PD-AAA 750

FILE
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SMALL-HOLDER IRRIGATION DEVELOPMENT SUB-PROJECT PAPER

PD-AAA-750

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT PAPER FACESHEET

SUBPROJECT 3

1. TRANSACTION CODE: A (A = ADD, C = CHANGE, D = DELETE)

PP

2. DOCUMENT CODE: 3

3. COUNTRY/ENTITY: TUNISIA/USAID

4. DOCUMENT REVISION NUMBER:

5. PROJECT NUMBER (7 digits): 664-0312.3

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7. PROJECT TITLE (Maximum 40 characters): Small Holder Irrigation Development

8. ESTIMATED FY OF PROJECT COMPLETION: FY 84

9. ESTIMATED DATE OF OBLIGATION: A. INITIAL FY 79; B. QUARTER 2 (Enter 1, 2, 3 or 4); C. FINAL FY 81

10. ESTIMATED COSTS ($000 OR EQUIVALENT $1 -

A. FUNDING SOURCE	FIRST FY B. FX	FIRST FY C. L/C	FIRST FY D. TOTAL	LIFE OF PROJECT E. FX	LIFE OF PROJECT F. L/C	LIFE OF PROJECT G. TOTAL
AID APPROPRIATED TOTAL	310	2400	2710	500	4300	4800
(GRANT)	(210)	( )	(210)	(400)	( )	(400)
(LOAN)	(100)	(2400)	(2500)	(100)	(4300)	(4400)
OTHER U.S. 1. Title I Counterpart		600	600		600	600
OTHER U.S. 2.						
HOST COUNTRY		2450	2450		2500	2500
OTHER DONOR(S)						
TOTALS	310	5450	5760	500	7400	7900

11. PROPOSED BUDGET APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C. GRANT	PRIMARY TECH. CODE D. LOAN	E. 1ST FY 79 F. GRANT	E. 1ST FY 79 G. LOAN	H. 2ND FY 80 I. GRANT	H. 2ND FY 80 J. LOAN	K. 3RD FY 81 L. GRANT	K. 3RD FY 81 M. LOAN
(1) FN	250	230	230	210	2500	-	-	190	1900
(2)									
(3)									
(4)									
TOTALS				210	2500	-	-	190	1900

A. APPROPRIATION	N. 4TH FY C. GRANT	N. 4TH FY D. LOAN	O. 5TH FY E. GRANT	O. 5TH FY F. LOAN	LIFE OF PROJECT G. GRANT	LIFE OF PROJECT H. LOAN
(1) FN					400	4400
(2)						
(3)						
(4)						
TOTALS	-	-	-	-	400	4400

12. IN-DEPTH EVALUATION SCHEDULED: MM 11 YY 80

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

1 (1 = NO, 2 = YES)

14. ORIGINATING OFFICE CLEARANCE

SIGNATURE

TITLE: Herman O. Marshall, Director, USAID/Tunis (Acting)

DATE SIGNED: MM 11 DD 17 YY 78

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

AID 1330-4 (3-78)

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II. SUB-PROJECT DESCRIPTION

A. General

The purpose of this sub-project is to optimize small farmer access to and income derived from agricultural groundwater in the CTRD zone primarily through on-farm irrigation infrastructure expansion and secondarily through the diffusion and institutionalization of appropriate on-farm water management practice. The sub-project involves a combination of capital and technical inputs comprising a number of discrete but interrelated types of interventions. Some of these will be predominantly U.S.-financed and others predominantly GOT-financed. U.S. resources are concentrated in those interventions where the Mission is convinced that the maximum small farmer impact and best economic returns lie. The GOT inputs are concentrated in the larger scale public irrigation perimeters where the GOT has already a major stake in both sunk capital and organizational overhead. Below are summarized the major types of interventions and the primary source of finance:

TOTAL GOT/AID PACKAGE OF CTRD IRRIGATION INTERVENTIONS

TYPE OF INTERVENTION	A.I.D. Financing	GOT Financing	
		(a) GOT Appropriated	(b) PL480 Generations
JOINT FINANCING			
Shallow well improvements	Major share	Minor share	- - - - -
Natural spring development	Major share	Minor share	- - - - -
Surface infrastructure for 5 unused deep wells	Major share	Minor share	Minor share
GOT FINANCING ONLY			
Rehab. of existing public perimeters	- - - - -	Major share	Minor share
New deep well development	- - - - -	Full share	- - - - -
Drainage and small dams	- - - - -	Full share	- - - - -

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This sub-project paper elaborates the entire package because the A.I.D.-financed interventions make sense in the context of the overall package. However, the intervention headings are marked (A.I.D. FINANCING) or (GOT ONLY) to distinguish those items being proposed for funding from those necessary to the project goal, but GOT-financed. Careful budgetary and planning reviews have been held with both GOT irrigation and planning authorities to sort out the lines of financing and establish both U.S. and GOT priorities. In addition to the loan financing of infrastructure development, USAID proposes to grant-finance a small component of technical assistance in water management to insure increased efficiencies of water use by small farmers.

B. Technical Interventions

This is a loan and grant activity to be funded over two years, with implementation and technical assistance running over a five-year period. The loan of $4.4 million would be used to finance selected irrigation infrastructure costs at the farm level, primarily by providing new funds for the existing GOT small farmer medium-term credit channels. Grant funds (amounting to $400,000) will cover a series of short-term technical missions in water management, a very small amount of short-term consultancies and $40,000 for commodity costs relating to field tests of on-farm water management techniques.

The types of irrigation interventions (both A.I.D.-funded and fully GOT-funded) are described below. Full details are provided in the Feasibility Report. 1/

1. Improvement of about 300 Existing Shallow Wells (A.I.D.-FINANCING)

a. Types of improvements

Well improvements: (1) deepening wells to about 3 meters below the groundwater table; (2) lining to ground level; and (3) installing either electric or diesel pumpsets.

b. Numbers of wells to be improved

(1) 200 wells in Foussana Delegation (approximately 40 in the Herich sector, 30 in Mzira and 60 in Brika); (2) 23 wells in Djedliane, (9 in Hmeima sector, 14 in Terbah); (3) about 70 wells in Rohia.

1/ Hagan, et al,"Recommendations for Irrigation, Erosion Control and Dryland Interventions," July 1978.

c. Electrification

Cost considerations favor electrification, where possible. The distribution of well sites with respect to the grid suggests that approximately half of the wells can be electrified. This ratio may improve over the life of the project as the grid is expanded. In all cases, an engineer of the CTDA will (in accordance with present practice) specify the motor power and pump capacity permitted for each well and make a determination that the well site is acceptable and will not create excessive localized drawdown on the aquifer.

2. Installation of about 200 New Shallow Wells (A.I.D. FINANCING)

a. Number of wells to be constructed

It is estimated that a potential exists for constructing 205 new shallow wells in the project area, located as follows:

(1) 50 wells in Foussana, equipped with diesel pumps (to be located at suitable distances from the existing concentrations at Brika, Mzira and Herich to avoid local aquifer drawdowns);

(2) 45 wells in the Chaker - Sidi S'hil sector of Thala, equipped with electrical pumps;

(3) 70 wells in Djedliane: 10 in Oued Kerib sector; 30 in the Hmeima sector, equipped with electrical pumps; 30 at Terbah, equipped with diesel pumps;

(4) 40 wells in Rohia.

b. Who constructs wells

The excavation will be undertaken by each farmer without using specialized equipment. This comprises his contribution to the investment. The deepening and lining require specialized equipment and considerable material costs. The A.I.D.-funded credit will permit the farmer to hire local entrepreneurs to execute this work related to well lining.

3. Development of About 100 Natural Springs (A.I.D. FINANCING)

Natural springs in the project represent small but low-cost water resources. A spring can irrigate 2-3 ha. if effectively utilized. It can serve two or more families.

a. Nature of spring development

(1) Construction of a concrete tank to conserve overnight flow and provide a sufficiently strong irrigation stream.

(2) Provision of portable outlet pipes to reduce seepage losses.

b. Number of springs

The number of springs to be developed is as follows:

Delegation	Number of Springs
Foussana	27
Thala	5
Djedliene	2
Sbiba	45
Sbeitla	18
Djilma	2
TOTAL:	99

The area irrigated by a spring is comparable to that irrigated by a shallow well, while the investment involved is much smaller (TD 750 vs. TD 2600) and the operating costs are nil. Thus the economic benefits of spring development is obvious.

4. Development of three New Irrigation Perimeters Based on Four Existing Deep Wells (A.I.D. FINANCING)

The opportunity for exploiting unutilized deep wells is limited to four wells in Foussana and one in Thala delegation. A.I.D. dollar funding will be limited to the four deep wells in Foussana. GOT will fund a fifth in Thala.

The four Foussana wells were capped in 1974 in expectation of Central Tunisia Project funds for their development. The depths of these wells range from 200 to 500 meters. Their characteristics are as follows:

Designation	Discharge (l/s)	Irrigable Area (ha)
SF 4	50	120
SF 5	50	
SF 6	20	30
SF 3	20	60
TOTAL	140	210

The SF perimeter will be planted entirely with fruit trees, which explains its large area in relation to the available discharge. The SF 4-SF 5 command areas (which form one perimeter) and the SF 6 perimeter are planned for forage crops and vegetables. U.S. loan funds and PL 480 counterpart funds will be utilized for investments in pumpsets, reservoirs, canals, interior roads and levelling. The CTDA Director of Infrastructure and Land Tenure Affairs will manage this loan component. Investments in tree plantations, stables, livestock, etc., will occur under a sub-project scheduled for development during the first two years of this project.

Since these perimeters are at present dry-farmed (barley) and contain no fences or residences, the land distribution process is expected to be straightforward.

With the above A.I.D. and parallel GOT interventions, infrastructure will be essentially complete with the exception of future levelling which will be addressed by the GOT (TD 120,000).

5. On-farm Water Management (A.I.D. GRANT FUNDING)

The sub-project will make an initial input of $210,000 into Technical Assistance for water management for the first two years of the sub-project. If the evaluation of the first stage is positive, an additional $190,000 is programmed for the remaining three years of the project life. Only the first phase TA intervention is described in this paper because the second element will be jointly designed by the CTDA and USAID on the basis of the first two years' experience.

The TA would be provided by the same land grant university contracted for the drylands project. This university would undertake to support the water management components with sustained short-term consultants and a continuity of project backstopping in the U.S..

The first element of the water management intervention would be two field observation and analysis consultancies (2PM ea.) to observe winter and summer irrigation practices on irrigated small farms in Central Tunisia and review water management policy with the technical staff of the CTDA.

On the basis of these two analyses, the contracting university would formulate with CTDA a program for the next 24 months. This program would center on controlled field testing of alternative water management systems. These tests would be designed with the support of the contractor, who would also make periodic visits to Tunisia to monitor and advise on the program. At the end of the first year of tests, the contractor would hold an extensive review with the CTDA technical staff and identify procedures which can be introduced directly into the CTDA extension program. This

review would also be the occasion for the redesign of the second year of field testing.

The TA intervention provides for $60,000 in short-term applied training (U.S. or third country) in water management for CTDA staff to be designed and managed by the contractor. It also includes $40,000 for the contractor to procure specialized commodities for use in the conduct of water management field tests.

The CTDA will be the chief implementer of the field testing program since it is the agency which will have to utilize the results in its extension system. The contractor's role will be centered on design and advising. It is judged best not to specify the precise types of consultancies over the life of the first funding tranche. It is believed that the contractor will be in a better position to make these determinations after conducting the initial field observations in winter and summer growing seasons of the 79 - 80 crop year.

C. Choice of Flood Irrigation Technology

The Mission has considered a number of alternative techniques of water delivery in this intervention. Each has advantages and costs. The decision settled on flood irrigation because although it is the most "inefficient" in the use of water, it was deemed to be the most efficient in terms of Central Tunisian costs and reliability.

1. Sprinkler systems eliminated because of:

a. The high cost per unit. The yields on these shallow wells (about one litre per second) limit the size of the cultivated unit. At the scale possible, the capital costs of the sprinkler systems would be prohibitive. Sprinkler systems are well known in Tunisia. Some USAID sprinkler systems from the 1960's are still in evidence and many new systems are in operation. They are confined, however, to areas like Cap Bon where high value crops and market economics have favored heavy capital investments.

b. Wind problems

Experienced Tunisian irrigation engineers argue that the high winds in the Central Tunisia region would seriously reduce the effectiveness of sprinkler systems.

c. Extreme evapo-transpiration rates

The intense solation received by the area and the low humidity in this semi-arid zone caused the Tunisian irrigation engineers to

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assert that sprinklers would encounter operating problems in Central Tunisia. Recourse to night-time sprinkling would be limited because this is the period of most intense desert wind activity.

2. Drip Systems Eliminated because of:

a. Poor fit with the crop mix

Trickle irrigation is generally accepted as being best suited to permanent tree and vine crops and crops under cover. The present marketing situation in Central Tunisia favors irrigated forage crops (lucerne, clover) and vegetables, including potatoes and carrots as well as summer tomato crops.

b. Water quality problems:

(1) Mineral content. The emmitters in drip systems are easily clogged by precipitates from limestone or iron containing waters. Mineral content of Central Tunisia well water is extreme.

(2) Suspended sand and silt. Even more severe clogging problems occur when irrigation water in drip systems carries heavy loads of suspended silt and sand. The open well, shallow aquifer situation in this area insures high sediment loads in the water. A day's irrigation often leaves 40 pounds of mud in the concrete reservoir of a Central Tunisian shallow well.

c. Availability and supportability of equipment

Trickle irrigation requires highly precise, difficult-to-manufacture components, particularly the filters and emitters. The range of such equipment on the market is still limited worldwide and no designs have been fully field proven and debugged. It is still a technology in transition from the experiment station to commercial application. No drip equipment proven under Central Tunisian conditions is available and no drip equipment has dealer and maintenance networks in Tunisia. Major drip projects in neighboring Libya are still in the trial phase.

d. Ability of the Central Tunisian small farmer to employ the system

The beneficiaries of the small farmer irrigation intervention are less than a generation away from nomadism. They have only partially adapted to the rudiments of settled dryland agriculture. The Mission and the Tunisian agricultural authorities seriously doubt the capacity of the majority of these farmers to install, operate and maintain sophisticated irrigation technologies. The typical farmer in this sub-project

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is perhaps 5 kilometers from a farm track and 15 kilometers from an all weather road. He has no regular access to a full-scale market town except when he makes a day's journey by horse or mule. Entrepreneurs do get his basic farming needs out to him with tough camionette trucks working off the established roads, but he must wait until they choose to come; he has no independent means of communication with the city or town. In short, he cannot operate a sensitive and complex system which requires expert maintenance and support.

Where the selection of flood irrigation is virtually foregone, there are wide ranges of possible efficiencies within this technique. Much of the most valuable California cash crop land in the Jaoquin, San Fernando and Imperial Valleys is flood irrigated. The challenge is to do it right. Tunisian and FAO irrigation authorities are agreed that the present small farmer approach to flood irrigation in Central Tunisia could be greatly improved. The current market relationships yield such a high return on even poorly managed irrigated production that the existing irrigating farmer group has not been forced by market pressure to improve. The irrigation sub-project, however, includes $400,000 for technical assistance (short-term TA, probably mostly in two-month blocks) to (1) identify the major possibilities for increased efficiencies in small farmer water management; (2) to design and supervise field tests of improved methods (tests to be implemented by CTDA staff); and (3) to work with the CTDA staff in initiating a water management component to the existing extension system in Central Tunisia. The size of this TA component is modest. By the conclusion of this project, virtually all the groundwater potential for agriculture will be exploited. Massive investment in irrigation TA is simply not warranted in the way it might be in an area development program in Egypt or the Punjab.

D. Expected Outputs

As noted in a preceeding section of the proposal, results or outputs may be expected early during the life of the project. Implementation can start soon after authorization of funds. The preparatory phase is minimal. Also administrative support and technical implementation requirements are relatively simple. Implementation should be underway midway of CY 1979.

TYPE OF INTERVENTION*	NUMBER OF POTENTIAL INTERVENTIONS
Improvement of existing shallow wells (deepening, lining, motors, etc.)	300
Construction of new shallow wells	205

TYPE OF INTERVENTION*	NUMBER OF POTENTIAL INTERVENTIONS
Development of natural springs	99
Development of new irrigation perimeters with existing deep wells	3
Improvement of functioning irrigation perimeter (TA only)	4

From the above interventions, it is estimated that approximately 1,000 - 1,500 ha. of land will be brought under irrigation, and improved irrigation (increased water supply per ha.) of an additional 2,000 ha. will result from improvements to existing perimeters. Roughly 3,000 families will be benefited. In addition, the improvements in on-farm water management will have some impact on this same population.

Some off-farm employment will be generated (not too much since most is family labor); on the order of 200 to 300 additional jobs.

Effects on unit yields will be discussed under the "Economic Feasibility" section of "Project Analyses".

III. SUB-PROJECT SPECIFIC ANALYSES

A. Economic Feasibility

1. Costs and benefits of surface wells

Field data collected by the Mission and review of the available documentation indicated the yields, prices and benefits from irrigated crops on small holdings in the project area to be approximately as shown in Table I (Page 11). These values are necessarily estimations; thus a range is given for most yields and prices rather than a single value.

Mission observations showed the area irrigated by each surface well to be planted approximately as follows:

SUMMER CROPS		WINTER CROPS	
Tomatoes	0.35 ha	Carrots Turnips	0.80 ha
Peppers	0.25 ha		

* SEE: Hagan et al, op cit Section III, pp [illegible] and Appendix A, tables A-2, A-[illegible], A-[illegible] and A-5

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SUMMER CROPS		WINTER CROPS	
Melon		Onions	0.20 ha
Watermelon			
Cucumber		Beans	
Pumpkin	0.15 ha	Peas	
		Cabbage	
Onions	0.10 ha	Cauliflower	
		Fennel	0.40 ha
Potatoes			
Maize		Barley	0.50 ha
Sorghum			
Minor Crops	0.05 ha	Alfalfa	0.10 ha
Alfalfa	0.10 ha		
TOTAL	1.00 ha	TOTAL	2.00 ha

This cropping pattern, with the benefits of different crops as shown in Table I, indicates that the value added by irrigation (excluding pumping costs) is approximately 1,300 TD/year per surface well. This calculated value agrees with the expectation expressed by farmers to recover the investment in well and pump in a year or two.

The existing cropping pattern has been retained for purposes of the economic calculation. In practice, however, the project will encourage the planting of forage crops (especially alfalfa) on at least 25 percent of the irrigated area.

The alternative use of the land (as unimproved pasture) has a very low net benefit on the order of TD 10/year which is negligible in this context.

The cost of a surface well is taken as 1,500 and of a pump as TD 800. Fuel and lubricants are estimated at TD 70/year, and maintenance at TD 80/year.

To calculate the economic internal rate of return, it was assumed that (1) the useful life of the well is 30 years and of the pumpset 10 years; (2) utilization starts the year the well is constructed; and (3) net benefits will be 50 percent of steady-state conditions in the first year; 75 percent in the second year, and 100 per cent from the third year on. With these assumptions, the internal rate of return on surface wells is 39 percent. This very favorable rate is due to the high value of the crops grown (vegetables and alfalfa) and to the rapid utilization of the investment.

TABLE I

YIELD, PRICE AND BENEFIT FROM IRRIGATED CROPS

CROP:	Alfalfa	Tomatoes	Peppers	Onions	Melons & Watermelons	Potatoes	Carrots & Turnips	Beans (in pods)	Barley
(1) Yield, t/ha.	10-15	15-20	6-10	15-20	14-20	7-10	8-10	6	2
(2) Price, TD/t	60-80	40-50	80-100	40-50	60-70	90-120	40	100-120	50
(3) Gross Benefit, TD/ha. ha.-(1) X (2)	900-1200	600-1000	600-1000	600-1000	840-980	840-1200	20-400	600-720	100
(4) Inputs (ploughing, seed, fertilizer, etc.), TD/ha.	80	80-230	80-300	80-110	150	180-360	100-110	80-120	40
(5) Value added by irrigation - (3) - (4)	820-1120	520-770	520-700	520-890	690-830	660-840	220-290	520-600	60
(6) Labor, days/ha.	76	125	154	113	124	118	50	60	24

Sources: "Evaluation of the Agricultural Potential of Central Tunisia", University of Missouri-Columbia, April 1978, "Données Agro-Economiques de Base sur la Tunisie Centrale", CNEA, April 1978; "Vulgarisation Agricole dans les Périmètres Irrigués du Gouvernorat de Sidi Bou Zid - Rapport No. AE/24 - Agro-économie", FAO, April 1977; ONVVM - PPI (Sbiba); Mission observations.

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The above calculation implicit ly assumed the shadow price of the farmer's labor to equal zero. This assumption influences the calculation, and the use of an alternative value for this shadow price would lower somewhat the IRR's. The Mission prefers the zero value assumption because the real wage opportunities are so few in the region as to make the assignment of a shadow wage problematic at best, but recognizes that it is an arguable assumption.

The total effect of the surface-well sub-project (new wells, improvements of existing wells and springs) will be an added value of about TD 650,000 annually for the region. If this benefit is compared, under the same assumptions, to the sub-project investment cost of TD 1,480,000 (Table I) plus the extension costs, the calculation shows that the economic internal rate of return for the surface-well sub-project as a whole is a respectable 29 percent.

2. Economic Value Added by Labor

The cropping pattern shown above was calculated to require 224 labor days per year for each surface well perimeter. Such labor requirement is well within the capacity of the family labor force. To calculate the economic return of labor, it was assumed that the well will be amortized over 30 years and the pumpset over 10 years at a rate of 10 percent, which approaches the real cost of capital in Tunisia. Under these conditions:

- Value added (excluding irrigation costs)	TD 1,300
- Operation (TD70) and maintenance (TD80)	150
- Amortization of well and pump	290
Net Value Added	860

Thus the economic value added by the farmer's use of his land, labor and management inputs equals about TD 3.840/day.

3. Financial Return to the Farmer

As mentioned before, the farmer will be expected to excavate his well to the groundwater level. The project will provide credit for deepening, lining, above-surface reservoir when necessary, and pumpset and pumpset accessories. Credit for these inputs amounts to some TD 408/year over a 7 year repayment period. Deducting this amount and the operation and maintenance costs (TD 150/year) from the value added (TD 1300/year) leaves the farmer a cash income of TD 742/year once steady-state is achieved (third year of operation). This amounts to financial return of some TD 3.300 per labor day.

4. Costs and Benefits of Deep-Well Irrigated Perimeters

The project proposes construction of the surface irrigation systems necessary to utilize the existing capped deep-wells at SF3 (20 l/s), SF4 (50 l/s), SF5 (50 l/s), SF6 (20 l/s), and Ein Hdia (30 l/s). Calculation of the economic benefits of these projects is based on the following assumptions:

a. The cropping pattern has been assumed to be similar to the one shown above for surface wells to facilitate comparision. Note, however, that in the case of the deep-well perimeters, the area irrigated in the winter cannot be larger than that irrigated in the summer since it is limited by the extent of the irrigation system. (in the case of the deep-well perimeters also, the project will push for expansion of fodder crops.

b. Benefits have been decreased by 10 percent with respect to Table I to allow for the fact that deep-well beneficiaries (who are persons that happen to own land near a deep-well site) typically show lower yields than surface-well owners (who are a group of self-selected agricultural entrepreneurs, and who also have more control over their water source).

c. Utilization was assumed to start the year after construction because of the time necessary for irrigation system construction and land parcelling.

d. The useful life was taken as 20 years for the borehole and the irrigation network; 30 years for constructions, and 10 years for mechanical and hydraulic equipment and for interior roads.

e. Net benefits were assumed to reach 50 percent of steady-state benefits in the first year; 75 percent in the second year, and 100 percent from the third year on.

Based on these assumptions, the value added per hectare (before considering irrigation costs) will be about TD 900/year.

According to the feasibility studies[1/], the costs of developing the deep wells at Foussana were, in the beginning of 1978, as follows:

1/ "Création de Périmètres Irrigués dans le Centre et le Sud Tunisien" - Périmètre de Foussana SF4 - Foussana SF5 - Project: "Périmètre de Foussana SF3 - Project:"Périmètre de Foussana SF6 - Project d' Exéctuion"; SCET/ Tunisie, April 1978.

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	SF3	SF4 & SF5	SF6
Irrigated area, ha.	62	120	31
Cost of irrigation system (TD)	72,925	203,192	53,350
Cost per hectare, irrigation system only (TD)	1,177	1,693	1,721
Cost of well, at current prices (200 TD/m) (TD)	81,000	242,000	41,800
Depth of borehole(s), m	405	1,210	209
Total cost (well & irrigation system) (TD)	153,925	153,925	95,150
Total cost per hectare (TD)	2,483	3,710	3,069

The largest (120 ha.) perimeter, to be irrigated by wells SF4 and SF5, has the highest per hectare cost owing to the very deep boreholes. If for this perimeter the well is regarded as a (literally) sunk cost, and the value added by irrigation is compared only with the additional investments required to construct the water distribution system, these investments show the satisfactory internal rate of return of 29 percent. The other perimeters, which have lower per-hectare costs, will show correspondingly higher returns.

These deep wells have been unutilized since 1975. If the cost of drilling the very deep (average 605 m) SF4 and SF5 wells is actualized, at present prices, and added to the perimeter development costs, the analysis still shows a passable internal rate of return of 11.5 percent. If the SF4/SF5 perimeter were constructed within 2 years of drilling the wells, as is usually the case, the project would have shown an internal rate of return of 13 percent.

The above figures point to the conclusion that:

(1) Constructing the distribution systems for existing wells (which may be regarded as a sunk cost) is an economically attractive proposition, with rates of return of 29 percent or higher, and may be recommended for USAID financing.

(2) The drilling of new deep wells and construction of their irrigation systems is economically acceptable, with internal rates of return of 13 percent or above, but much less attractive than the creation of new surface wells, which shows a rate of return of 39 percent.*

* A.I.D. funding will be used for the latter (39 percent) interventions, while the GOT plans to fund new deep wells despite the lower (13 percent) return.

It might be noted that the present designs of the distribution systems are deluxe models (at the insistence of Génie Rural)*. Thus, in the case of SF6, elimination of the surface reservoir (4 hours storage capacity) will reduce the distribution system cost from 1721 TD/ha to 915 TD/ha, i.e., by 42 percent. In the case of SF3, elimination of the surface reservoir will diminish per hectare cost by 29 percent. Replacement of the buried PVC pipe systems designed for these projects by prefabricated elevated canals, such as those widely used throughout Tunisia on existing projects, can further reduce distribution system costs by about 10 percent.

Operation and maintenance costs are calculated at 0.128 TD/m3 for the SF4/SF5 perimeter and at 0.0088 TD/m3 for the SF6 perimeter, i.e., two to three times higher than the water duty of 0.004 TD/m3 charged to the irrigators. Thus the operation of these projects will imply continuous subsidies (as is the case for most public irrigation projects anywhere).

The financial return to the farmer at the above water duty amounts to about TD 850/ha/year. The cropping pattern assumed requires labor input of 170 days/ha/year, thus showing a financial return of TD 5.000 per labor day.

B. Social Soundness Analysis

(See revelant section on this subject in the project paper.)

C. Technical Feasibility

A technical assessment of each of the proposed A.I.D. interventions has been made by the Missouri Assessment Team. Their detailed findings are contained in the "Recommendations for Irrigation, Erosion and Dryland Interventions", July 1978.

The technical findings of the Missouri assessment are summarized below:

- Phreatic Aquifer in the Project Area

The aquifers in the project area have been sufficiently studied to warrant the proposed interventions. On the basis of the Missouri study, development of new wells in the Djilma delegation have been eliminated from the original proposal.

- Condition of the Deep Wells

The four deep wells which will be augmented with A.I.D. funding of surface infrastructure are sound. Their yields have been verified and are adequate to cultivate the lands proposed for inclusion within their perimeters.

* USAID will review the final designs and fund only up to the level necessary for a sound, efficient structure.

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Salinity and Drainage Problems

The report finds that "salinity and drainage problems do not seem to be a significant constraint to the development of a well-irrigation program, thanks to a good water quality and to the adequate slopes at the well sites." Only in Rohia were some saline sites reported and these have proven to be the result of a recently built watercourse barrier which has raised groundwater levels in the area. No such dams are projected in any of the A.I.D. well sites.

D. Administrative Feasibility

(See relevant section in the project paper and following details.)

1. Public Irrigated Perimeter

The CTDA, when established in Kasserine, will absorb the present regional office of the OMVVM for Kasserine Governorate and, therefore, will inherit a qualified and experienced staff which can provide direct supervision over the development of the three perimeters for the four existing deep wells in Foussana. The actual work will be performed by public enterprises (e.g., Regie des Terrassements for land levelling, if needed) and/or private enterprises (for construction of the irrigation netowrk). Bid packages for the three perimeters have already been completed.

2. Surface Wells

The CTDA will recruit personnel specifically for the purpose of assisting the small farmers in obtaining credit for construction and improvement of surface wells. Concurrently, other CTDA staff members will be working with the "Délégués" in each delegation to accelerate the distribution of certificates of possession to farmers. We expect the two proposed CTDA interventions to accelerate credit utilization by small farmers. It should be noted that farmers who have obtained credit for surface wells heretofore have been successful in increasing their income and have not experienced difficulties in reimbursing loans.

3. Springs

No problem is anticipated inasmuch as these interventions will be grant-financed. Since only a few families will use the water from each spring, there should be no serious water allocation problem.

4. On-Farm Water Management

The CTDA extension staff will be responsible for assisting small farmers in improving the use of irrigation water, with U.S. short-term technical assistance. While the OMVVM staff already in place in Kasserine

Governorat has only barely begun extension activities in shallow well areas, it is expected that this process will be accelerated following establishment of the CTDA.

E. Environmental Analysis

(See relevant section in project paper.)

IV. FINANCIAL PLAN

The following table summarizes the financial plan for the three-year fiscal period of 1979 through 1981. The U.S. contribution will consist of a grant of $400,000 and a loan of $4,400,000. Subject to the availability of funds, A.I.D. will finance the project each fiscal year indicated on an incremental funding basis in accordance with the financial plan below.*

A loan of $4,400,000 will be made available to the GOT. A portion of these funds (approximately $3,200,000) will be sub-loaned to area farmers for surface well improvements. These improvements include deepening and lining; acquisition of diesel or electric pumpsets; portable outlet pipes; connection and instrument panels; transformers, and low tension lines - where grids exist and where electric pumpsets are recommended; and some construction of above surface reservoirs. The potential borrower, or beneficiary, would complete excavation to the groundwater level. The excavation will represent his contribution to the investment. These funds will not be used for surface well improvements in the Djilma area. Further elaboration on the proposed mechanism and arrangements for extending credit to area farmers for surface well improvements is contained in Section 5, Implementation Plan. Some $200,000 will also be made available for development of natural springs, i.e., construction of concrete reservoir tanks and installation of portable outlet pipes. The remaining $1,000,000 will be utilized by the GOT for the development of Public Irrigation Perimeters (PIP) based on four existing deep wells in Foussana. PIP development will include investments in pumpsets, reservoirs, canals, interior roads and levelling. Recoupment of investment outlay for both natural springs and PIP investments will be obtained through water use levy and taxes.

The GOT component will be provided from appropriated funds and PL 480, Title I counterpart proceeds. The dinar equivalency of some $3,100,000 ($2,500,000 in appropriated funds and $600,000 in PL 480 proceeds) will be used for rehabilitation of existing PIP's, new deep-well and PIP development, and for drainage and small dam development.

The total cost of the project is $7,710,000 of which $4,610,000 will be provided by A.I.D. loan and grant funds, and the dinar equivalent of $3,100,000 will be provided by the GOT (approximately 67 percent of total project costs). The GOT contribution is projected as follows: FY 1979 - $3,050,000; and FY 1980 - $50,000. Proposed A.I.D. fiscal year appropriations

*NOTE: Incremental funding reflects present funding level guidance to USAID. Mission believes that life-of-project funding would be better from program and operational points of view. Mission would favor maximum life-of-project funding acceptable to AID/W.

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are: FY 1979 - $2,710,000; and FY 1981 - $1,900,000.

Funds made available under this sub-project will be disbursed as follows:

A. In the case of public irrigated perimeters, the GOT will be reimbursed for actual costs incurred for specific segments of the work and up to a maximum (for each request) fixed at the time the final design is accepted. The same procedure will apply to springs.

B. In the case of credit for surface wells, disbursement will be handled in the same manner as disbursements for local costs under the Small Farmer Supervised Credit Project. An advance will be made to establish the credit fund on the basis of a GOT statement identifying the lending account in the National Bank of Tunisia (BNT) and a jointly derived projection of the amounts to be loaned during the first year of operation of the loan fund. Replenishment of the fund will be at the pace required by actual borrowing. Since the possibilities for continued lending for irrigation development in the area is strictly limited, the GOT will be bound by covenant to insure that repayments on the initial credit continue to be reserved for medium-term credit in the project area, but not necessarily limited to irrigation loans. Additional CTFD subprojects involving medium-term credit (such as a dryland fruit-tree activity) are already in development by the USAID. It is anticipated that we will have an ongoing requirement for medium-term agricultural credit facilities throughout the life of the CTFD program.

FINANCIAL PLAN
(000 U.S. DOLLARS)

	FY 1979	FY 1980	FY 1981	Total
U.S. COMPONENT (Loan & Grant)	2,710	-	2,090	4,800
Loan	2,500	-	1,900	4,400
Surface well improvements	1,400	-	1,800	3,200
Natural springs development	100	-	100	200
Small scale PIP development	1,000	-	-	1,000
Grant (Water Management TA)	210	-	190	400
Short-term consultant services	160	-	140	300
Short-term participant training	30	-	30	60
Project commodities for field tests	20	-	20	40
GOT COMPONENT	3,050	50	-	3,100
Appropriated Funds	2,450	50	-	2,500
Existing PIP rehabilitation**	1,750	-	-	1,750
New deep well development	500	50	-	550
Drainage and small dams	200	-	-	200
PL 480, Title I Counterpart Funds	600	-	-	600
PIP development*	200	-	-	200
PIP rehabilitation**	400	-	-	400
PROJECT TOTAL	5,760	50	2,090	7,900

* Around existing unutilized deep wells

** Sbiba, Thala and Djilma

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V. IMPLEMENTATION PLAN

A. U.S. Monitoring Responsibility

(See Administrative Feasibility - Implementation Plan in Project Paper)

B. GOT Monitoring Responsibility

(See Administrative Feasibility - Implementation Plan in Project Paper)

C. Implementation Responsibilities

The CTDA will be responsible for overall implementation of the sub-project including:

1. Public Irrigated Perimeters and Springs

The CTDA will contract with Tunisia private enterprise for the construction of irrigation systems. It will be responsible for monitoring work in progress and disbursing funds to the contractors.

Prior to initiation of construction, the CTDA will obtain assistance from the Land Reform Agency and the Delegue of the Delegation concerned in resolving any land titling or distribution problems within the areas to be assisted.

Maintenance of such structures, and dams, roads, wells or related facilities, will be the responsibility of the CTDA.

2. Surface Wells

As noted earlier, the same credit terms, conditions and procedures applicable to medium-term loans under the Small Farmer Supervised Credit Project (664-0302) will apply to the credit portions of this sub-project. There are certain special aspects, however, related to this sub-project. They include:

a. The CTDA will be responsible for technical management of this sub-project (instead of the Director of Agricultural Production of the Ministry of Agriculture).

b. The CTDA will replace the Ministry of Agriculture on "local credit committees".

c. The CTDA will assist local farmers in preparing loan applications, in processing loans through "local credit committees", and in certifying vouchers for equipment, materials, and for services provided

to farmers/borrowers - presented by the suppliers for payment.

d. Special procedures (See Annex B for credit documentation)

Similarly, as in the case of public irrigation perimeters, all problems associated with land titling, etc., will be settled with the help of the CTDA prior to initiation of individual well developments or improvements.

The National Bank of Tunisia (BNT) will be responsible for the financial management of the credit. This will consist primarily of making reimbursement to suppliers for equipment, materials, and services provided to borrowers, and collection of loan interest and repayment of principal.

Criteria for selection of borrowers will be: first come, first serve; one well per farmer; and a certificate of possession.

All loans will be dependent upon engineering certification, to be provided through CTDA, attesting that the establishment of an individual well will not result in local or general aquifer exhaustion.

3. Technical Assistance

The CTDA will contract with a single U.S. university for advisory and training services under both this sub-project and the Dryland Farming Systems sub-project (see Section II,B,6 on Farm Management for details).

4. Supporting Services for Project Implementation

a. Deepening and lining of shallow wells will be carried out by contractors already established in the area and/or those new contractors which will be developed with assistance of the non-agricultural enterprises section of DARDS.

b. Supply, maintenance and repair of pump sets for shallow wells will be carried out by small merchants who will be assisted by the non-agricultural enterprises section of DARDS.

D. Implementation Schedule

(See Project Paper)

VI. EVALUATION PLAN

(See Project Paper)

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VII. CONDITIONS, COVENANTS, AND NEGOTIATING STATUS

(See also the Conditions and Covenants Section of the Project Paper).

Conditions Precedent

A. Technical Assistance

Before any disbursement can be made for technical services, a contract acceptable to A.I.D. must be signed between the GOT and a U.S. land/grant institution for the provision of such services.

B. Disbursement of Funds for Public Irrigated Perimeters and/or Springs

1. As a condition precedent to financing public irrigated perimeters or springs, A.I.D. shall approve the construction contract for each perimeter and the general contract format that the CTDA will be using for spring site construction.

2. As a condition precedent to disbursement of funds for construction of public irrigated perimeters, the CTDA will provide satisfactory evidence that all farmers in the perimeters have a clear legal right (certificates of possession or title deeds) to the land they occupy and that acceptable number of beneficiaries will be served by each perimeter.

C. Financing Small-Farmer Credit for Surface Wells

The following conditions must be met before disbursements can be made under the small farmer credit component of this sub-project:

1. An agreement must be in effect between the CTDA and the BNT regarding the responsibilities of each party and the procedures to be followed in implementing the credit portion of the sub-project.

2. The CTDA must furnish satisfactory evidence that an adequate number of credit agents, extension agents, and engineers qualified to make engineering certifications of loan applications are assigned to work in the areas covered by the surface wells portion of this sub-project.

Covenants

A. The GOT agrees to operate and maintain in good working condition all public irrigated facilities financed under this sub-project for a period of no less than 10 years.

B. GOT agrees that small farmers operating private irrigation wells shall be provided inputs and advisory services routinely made available to farmers on public irrigated perimeters.

IRRIGATION LOG FRAME

ANNEX A

PURPOSE	EOPS & MEASURES		MEANS OF VERIFICATION	ASSUMPTIONS
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.	1. Total utilization of agricultural groundwater resources with optimal beneficiary spread to about 3,500 small farmers	a. Target as percentage of potential small-farmer irrigation beneficiaries in the region: 100% b. Target as percentage of total farm households in region: 11%	Base-line studies Sample Surveys CTDA Information System	1. Agricultural prices will continue to provide incentives for those small-holders who invest in private irrigation development. 2. The Certificate of Possession accrediting system for small-holders will be speeded in it's operations through CTDA interventions and Delegue support. 3. The system of small farmer credit assistance already developed by AID with the GOT can be followed, in terms of procedures, also in this project. 4. The CTDA will be able to assign special staff for purposes of effectively handling infrastructure and water use technical assistance inputs.
	2. Optimization of agricultural groundwater access by capital and technical intervention:			
	a. Capital:	a. Capital:		
	-Shallow wells improved: 600 households	- Target as percentage of households served by all capital interventions 46%		
	-Shallow wells new construction: 225 households	- Target as percentage of households served by all capital interventions 18%		
	-Natural Springs development: 250 households	- Target as percentage of households served by all capital interventions: 19%		
	-New Irrigation Perimeter development: 210 households	- Target as percentage of households served by all capital interventions: 17%		

PURPOSE	EOPS & MEASURES		MEANS OF VERIFICATION	ASSUMPTIONS
	b. Technical Assistance: -Improved water management practices on small farms with privately owned irrigation:	b. Technical Assistance: -Full adopters - 400 -Partial adopters - 1,100	CTDA information system	5. The CTDA can effectively engage and supervise private contractors for irrigated infrastructure development.
	-Improved water management practices by small-farmers on public irrigation perimeters	-Full adopters - 400 -Partial adopters - 1,800	CTDA information system	6. The limited amount of U.S. technical assistance provided for water use management improvement will be sufficient to encourage the CTDA to go forward effectively with training and extension work concerning this subject.
	-Improved whole system water management on public irrigation perimeters	-Major improvements - 4 -Minor improvements - 10		
	3. Income Changes: a. Major income changes resulting both from new entry into irrigated farming and improved water management:	Per Capita Income gains in the 50% to 300% range for 1,300 households	Sample Surveys CTDA information system	7. Effective CTDA-operated systems of information flow and analysis can be developed in order to adequately measure changes.
	b. Incremental income changes resulting from technical improvements in On-farm water management: (no capital input)	Per Capita income gains in the 5% to 25% range for 2,200 households		8. Water practices and management systems suitable to on-farm water applications in the CTRD region can be developed and adequately tested during the first year of this project.

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PURPOSE	EOPS & MEASURES		MEANS OF VERIFICATION	ASSUMPTIONS
	4. CTDA organization, staff, and procedures effectively assisting' technology diffusion among 3,500 farmers in 8 Delegations	-Ratio of farmers served by CTRD extension staff with water management training, per delegation 1/340 -Ratio of Ingenieur Adjoint and Adjoint Technique to 11 shallow well and natural spring sectors (20/60 wells or springs per sector) is 1 Ingenieur Adjoint or 1 Adjoint Technique/sector. -Measured increase in number of effective advisory contacts concerning water use practices between farmers and trained extension staff	CTDA management records CTDA information systems Special Studies Special measures developed by technical assistance contractor	9. Effective, French-speaking, technically qualified American short-term technical assistance can be steadily accessed in terms of CTDA-defined needs conce ning water use practices and water management.
	5. Farmers in 1983 using water with substantially increased efficiency over 1979 base-line.	-For a given well, yields in liters/seconds showing an increase in any two of the following: * Area cultivated under irrigation * Net annual yield per unit cultivated area * Cropping intensity	Technical measures introduced by technical assistance contractor CTDA information system	

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OUTPUTS	EOPS & MEASURES		MEANS OF VERIFICATION	ASSUMPTIONS
A. Loan 1. Development/improvement small-farmer irrigation infrastructure according to cost-effectiveness criteria appropriate to CTRD area	A. Loan a. Improved shallow wells	300	Records of loans Site surveys Records of CTDA	1. Adequate technical criteria for approval and development of sites will obtain early agreement as between CTDA and AID.
	b. New shallow wells	200		
	c. Developed natural springs	99		
	d. Development new irrigation perimeters	3		2. Current estimates on costs of infrastructure development are not badly skewed during the first three years by supply or inflationery factors.
2. Small farmers assisted through capital support for irrigation development	a. Electrical pump sets at TD 1,250/well (est.)	145	BNT records Sites surveys CTDA information system	
	b. Diesel motor pump sets at TD 800/well (est.)	54		3. Adequate numbers of private contractors will be involved so as to insure timely performance in meeting infrastructure installing targets.
	c. Lining and deepening shallow wells at TD 1,500/well (est.)	293		
	d. Small improvements in wells at TD 400/well (est.)	200		4. Suitably qualified CTDA engineers can be quickly assembled so as to insure timely certification of the proposed construction and environmental specifications/effects of each intervention.
	e. Infrastructure for natural spring sites at TD 750/site (est.)	99		
3. Development of new public irrigated perimeter facilities	Deep well new irrigation perimeters in Foussana at TD 100,000 each (average)	4 deep wells in 3 provinces	CTDA records	

OUTPUTS	EOPS & MEASURES		MEANS OF VERIFICATION	ASSUMPTIONS
3. Technical Assistance:				5. CTDA engineer and water use extension staff sufficiently mobile so as to effectively reach farmers.
1. CTDA extension staff trained in water management practices by CTDA trainers	CTDA staff in each of 8 delegations	100	CTDA information system	
2. Engineers, technicians, trained specially in water management practices	CTDA staff in each of 8 delegations and headquarters staff	11	CTDA records on training/staffing	6. CTDA, at a policy level, becomes increasingly convinced of the value of improved water use practices and management on small farmer private irrigated fields.
3. Water management practices appropriate to some of the needs of the CTDA area developed and tested	A distinct number of different kinds of practices field-tested, costed, and used for training of CTDA staff		CTDA information system Packages and practices recorded	
4. Extension of water management practices established as an operative function of the CTDA.	Staff trained, assignment and procedural systems operative, and measures of efficiency in contact and advisory work installed.		CTDA records CTDA staff assignments CTDA budget allocations	7. Effective means can be found to foster improved water use practices and management on public irrigation perimeters.
5. Basis laid for more rigorous expansion of water management practices farmer-training by CTDA after 1981.	Data assembled showing increased efficiencies of farmers attainable with improved water use as advised/assisted by CTDA		Technical assistance contractor-provided criteria and measures.	

INPUTS	EOPS & MEASURES	MEANS OF VERIFICATION	ASSUMPTIONS
U.S. GRANT		Loan Agreements and Project Agreements Records of Disbursements GOT budget allocations and disbursements CTDA records CTDA information system	1. The necessary Loan Agreements and Project Agreements will be negotiated on schedule. 2. CTDA will come into effective operation early in the life of the project. 3. Systems of farmer loans, site selection, private contracting, and provision of technical assistance will become operational during the first six months of the project. 4. GOT investments in improving agricultural water resources and use in the CTRD area will expand at some reasonable level.
a. Equipment Small-scale technical equipment for on-farm water management experiments	$40,000		
b. Technical Assistance Short-term consulting services	$300,000		
c. Participant Training Short-term	$ 60,000		
	$400,000		
LOAN			
a. Surface Well Improvements	$3,200,000		
b. Natural Springs Development	200,000		
c. Deep well development	1,000,000		
	$ 4,400,000		
2. GOT			
Rehabilitation of existing perimeters	$1,750,000		
New deep well development	550,000		
Drainage and small dams	200,000		
	$2,500,000		