of the furrow where the crop is planted. This system can produce major yield improvement with high dependability. The labor can be minimized

as only half of the farm is cropped each year. The loss of grazing under current fallow methods can be more than offset by planting a portion of the field to improved annual forages. The high efficiency of moisture and nitrogen accumulations should produce more grain and forage than the current system, so will lead to higher income from both crops and livestock. It obviously requires more capital investment and training than the current system, but recovery from increased amount and dependability of income should be rapid.

(c) Cereal/pulse or cereal/forage rotations.

In the higher rainfall areas (350 - 450 mm/yr), crop rotations may be advantageous. They tend to reduce disease, insect and weed problems. The use of legumes in the rotation can reduce nitrogen fertilizer costs. The subproject has initiated plot tests on annual forages, both legume and grass and pulses (grain legumes). As rapidly as possible these should be tested under farm conditions in a rotation system where the legumes accumulate maximum nitrogen that is used by the following cereal crop. This rotation can be used under annual cropping conditions in the highest rainfall areas and under a three year rotation of legume/cereal/fallow where moisture is marginal for annual cropping. So far the subproject has not introduced legume inoculation with improved strains of nitrifying bacteria that have been identified, tested and made available by the AID financed project "Nitrogen Fixation in Tropical Legumes", NIFTAL, at the University of Hawaii. They have superior inoculation cultures available for most of the legume species under test.

(d) Farming systems.

Because livestock are a dominant part of dryland farmer income, the plant material testing and seeding methods for range forages being

undertaken by the AID supported Livestock and Range Management Project should be utilized as rapidly as feasible to examine an improved crop/livestock farm system that would give maximum utilization of both the available tillable and non-tillable land to maximize crop and livestock income.

(e) Plant breeding

Changes in the production practices already discussed should lead to major yield improvements of existing crop varieties. Future improve-

and soils conditions of the region and through improved resistance to the plant diseases and insects present. Therefore, this subproject should work closely with the agencies that will be responsible for plant breeding for this region to identify the disease, insect and other constraints that reduce the efficiency of current varieties which might be reduced through plant breeding.

B. RECOMMENDATIONS

a. Administrative and Organizational

A lessor geographic separation between this research subproject and the extension specialists of the Rural Extension and Outreach Subproject would have facilitated program planning and coordinated implementation of related dryland farming activities. Every effort should be made to improve exchange of ideas by more frequent meetings of the two subproject staffs and more, importantly, by increase in the number of jointly executed activities.

Other agency programs have direct and indirect relationship to the planning and implementation of a sound applied research program for dryland agriculture in Central Tunisia. Certain parts of the AID supported Range Development and Management Subproject under the Office of Livestock and Pastures (OEP) have direct usefulness, particularly the plant materials and seed production program. Others of their applied research activities related to production and use of improved livestock feed resources including straw utilization should be considered in the development and testing of improved dryland farming systems.

The graduate thesis studies of the Institut National Agronomique de Tunisie (INAT) and the research activities at the Institut National de la Recherche Agronomique de Tunisie (INRAT) have direct support potential. The INRAT is developing a new experiment station for dryland agricultural research adjacent to the site of the Ecole Superieure d'Agriculture at El Kef. Clearly the Central Tunisia project will benefit from close coordination among these and other institutions which do or might contribute to achievement of the Central Tunisia development program objectives. Specifically the following is recommended:

1. Include Sers and Tajerouine among the areas for research activity.

2. Involve other institutions in the research and related activities and, as appropriate, share resources available.

3. Create a coordinating committee for research and related activities.

As these Institutions develop and expand their work, continued attention will be needed for definition of responsibility and coordination of programs between the two institutions. Currently there is a division of

responsibility between the two with ESAK concentrating on agronomic aspects and INRAT (Le Kef) on cereal and grain legume varietal improvement.

The bottom up coordinating mechanism of the "Research Teams" approach proposed under the pending AID supported Tunisia Agricultural Research Project 664-0327 should be examined as a model for developing the planning, coordination and implementation needed for Central Tunisia. The future experience gained in Northwestern Tunisia by Project 0327 should be utilized where appropriate to improve the coordinated program developed for Central Tunisia. It is recommended that the approach proposed under Project 664-0327 be initiated in parallel for Central Tunisia with existing resources.

b. Substantive Priorities

1. The ESAK study of the characteristics of dryland farm units should be undertaken on a high priority basis and expanded to:

(a) Provide a baseline for future progress evaluation and impact analyses.

(b) Identify alternative high yielding technology currently being successfully employed by more progressive farmers and the physical, social and economic milieu in which it is being employed to provide a basis for immediate selection of technology for the demonstration program.

(c) Provide direction for the applied research subproject to ensure that it is concentrated on real deficiencies, rather than re-discovering current farmer practices.

(d) Identify constraints faced by medium and smaller farmers in adopting known production increasing technology, and new innovations under study.

This study should be carried out in close collaboration with CTDA and INAT/INRAT. It is recommended that arrangements be made to provide the assistance of an economist/social scientist to help the Director of ESAK in conducting this study. The study should be scheduled to provide preliminary data in time for planning of the 1983-84 applied research and demonstration program.

2. Development of a Comprehensive Long Range Research and Demonstration Program with Near Term, Medium Term and Long Term Objectives and Implementation Schedule

Careful planning is necessary for efficient deployment of the currently budgeted funds and to insure the future continuity of the applied research program after the close of the current subproject. This will require support from the other agencies and projects needed to accomplish the purpose and goal in the short term and a commitment at the top level of the Ministry of Agriculture and CTDA to insure the necessary future budgetary allocations required for continuity. It is recommended that the CTDA take immediate action to initiate the development of the required long range program and its immediate and longer term objectives and requirements. Responsibility for implementing this request should be assigned by the new OSU Projects Coordinating Committee. Once the plan is completed and endorsed it should be recommended for Ministry of Agriculture adoption and the necessary future budgeting.

3. Development of a Comprehensive Program for the Soils Laboratory

Crop response curves to soil moisture and fertility levels have not been developed for the primary soils and cropping conditions of Central Tunisia. This is a critical need before soil analysis can be used effectively

in support of either research of farmer recommendations. This will require a carefully planned joint effort between the soils laboratory and the field program. Once this basic information is available, a long term utilization plan for the laboratory is needed. TDY technical assistance will be required to prepare the needed plans and should be given high priority.

4. Implementation of the Tillage/Moisture Conservation/Crop Rotation Elements of the Subproject

This type research requires two years for a single cropping cycle. It is recommended that preliminary studies be implemented before mid-March through a TDY from Oregon State University. These should be implemented on the farm of ESAK where multiple year use of an adequate site can be assured. This trial should test the various potential procedures to identify those with the most promise for additional testing starting in 1984. The support staff for this program should be identified and sent for short term training at an appropriate site where this type of work is conducted.

5. Because straw is utilized as a major source of livestock feed, its value often approaches or exceeds that of the grain. It is, therefore, recommended that straw yields also be taken for promising treatments and varieties in comparison with the control varieties and treatments.

6. Joint Farmer Demonstration Program with the Rural Extension and Outreach Subproject.

The technology package to be used to implement the demonstrations should be finalized after harvest of the current trials. It is recommended that a simple demonstration design be established on as many farms as feasible. These might be established following of alternative plans. First, in early stages would be typical 1x4 layouts with all variables but one

(e.g. fertilizer or variety) held constant; thus the farmer would be involved in simple fertilizer rate or variety trials. Later each farmer could use improved seed, fertilizer and weed control on a small portion of his field along side his normal practice. The extension subproject should train the agents to select the farmers, oversee the tests and publicize the results. The drylands subproject should help train the participating extension staff, select the improved technology package and provide the improved seed fertilizer and herbicides. The subprojects should work together in the fertilizer and herbicide applications. The dryland project plot combine should be used to harvest a measured swath both in the new technology part of the field and the farmer's traditional portion as nearly adjacent as possible. The yields from the combine swaths can then be weighed and the bags compared for visual effect and use in media and other presentations.

c. Rescheduling

Because the project is behind schedule due to the factors already outlined, it is recommended that activities and documentation be extended to September 30, 1986. The assignment period of the senior resident advisor by Oregon State University to replace the current departing advisor should be for two years, provided this can be accomplished without reducing resources available in other program purposes. This is considered to be the needed minimum period to implement the rest of the program and provide the needed in-service training for the returning post graduate degree holders.

d. Use of Equipment

The team recommends that equipment purchased under the subproject be exclusively used for execution of research and demonstrations contributing to the project purposes. In general, first priority should be given to research and second priority to demonstrations carried out under the Dryland Farming Systems Research Subproject.

APPENDIX I

a. Expected Costs and Benefits

Virtually no new cost/benefit data have been generated by the project to date except for actual experience with installation of shallow well lining, deepening, pumps and related improvements financed in part by FOSDA grants (15%), farmer self-financing (10%) and loans (75%) and the initial development of public irrigation perimeters, and springs. The average loan for 323 existing shallow wells is slightly under 1,000 D implying an average total cost of improvements of about 1,350 D per well plus some labor costs of the farmer and material for the holding tank. Loans for new wells averaged over 2,000 making the total an estimated 2,700 D plus the tank and labor the farmer supplied. The team was informed that the pumps and related equipment for new wells will be provided under a subsequent loan. Thus total costs will average over 4,000 D but the median would be about 3,500 D. A few wells involve high costs not typical of the majority.

In general, returns to irrigated land were reported to run 800 1,500 D/ha with vegetables compared with typically about 20 D under dryland cereals (above seed). Vegetable prices recently were reported to be about one-third higher than the assumptions in the project paper - a result mainly of inflation. Apple prices included in the paper and presented by project personnel were 600 - 800 mill./kg which the team considers to be above an equilibrium level with apples being planted in large numbers. Apple trees at yields of 50 kg/tree, 200 trees/ha and a net farm gate price of only 150 mill./kg would provide a gross of 1,500 D/ha. They would involve a delay in production but less costs thereafter compared with vegetables; in the interim, vegetables could be interplanted in orchards.

It is easy to see why fruit trees are so popular.

With total cost of a new well of at least 3,500 D - 4,000 D to irrigate 2 hectares the average cost would be 1,750 - 2,000 D per hectare. (Higher cost wells and equipment likely would irrigate much more land.) The gross return on the investment would thus be in the 40 - 90% rate annually. Costs of diesel fuel, maintenance and depreciation are estimated at an average of 200 D/ha/year for efficient pump use reducing returns above water cost to 600 - 1,300 D/ha. Assuming 100 D average out of pocket (cash) cropping costs/ha/year would reduce net returns to land, labor and capital investment in the well to 500 D - 2,100 D/year. Assuming farm family labor otherwise would have been largely unused, the imputed increase generated by the shallow well represents a family return of between 25 and 65% annually on the combined public and private investment. Major improvements in product mix in the region and improvement in marketing could substantially improve on these levels. Illustratively, supplemental irrigation of cereals which added 10 qx/ha at 13 D/ql and used .125 meters over each hectare would provide a return of 110 D/ha over water cost of 25 D per ha (20 mill./m3). Supplemental forage irrigation should provide higher returns with the current high forage (e.g. legume) prices. Arranging schedule to add supplemental irrigation to only 2.5 hectares of grain would add 50% to the net income while using only about 10 - 15% of the water available.

Results on public irrigation systems are expected to be slightly lower than for shallow wells because of lower efficiency of water use and higher costs per hectare irrigated (about 2,500 D). Partly offsetting this, PPI farmers are reported to be better served by marketing. Hence they may

cultivate more intensively and specialize in higher value crops and receive higher prices for their vegetables.

Information on spring irrigation was too fragmentary to provide estimates of benefits. Dissatisfaction was common in old spring improvement projects visited. AID has improved 20 springs with number of families ranging from 3 to 42 and area averaging about 3 hectares per spring. Use includes potable as well as irrigation water.

More data are needed in the spring improvement program, e.g.

1. Level of flow before and after improvement
2. Irrigated area before and after
3. Quality of potable water before and after.

If flow rate data are available that might permit initial inferences on area that can be irrigated where suitable land exists downstream. There would still be the uncertainty of effects of increasing the flow in an upper spring or lower springs.

No significant new information has been produced on costs and benefits of the possible range of dryland interventions. IBRD models suggest higher rates of average return for rainfed improvements than for irrigation (capital output ratios of about 4.0 versus 4.8). These data may not be as applicable to dryland areas typical of Central Tunisia as to other parts of Tunisia. Returns might be lower or higher for Central Tunisia than for higher rainfall areas. Risks clearly are higher for some practices, such as fertilizer and seeds, but the devisibility of such inputs compared with large, lumpy investments such as wells and machines makes their adoption quite feasible even for the risk adverse small farmer. They lend themselves very well to the minimum/risk low-gain orientation of most subsistence

farmers:

One requirement, of course, is to be able to buy inputs in less than usual full size input containers.

Some practices already being widely adopted by farmers indicate bright dryland prospects, e.g. planting of spiny and spineless cactus and protection of the latter suggests willingness of farmers individually to undertake improvements of private range or pasture. They likely will accept and plant other improved forage (grasses) as proven technically feasible.

Research under conditions similar to Central Tunisia suggest very high returns from improved grasses such as crested wheat grass being tested under the range management project[1/]. Clearly the range management, dryland research and extension need to cooperate very closely. A high percentage of land is in range use, some with periodic tillage. Permanent improved forage crops should provide much higher returns than rotation fallow and cereals with 2-5 qx average yields. Annual costs and risks also will be much lower. Large areas with improved, better managed private grazing lands might present a more spectacular development showpiece as well as higher economic impact than sporadic irrigation plots and also contribute to long term regeneration of the ecology.

Major increases are possible in crop yields by introduction of improved practices such as use of drills to plant grain, use of commercial fertilizer (N, P), weed control, and better adapted seed. Differences in stands with use of suitable drills over broadcasting impressed the team

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1/ Morocco initiated similar work in the 1968-74 period with AID support which produced several fold increases in yield per hectare and much higher returns per animal unit with crested wheat grass in arid areas similar to Central Tunisia.

in its field visits. Introduction of new cereal legumes also appeared to be very promising both in terms of returns and nutritional impacts. One indication of acceptance is the shift from unwillingness, last year, of cooperating farmers to make good land available, to, this year, the desire to have plots put on their best land.

Rates of adoption are always unpredictable, but it does appear that suitable high yielding crop technology will be forthcoming fairly rapidly for the 97% or more of the land which can not be irrigated.

b. Marketing

Marketing of the increasedvegetables produced in the various irrigation systems already in operation has presented problems for farmers and development agencies. The problem up to now in Central Tunisia has been most serious for winter-grown carrots and turnips (two crops that appear to do well under Central Tunisia's chilly winters) and summer-grown tomatoes. Early warm weather crops (tomatoes, sweet peppers) grown under plastic for early markets are as yet relatively small and produced mainly by more progressive farmers with better market contacts. Their marketing problems are not serious

In March 1982, AID arrangedfor consultant A. Waldstein to appraise market activity in Central Tunisia and make recommendations. His report focused on vegetables which are likely to be grown in some quantity by virtually all farmers with irrigation facilities whether shallow wells, sp[illegible]s or public perimeters. Current CTDA policy is to avoid major direct involvement in marketing development, leaving that mainly to farmer organizations and private traders. According to Waldstein, CTDA does, however, provide hauling services to processing plants and operates three collection centers. Tomatoes and Cayenne peppers are hauled to processing plants at a charge of 0.002 D/kg.

Instances of very successful farmer organizations are cited by Waldstein such as the Bakourat, Sfax cooperative started in 1974 under WFP. With about 1,000 members in 1981 it sold D1,400,000 worth of produce on the Sfax market (1/6 of the total wholesale market sales there). According to Waldstein, in winter 1982, members had 650 greenhouses with 240 devoted to export of tomatoes - clearly a system much more advanced than generally found in the CTDA area. (The Sfax Governorate guarantees tomatoe prices at export price levels and pays costs of transport.)

Clearly the rapid rate of increase in irrigated areas will impose increasing vegetable marketing problems for farmers with irrigated land. They are generally at economic disadvantage relative to vegetable growers closer to Tunis and Sfax which in addition to lower transport cost were organized earlier, are better capitalized and more experienced. Further, Central Tunisia appears to suffer some climatic disadvantage in terms of cooler winters and hotter summers. Its principal advantage may be somewhat lower wage rates which could be lost by the requirement that farmers pay the SMAG rate.

Share cropping arrangements between owner operators and workers as reported by Hopkins might overcome this labor cost problem and provide landless workers with some entrepreneural opportunities. In any case it is fairly clear that vegetable produces in Central Tunisia can not expect higher returns than Tunis or Sfax wholesale prices reduced by costs of assembly in Central Tunisia, transport and selling costs in Sfax or Tunis. Central Tunisia should offer opportunities for establishment of processing facilities for vegetables - canning, freezing, drying, pickling, etc. It has the potential advantage of a substantial concentration of produce,

a variety of crops maturing over an extended period, lower wage rates (if allowed) for production, harvesting and processing. Private investment should be encouraged and CTDA and DRES should insure that water and power supplies needed for such processing and for temporary storage are not preempted by irrigation and other development. While processing markets offer much more assurance both in terms of quantities and prices, the prices paid to farmers generally are lower than for fresh sales. However, this may be partially offset by specialization in few crops with resulting higher yields.

Deciduous fruit, particularly apples, are being widely promoted in Central Tunisia as an alternative to vegetables. They are widely believed to offer much higher future returns with lower labor and other costs per hectare than vegetables.

Further, Central Tunisia has some climatic advantage in production of apples (more adequate winter chilling than other areas of Tunisia).

High current prices were widely cited as indicative of prospective returns, e.g. D0,800 to as much as D1,500 per kg for apples paid locally. As a result of this optimism, Central Tunisia currently has an estimated 390,000 apple trees on 1,500 hectares and plans an addition of 150,000 trees per year for at least the next 3 years bringing the total by the year 1986 to 840,000 trees. This may be conservative, e.g. the agro-combinat at Kasserine alone plans 800 hectares of irrigated orchards, with most likely to be in apples. The 840,000 trees by 1986 (all standard size) with estimated minimum average yields of 50 kg per tree would produce 42,000 MT with substantially more in higher producing years. Apples, like olives, have a tendancy to biennial highs and lows in a given area induced by natural weather phenomena. Even in an average year this 42,000 MT for Central Tunisia would provide 6 kg per capita, harvested over a small

part of the year. Information on varieties, their ripening dates and keeping qualities were not available.

The latest available data in Tunisia show production of apples for 1980/81 and 81/82 averaged 20,000 MT, pears 14,600 and peaches 23,500 MT. Imports of apples in 1980 totaled 5,585 MT at an average price of 230 mill. per kg, and pears 1,392 MT at an average price of 290 mill. per kg. By comparison, in recent years, oranges have average about 100 mill. per kg at wholesale, mandarines about 125 mill. and clementines about 300 mill. per kg.

Apple production in 1982 is estimated at 19,300 MT and imports for 1982/83 projected at 10,000 MT for a total of 29,300 MT which apparently would be 10-12% above the 1980 level.

In the first month of 1983, 1,200 MT of apples were imported from Turkey and retailed at 480 mill. per kg, slightly over Tunis citrus prices. As long as Tunisia is a deficit producer of apples, local apples can be sold in a short period. Imports can be made during the period when local apples are not available thereby reducing demands on local cold storage and growing of highly storable apples. A cold storage unit in Central Tunisia visited the first week of February had some apples in storage, but the quality had deteriorated to the point where they were scarcely marketable even with heavy sorting. Such deficiencies must be overcome if local production is to serve a major part of the year's needs.

Clearly formidable marketing problems must be anticipated for apples beginning the latter part of this decade if present plans are successfully carried out. By 1990 production could reach 2.5 times present production in a good year and supplies be nearly double recent combined production

and imports, with the total coming in a relatively brief harvest period (3 months or less).

It is difficult to make longrun price projections, but experience in other countries would suggest that farm level apple prices probably will fall to near citrus prices as presently planned production comes on stream.

Illustratively, in the United States in 1979 apples for the fresh markets averaged about 33 cents (0.2 D) per kg and for processing about half that. Citrus sold at about the same price as apples. The U.S. is a major exporter of high quality apples with substantial shipments to Europe. The total supply of domestically produced apples would amount to about 6 kg per capita. The U.S. which, like Tunisia, has a wide variety of other fruits, consumes an average of about 8 kg of fresh apples per capita. But then apples are within the physical and economic reach of U.S.consumers and apples are available the year around at prices competitive with other fruits. In 1978, Chile produced 178,000 MT, exported 116,000 MT and consumed 4-5 kg per capita. Australia, another net exporter, consumes about 10 kg per capita. Germany at the high extreme consumes about 50 kg per capita. (Data from USDA annual statistics and Government of Tunisia production and trade statistics.)

Given the quality, transport differential, Tunisian producers probably should base their plans on no more than D0.200 per kg of marketable quality, and the actual price in a good yielding year might be 100 to 200 mill. per kg which would still be substantially above the recent wholesale price for citrus. With 200 trees per hectare and 50 kg per tree, 150 mill. would still be 7,500 per tree, 1500 D/ha (less costs of harvest and packing and hauling

to a local collection point).

The applicability of some of the data presented above may be argued, but if apple varieties are not distributed such as to permit harvest over a maximum period, and collection and storage facilities not operating effecitvely, prices could fall much below 150 mill. per kg. They might fall to the point where the market will not pay costs of harvesting and packing. It is of the upmost importance that marketing facilities and operations be very closely coordinated with planting and production of future orchards.

Marketing of other tree crops should present much less problems since volume is expected to be much lower. However, if a major shift is attempted from apples to, for example, pears this would create problems for pear producers.

Other crops such as cereals, forage and liestock products appear unlikely to encounter serious market problems by any possible increase in production coming either from the irrigation or dryland development activities. In view of the above, it may be desirable now to anticipate use of more of the irrigation water for forage production and for supplemental irrigation of cereals (e.g. one irrigation at the critical stage could increase cereal yields by 10 qx or more per hectare). (Recommendations are presented in Chapter IV.)

c. Credit for Irrigation

Farmers participating in irrigation development are entitled to two forms of assistance. These are subsidies or grants of 15% of the cost of irrigation development from FOSDA, a loan at 6% for 75% of the cost. The remaining 10% is to be self-financed[1/]. However, a farmer may receive an additional grant on the self-financing portion of up to 150 D from CTDA. Hence a farmer with a total project cost of 1000 D would receive a 150 D grant from FOSDA, 100 D grant from CTDA and a loan of 750 D from BNT drawn from AID funds. Development loan terms may extend to 7 years.

On shallow wells the farmer is supposed to bear the full cost of the excavation down to the water table. The cost of deepening would be financed by loan and grant. The cost of pump, motor, pipe, etc., which typically may be 100 - 1500 D, would be shared as per above.

Until very recently, loans and grants were much delayed in the review and approval process by the review committee and by the land title clearance requirements.

The loan committee is composed of representatives of the following:

BNT - Banque Nationale de Tunisie

CRDA - Commission Rurale du Developpement Agricole

UNA - Union Nationale des Agriculteurs

DRES - Directeur des Ressources en Eaux et en Sols (or other technical staff)

CTDA - Central Tunisia Development Authority

1/ There was some initial confusion on regulations which led to higher grant rates.

This committee now meets 2-3 times weekly, and we were told clears requests within a week or so. As of February 4, all loan requests received by the BNT office Kasserine, approved by the committee, had been approved by the BNT office director.

The process of obtaining a certificate of possession, a prerequisite to a loan, previously took a long period. Now the Governor has fixed a maximum of two months for such title clearance.

Up to February 3, 1983, a total of 323 loans had been made for improvements on farmers' existing shallow wells with the total amount loaned of D317,200. An additional 15 loans had been granted with one pending for wells to be constructed at a total value of D 36,643.

Farmers having water are eligible for crop loans, as are dryland farmers. The BNT office Kasserine granted 1,158,000 D for small farmer crop credit for 1982/83, "up greatly from 1981/2". A major increase in nitrogen use was reported by BNT.

At the moment no serious problems appear to exist in lending operations. However, collection does appear to present a problem. Given the low rate of past repayment of government-sponsored loans, and the small stake of BNT in repayment (5%), and occurrence of defaults already, the project should monitor closely loans and loan repayment.

The Hopkins Social Analysis report identified major problems in credit and repayment operation especially in public irrigation perimeters. Unless repayment is disciplined and levels adequate (95% as a minimum), any prospects for future rollover of the fund for other uses will be jeopardized. The adequacy of repayments should be a major criterion on future lending for shallow wells and a consideration in release of funding for support of PPI's.

Recommendations:

1. Careful monitoring of loan repayment with monthly BNT reporting.
2. Monthly reporting and monitoring of rates of loan approvals and issuance of Certificates of Title.
3. Delay the making of new loans until technical analysis indicates possible repayment problems have been resolved.

The existence of a significant number of farmers in default on loans at this early date may suggest that repayment schedules do not realistically reflect the investment the farmer must make himself in the improved water supply, in fitting his land to receive water, and in planting, harvesting and marketing the increased produce, and the time required to realize a significantly increased cash flow. If schedules do not reflect such realism, this would be an important factor in breakdown of repayment discipline. These procedures and schedules should be reviewed for all loans and particularly for those in default, before further lending proceeds.

d. Notes on Irrigation Costs Per Hectare

Shallow Wells

Shallow well costs vary widely with depth to dependable water a major factor.

CTDA (Devis report) estimated cost of digging and lining at 140 D/ meter depth (approximately 3.5 m diameter well) for a well of 30 m. Since costs/meter are higher for deeper wells, the cost for a 15 m well would be somewhat less. Cost of equipping a well with a motor pump, pipe and related equipment varies with volume and depth of the well. An enumeration of wells finances shows costs typically have run in the 1200 D to 1600 D range for small pumps (8-10 CV) in most delegations. Illustratively, of 49 pump and well improvement loans/grants on DJILMA, only one was above 1500 D (1635) and most were about 1200 D. Sbeitla had highest cost at an average of about 2000 D per well improved. New wells constructed under the project were few but generally in the 1200 - 2500 D range (excluding pump installation). The total cost of a new well typically will be within the 2400 - 4000 D range with the medium probably near 3500 D including the loan, the FOSDA grant and self-financing (of which up to 150 D is granted by CTDA[1/]).

These wells typically should irrigate 2 hectares minimum with fairly intensive vegetable and tree cultivation. In addition, careful planning should permit supplemental irrigation of some grain and forage area. Based on the above, typical investment per hectare intensively irrigated will be 1750 D to 2000 D per hectare with new shallow wells (1981-2 value of the dinar). Improvement of existing shallow wells by provision of pumps and

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1/ Data from CTDA and BNT summary of 248 shallow wells of February 4, 1983

auxiliary equipment generally cost under 1000 D per hectare irrigated. Once the well is completed the farmer must bear the costs of loan repayment at 6% (75% loan, up to 25% grant) over 7 years, plus costs of operation and maintenance. It is estimated that total costs per m3 of water will be in the 20-25 ml range for most shallow wells. The above data do not include the farmer's cost of preparing the la i for irrigation.

PPI's

Costs for Public Perimeters are estimated to average about 2500 D per hectare irrigated. However, the public investment currently is not repaid from water user charges and the public incurs a further obligation for maintenance and operation with water now being sold at about 6 ml/m3 which is about 25% of the public cost. (The above do not include costs to the farmer of preparing his land for irrigation.)

Spring Irrigation

Insufficient data were obtained in spring irrigation results to estimate costs per hectare of irrigation area added.

e. Centre de Recherche du Genie Rural (CRGR)

CRGR is involved in research activities dealing mainly with irrigated crops in 4 different stations located at

Hendi Zitoun (Kairouan area)
Cherfech (Sidi Thabet area)
Chott Mariem (Sousse area)
Ksar Ghriss (Sidi Bou Zid area)

The station at Hendi Zitoun covers an area of 30 hectares, used for testing under irrigation with good quality water (around 1 g/l) of cereals crops (barley, durum and bread wheats), forage crops and "industrial" crops (cotton, corn). Beginning from this year, fruit trees (apples, pears.....) are being planted.

The station at Cherfech covers an area of 10 hectares devoted to vegetable and forage crops. Four types of irrigation water (from tap water to water of 4.5 g/l of salt) are used in this station to determine the effects of salts on crop yield, crop quality and chemical and physical soil characteristics. Three laboratories (headed by MS or BS level technicians) are focusing much of their work on this station:

Soil chemistry lab (Mme Bahri)
Soil Physics lab (M. Chaahouni)
Plant Physiology lab (M. Bouaziz)

The station at Chott Mariem covers 10 hectares and is used for testing of early maturing vegetable crops.

The station at Ksar Ghriss is used for testing irrigation of olive, pomegranite and pistachio trees.

Besides the activities undertaken at the levels of the three laboratories mentioned, two other sections exist within CRGR and deal respectively with machinery (agricultural engineering) and protective culture.

The director of the center (M.S. El Amami) has expressed a ready willingness to cooperate with CTDA or other institutions in the field of irrigation.