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Water Quality Improvement and Conservation Project

Survey of On-Farm Water Management in the Jordan Valley

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WATER QUALITY IMPROVEMENT AND CONSERVATION PROJECT

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PREFACE/ACKNOWLEDGMENT

This report is the result of a six week survey and evaluation of irrigation management literature available to farmers and current farming practices in the Jordan Valley. The purpose of the study was to collect information that could assist in preparing training material for farmers. The executive summary on the following pages outlines the findings and recommendations for next steps.

Several individuals on the Water Quality Improvement and Conservation Project contributed to this report. Dr. Hani Rashid, Mr. Mohammad Hanbali, Mr. Rasim Anshazi, and Mr. Isam Al-Naquib, engineers at the Ministry of Water and Irrigation, and many others shared their knowledge. These specialist worked with Dr. Ross E. Hagan, who heads the WQIC component under which the survey was completed. It is from their combined expertise that this report is possible.

Special appreciation is given to Dr. Mohammed Bani Hani, Secretary General of the Ministry of Water and Irrigation (MWI); Mr. Hashim Shboul, Secretary General of the Jordan Valley Authority (JVA); Dr. Muwaffaq Saqqar, Project Coordinator; the members of the Irrigation Management Working Group, who assisted in preparing the survey questionnaire and in conducting the survey; and to Development Alternatives, Inc., as represented by Edwin D. Stains, Chief of Party; for their cooperation and confidence.

Opinions expressed in this report are solely those of the authors and do not necessarily reflect those of any other individual or body.

EXECUTIVE SUMMARY

Results from the survey of organizations responsible for preparing literature and working with farmers to improve agricultural production practices in Jordan were not unexpected. We found that these organizations have not done any work, excepting a few theoretical research studies conducted by the Jordan University, or prepared any literature for farmers on topics relating to on-farm irrigation water management. The farmers interviewed did not know of any materials available in this subject area. The survey results reinforce thinking that there is a need for on-farm water management materials that are relevant to farmers practices and that are written at a level that farmers can understand.

The second part of the survey obtained information on how the farmer currently operates his irrigation system and how he sees his relationship with the Jordan Valley Authority (JVA). This information is critical if materials are to be prepared and training offered that is relevant to farmers practices. The survey results show that farmers need assistance in the full spectrum of on-farm water management topics. Selected focus areas that can be addressed by preparing literature for farmers and by conducting short-term practical training of farmers are:

- Water scheduling — determining when to irrigate using modern prediction methods or soil based measures. In addition the farmer needs training in how to monitor the salinity buildup, if any, in his soil to determine the best time to leach.

- Water applications — monitoring the quantity of water applied, and how efficiently it is distributed over the field. Included in the training would be how to determine the proper quantity of water to apply for leaching.

- Trickle system maintenance — importance of using the correct size media in sand filters, care of screen filters, and regular flushing of the tubing network.

- Communication and cooperation between farmers — talking among themselves, so everyone knows everyone's constraints and limitations, is the first step to resolving problems of water theft. The Water Quality Improvement and Conservation (WQIC) Project and JVA personnel, when trained, can act as facilitators to assist farmers in working together.

Results from the survey also point out several areas where the JVA needs assistance in meeting the requirements of its clients (farmers).

- Management deficiencies — inconsistencies, in water pressure, irrigation water delivery flow rate, and delivery time, are problems that seriously impact on the farmers operations. Farmers lay most of the blame for these problems at the feet of the ditch riders, who come late, leave early, and can be bribed to give more water. The widespread use of pools, and the associated high cost, is mandated by these problems. One proposed solution is to organize farmers, assistance to be given by JVA and WQIC Project personnel, and let them manage water distribution along their line. JVA would base delivery charges upon the volume of water measured at the head unit.

- Delivery system maintenance — damage to volumetric water meters, caused by fine sand, small trash, and sediment in the irrigation water carried by the pipeline, leads to disagreements and arguments between JVA and the farmers over water billing. In addition to destroying water meters, the fine sand passes through the filters farmers use (currently incorrectly maintained) and causes major problems by clogging trickle emitters. The only long-term solution, and likely the most economical, is to upgrade the headworks of the pipeline network to exclude the foreign material from the water before it enters the pipe.

There is also an area of concern that requires cooperation between both farmers and JVA field personnel.

- Communication between farmers and JVA field staff — farmers have been telling JVA staff what their problems are, but the JVA has not been doing a good job in communicating to farmers the seriousness of the water situation in Jordan and the role that farmers play in addressing the problem. The WQIC Project through its Awareness Project in Water can assist both parties to develop better communication channels and understanding of the water crisis issues facing Jordan.

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ACRONYMS/TERMS

JV	Jordan Valley
DA	Development Area
FAO	Food and Agriculture Organization
GTZ	Deutsche Gessellschaft Für Technische Zusammenarbeit (German Agency for Technical Cooperation)
ISPAN	Irrigation Support Project for Asia and the Near East
JD	Jordan Dinar
JU	Jordan University
JVA	Jordan Valley Authority
KTR	King Talal Reservoir
MCM	Million Cubic Meters
MOA	Ministry of Agriculture
MWI	Ministry of Water and Irrigation
NCARTT	National Center for Agricultural Research and Technology Transfer
NRA	Natural Resources Authority
PRIDE	Project in Development and Environment
USAID	US Agency for International Development
WQIC	Water Quality Improvement and Conservation
du	Dunum
ha	Hectare
l/hr	Liters per hour

BACKGROUND

The farmers in the Jordan Valley (JV) started intensive irrigation from the open canal network in 1961. Vegetables were irrigated by furrows, citrus and bananas by small basins. Very simple earthen ditches were constructed for irrigation. The East Ghor Canal Authority at that time was assisting farmers by carrying out spot leveling only on parts of farms which were higher than the water surface at the farms turnout. The average farm irrigation efficiency at that time never exceeded 30 percent.

Between the years 1964 and 1968, the Ministry of Agriculture (MOA) established the Land Development Division to execute an Intensive Payment Program to assist farmers of the JV to improve farm irrigation practices. The idea was to convince farmers to share with this Division the cost of lining farm ditches and leveling land to suit border and furrow irrigation methods. Engineering, survey works, and extension activities were free for farmers. The division paid back to the farmer 50 percent of his land improvement cost, up to a maximum of JD 200 per 30 dunum farm.

In spite of all attempts, farmers did not believe in the program. It was difficult to convince them to carry out land leveling and to use proper surface irrigation methods. Around 1976, farmers became aware of the importance of efficient use of irrigation water and began to adopt better techniques, like drip irrigation methods. Consequently, agricultural production in the valley increased significantly.

Today about 75% of Jordan's total water budget is allocated for irrigation. The 1991 budget was 833 million cubic meters (MCM) from all sources, 613 MCM of which were used for irrigation. Annual renewable resources are about 553 MCM and the balance used is obtained by over drafting the ground water aquifers. The JV, including the South Ghors and Wadi Araba, used 277 MCM to irrigate around 30,850 hectares (ha). Areas under the irrigation system network in the JV are distributed as shown in Table 1.

Table 1. Distribution of irrigated area in the Jordan Valley.

North of Dead Sea:		
Surface Canals systems	7300 ha	23.7 %
Pressurized pipe systems	18700	60.6
South of Dead Sea:		
Pressurized pipe systems	4850	15.7
Total	30850 ha	100.0 %

During the last 10-15 years Jordan has experienced water shortages that become severe in the summer months. The middle and southern regions of the JV are most seriously affected by these shortages but the northern region is also beginning to suffer. The JV is also suffering from degraded water quality caused by increases in salt in the water from the King Talal Reservoir. These serious problems are effecting irrigated agriculture in the JV.

Previous studies revealed that the JV has low on-farm irrigation water management efficiencies. More recent studies showed that even high technology drip irrigation systems in the valley have very low water management efficiencies. Results from this study are important because they show that farmers either don't know about proper operation and maintenance of trickle systems, there is no incentive for conserving irrigation water, or both. Before developing a program for correcting a problem(s) the cause of the problem must be identified.

To begin addressing these serious problems the Government of Jordan signed an agreement with the United States Agency for International Development to establish the WQIC Project. This project is under the Ministry of Water and Irrigation (MWI) and has one component specifically focused on Irrigation Water Management at the farm level. The Awareness Project in Water, under the Public Awareness component, is to work with the MWI and JVA to inform farmers of the seriousness of the water crisis and how they can improve their practices to ensure the viability of their farming operation over the long-term.

To begin tackling these problems there is a need for a survey of the available extension literature on management of on-farm irrigation systems that is available to farmers. A survey of organization responsible for preparing and distributing agricultural extension literature was the first part of the Scope of Work (SOW), given in Annex A, for this contract.

To address deficiencies, information is also needed of the prevailing water management practices at the farm level. Collecting this information was the second part of the SOW. Information from this survey will be used to develop a sustainable on-farm irrigation water management improvement plan and to develop training and informational material for farmers that covers the operation and maintenance of micro-irrigation systems. Some of the information can be used in developing training for JVA field personnel and in planning for high priority improvements to the delivery system.

AVAILABLE LITERATURE

Survey Findings

Discussions with officials from government organizations, private industry, and farmers revealed that information on farm irrigation management practices was not readily available to farmers. The persons contacted are listed in Annex B.

Limited research studies on irrigation management practices have been carried out in the JV and other areas. The first study regarding consumptive use and water requirements for Jordan was conducted during the period 1971-1977 by the staff of the Natural Resources Authority (NRA) Irrigation Department. It was published as an interim report in 1977. A few other studies were carried out at the university farm in the central JV by the staff of the Jordan University (JU) Agriculture College. Results from research studies have not been prepared in a format that is usable by farmers

All farmers contacted believed that their knowledge and experience regarding irrigation practices on their farms is adequate and enough for them. Due to the lack of information and an extension program relevant to their farming operation, farmers in the JV depend mainly on themselves for selecting farm irrigation techniques and cropping patterns. Many farmers have developed a negative attitude toward outside assistance. Because of their self reliance, the lack of accurate and available information on farm irrigation system operation and maintenance is not mentioned as a concern.

Fertigation practices are only carried out by farmers using drip irrigation systems. Information on how to use fertigation and when, is obtained either from the label attached to the container or from the salesman. Another source of accurate information is not available to the farmers.

The Jordan Valley Authority (JVA), which is responsible for delivering irrigation water to the farm units and collecting water charges, is interested in farmers adopting new irrigation technologies and management practices. The JVA has not offered any direct assistance to farmers on irrigation water management.

The private sectors sole interest is in selling modern irrigation and plant production equipment, such as drip irrigation and plastic houses, to farmers. They do not offer information, beyond the mechanical aspects, on the operation of the systems sold.

Recommendation

- Appropriate extension materials should be prepared to help the farmer improve his irrigation practices.

FARMERS KNOWLEDGE OF ON-FARM IRRIGATION

To evaluate the farmers' level of knowledge in on-farm irrigation management, a survey questionnaire was prepared to cover the various aspects related to this knowledge. The survey was carried out in December 1994 and January 1995. Development area (DA) 29, the Zarqa Triangle, was given more emphasis because this area is the focus of the USAID funded WQIC Project. A copy of the questionnaire is found in Annex C and a map of the DAs in the JV in Annex D. Not all farmers responded to each question and for some questions more than one response was given.

Survey Results

- Fifty two farmers were interviewed in this survey, Table 2 shows the distribution of farmers interviewed according to JVA DA. The number of farm units surveyed totaled 118. The smallest farming enterprise was 12 dunums (du) and the largest was 1000 du. The average farming enterprise was 54 du. Table 3 shows the distribution of farmers interviewed according to position, and number of farm units operated.

Table 2. Location and number of farmers interviewed.

DA	Number
1	2
7	1
11	1
12	4
15	3
16	6
20	1
21	3
22	1
25	3
27	7
28	6
29	14
Total	52

Table 3. Farmers interviewed by position and farm units operated.

Position	No.	%	Units
Owner	29	56	50
Tenant	20	38	44
Share cropper	2	4	26
Manager	1	2	1

- A comparison of education level and type of irrigation system used is shown in Table 4. Regardless of education level, there is a preference for the high technology systems. Farmers in the JV are turning to high technology drip systems not in order to save water, in most parts of the world the primary reason for use, but to obtain high yields and reduced labor cost.

Table 4. Education levels and systems used by the farmers surveyed.

	Education		Irrigation System	
	Number	%	% Drip	% Surface
Illiterate	12	23	67	33
Elementary	10	19	70	30
Secondary	13	25	69	31
Higher	17	33	94	6

- The total cropped area of the sampled farms was 3,868 du for the winter 1994/1995 crop season. Vegetables comprised the largest crop, while permanent crops such as citrus, guava, grapes, and others were about equal to the area devoted to field crops, led by wheat and barley. Potatoes and tomatoes are the main winter vegetables in the valley and citrus fruits are the main permanent crop. Most of the farmers interviewed do not plant annual crops in summer to avoid problems with water shortages and water of poor quality. Tabie 5 shows the cropping pattern of the farms surveyed with regard to the irrigation method practiced

Table 5. Cropping Pattern and area in dunums covered by irrigation method.

	Irrigation Method			
Crop	Surface	Drip	Total	%
Vegetables	706	1816	2522	65
Orchards	538	172	710	18
Cereals	636	---	636	16
Total	1880	1988	3868	
%	48	52	100.0	

- A high percentage of the drip irrigation systems were designed and installed by the farmers themselves; only a small portion were designed by companies or specialized engineers. Most of the farmers who have drip systems also use reservoirs and pumps on their farms. The reservoirs and pumps, although they add significant cost to the farming operation, are necessary because of the high sediment load in the water supplied by the JVA. All farmers contacted were satisfied with their drip systems. Table 6 shows the data for drip system design and reservoir use. 16 mm diameter polyethylene laterals with in-line emitters are the most common type of drip system used for vegetables; the discharge of these emitters is 3-4 liters per hour (l/hr). On-line emitters used for orchards have a flow rate of about 20 l/hr.

Table 6. Design of drip systems and use of a reservoir.

	Designer		Reservoir	
	Engineer	Farmer	Yes	No
Number	11	29	37	3
%	28	73	93	8

- Most farmers schedule their irrigation applications according to the duration and frequency of water deliveries from the JVA or by experience. Water is made available to the farmers twice per week, for both vegetables and orchards. Those farmers using drip systems with a large reservoir can be more flexible in scheduling their irrigation applications. Only two farmers said they used scientific methods for scheduling irrigations, tensiometers and class A evaporation pan.

- Most farmers interviewed have no information or knowledge whatsoever about crop water needs and irrigation requirements. They believe that the more water you supply to the crop the better will be the yield. The limiting factor for the quantity of water used by the farmer is the amount of water delivered by the JVA. The water supplied varies according to the water available at the sources. During shortage periods, many farmers try to satisfy their perceived water needs by stealing water. Of the 37 farmers responding to a question on water thefts, 73% reported that there had been water thefts on their delivery line.

- The majority of farmers interviewed relied upon themselves for information about irrigation, Table 7. Of those who knew about and watched the Ministry of Agriculture extension programs on television, or read the MOA publications, most expressed the opinion that the information was of little or no use to their farming practices. This survey did not evaluate the MOA extension programs but either the programs are too advanced for farmers (they cannot understand the message) or they are not focused on problems and issues of concern to JV farmers. The MOA Information and Extension Division admits that it has limited expertise in on-farm irrigation practices and is not active in this subject area.

Table 7. Where is irrigation information obtained.

Source of Information	Number	%
Self	30	55
Experts	14	25
Neighbors	1	2
Ministry of Agriculture	10	18

- Instead of graded sand filters, farmers in the JV use coarse gravel filters. Some of them use three sizes of gravel, others use only two. This practice is not efficient in preventing emitter clogging, which is experienced by all farmers using drip irrigation systems. Only new systems or newly replaced laterals operate efficiently during the first season, but they start experiencing emitter clogging soon afterwards. Table 8 shows that some farmers do not use gravel filters, while others do not use any type of

filtration. Farmers report that sand of the correct size is not available to them at a price they can afford.

Table 8. On-farm filtration practices used by the forty drip systems surveyed.

	None	Gravel only	Screen only	Gravel and screen filters
No. Farms	2	4	10	24
%	5	10	25	60

- The use of a double-layer screen and gravel filter combination is not highly effective in preventing clogging problems, especially during winter season when the irrigation water carries a high sediment load. An effect of usimg gravel filters instead of sand filters is that much of the sediment that should be removed by the filter media passes through and is caught on the screen filter. As a result, much effort and time is wasted in frequently back-flushing and cleaning screen filtration units.

- Removal of the foreign material trapped by the filter requires back flushing the filter. The correct procedure requires the use of pressure gages to measure the pressure drop across the filter; at a specified drop the filter should be backflushed. The survey found that of the systems using filters, not all have pressure gages installed and some of those having gages did not use them to determine back flushing intervals, Table 9.

Table 9. Presence and use of pressure gages with filters on trickle irrigation systems.

	Sand Filter	%	Screen Filter	%
Have	21	78	21	58
Do not use	6	22	4	11
Do not have	6	22	15	42

- A properly operated and maintained drip system needs replacement of laterals and drippers once every 7 years. The prevailing conditions in the JV oblige the farmers to replace laterals and emitters every 3 to 5 years. From the second season, farmers use phosphoric or sulfuric acids to clean their laterals at the end of each crop season. This practice allows them to continue to use laterals for an additional 2 or 3 years. With the high pH of the irrigation water used in the JV, acid should be regularly added to the irrigation water after it has passed through the filtration units. By reducing the pH of the water, problems with the dissolution of fertilizer chemicals and the reduced effectiveness of some pesticides can be diminished.

  No farmer uses periodic chlorination for algae control. Algae is one of the most common reasons for emitter clogging. The prevalent approach for cleaning trickle laterals after the crop season is to throw the rolls of tubing into the pool and add acid. Often the pool also has a high concentration of algae which enters the emitters and causes additional clogging problems when the tubing is returned to service.

- The pressurized irrigation water delivery system in the JV is an advanced system for supplying water to the farmer. From our survey we observe that the pressure is not used by most farmers, see Table 10. A majority of the farmers interviewed complained about the unreliable water pressure in the JVA lines, the high sediment load, and the low quantities of irrigation water received. As a result farmers are obliged to use pools and pumping units.

Table 10. The use of JVA pipeline pressure by on-farm trickle systems.

	Pressure unavailable	Pressure available		
		Used	Partially used	Unused
No. of farms	23	3	3	21
%	46	6	6	42

- The water meters used at the farm turn-outs are not suited to the quality of water available in the JV It was found in the survey that about half of the meters installed are out of order, mainly because of the water quality. Table 11 shows the status of the water meters at the farm outlets.

Table 11. Condition of volumetric water meters at the farm outlets.

	Unavailable	working	out of order
Number	23	14	13
%	46	28	26

- The farmers interviewed were generally satisfied with the JVA's delivery management. Farmers' attitudes toward on-line water use cooperation are shown in Table 12. The totals, for both positive and negative responses, are greater than the sums for the reasons because many farmers did not give a reason for their answer. Irrespective of farmers' negative attitude toward on-line water use cooperation, most farmers prefer less government routine and interference.

Table 12. Assessment of a need for a water user organization.

Reason given	Positive	Negative	Reason given
Decrease water stealing	2	17	Create conflict between farmers
Less JVA routine	6	1	Increase in water stealing
Better water management	3	1	Worse water distribution
Total	14	36	Total
%	28	72	%
DA-29, Zarqa Triangle	7	6	

- Most farmers blame ditch riders and other JVA field staff for system breakdowns, especially water theft, mismanagement of water delivery, measurement, and control.

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Around 50% of water diverted from the source is not billed. Assuming a maximum of 20% is lost in the conveyance system, the remaining 30% is in some way or another lost as theft.

- In response to a question about what they would do when the fee for water delivery increased, the great majority said that it would not affect their farming practices, Table 13. This result is in line with findings in the baseline survey that the costs associated with water are only about 0.5 % of all input costs; water delivery is not of economic importance at this time.

Table 13. The effect of a water fee increase on farmer's water use.

	Number	%
Use less water	4	8
Change crops	10	19
Change irrigation method	2	4
No change in practices	37	70

- The current charge for irrigation water delivery (6 fils per cubic meter) is not creating any problems for farmers. They would like matters to continue as they are now. Only two farmers stated that they sometimes measured the water that they used. If water was more valuable, i.e., had a higher delivery charge, it would be measured to ensure optimum use.

- Farmers were asked what they would consider in changing the crops that they grow. The responses total more than fifty-two because three farmers gave more than one answer, Table 14. It is apparent, not unexpected, that farmers are driven by economics and not by the volume of water used. To encourage water conservation, the economics of production have to be such that water conservation increases the net profit for a crop.

Table 14. Factors to be considered in making decisions to change crops.

Consideration	Number	%
Net profit	45	87
Crop water requirements	4	8
Water quality available	6	12
MOA Extension agents	1	2

- Occasional labor comprises the largest source of manpower in the valley. Farms hire an average of three permanent worker. The family farm is not common in the JV. Only 13% of the sample survey use family labor. Most hired labor are expatriates with about 95% from Egypt. Table 15 shows the labor distribution found in the sample surveyed.

Table 15. Labor used by farmers.

Position	Family	Hired Permanent	Hired Seasonal	Total
Owner	20	55	93	168
Tenant	38	91	128	257
Share-Cropper	4	12	28	44
Manager	--	2	2	4
Total	62	160	251	473
%	13	34	53	

- Pre-irrigation is quite common among farmers growing vegetables, either under protection or in the open with drip systems and mulching. Some do not pre-irrigate because of water shortages at the required time. The amount of water used for this practice depends mainly on the quantity of water available from the delivery system. The survey found that the volume used ranged between 20-100 cubic meters per dunum. Pre-irrigation's purposes are mainly to moisten the dry soil before planting, to ferment the manure, and to cool the soil. Many farmers use excessive amounts for these purposes. Table 16 shows the pre-irrigation use in the area surveyed.

Table 16. Pre-irrigation and fertigation use.

	Pre-irrigation		Fertigation	
	Number	%	Number	%
Yes	39	75	40	77
No	13	25	12	23

- All farms with drip irrigation systems use fertigation. In this regard, farmers draw heavily on their own experience. Very few of them consult salesmen or extension officers for accurate instructions. Information available on this subject for the most part is limited to labels fixed on the product. Table 16 also shows the fertigation use in the survey.

Recommendations

The one finding that was quite clear was that farmers have many misconceptions about water availability, crop water use, crop yield versus water use, and proper irrigation system operation and maintenance. Farmers also believe that they have all the knowledge needed to correctly operate their on-farm irrigation systems. These facts significantly impact on Jordan's drive to encourage water conservation throughout the nation.

Correcting the many misconceptions will first require getting the farmer to realize that they have a need for information and assistance. In addition, the capacity to deliver information and assistance must in place when it is requested by farmers. Both pieces are vital if an irrigation water conservation program is to succeed.

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Some interlinking ideas for moving forward an irrigation water conservation program are:

- The Awareness Project in Water should prepare posters and literature targeting farmers current water use practices. Initial focal points can be the belief that more water gives more yield and the farmers role in solving Jordan's water crisis.

- Appropriate information, training and pilot demonstration activities are essential elements for convincing and assisting farmers to adopt better irrigation practices.

- A body (similar to the Irrigation Management Services in the Western United States), with representation from the JVA, water users, and the WQIC Project, should be created to improve water management practices on the farm and to monitor water quality. This body would work through pilot and demonstration programs.

- To decrease incidences of water theft, to encourage farmer to farmer cooperation, and to improve farmer to JVA cooperation, joint responsibility for water distribution on the lines should be tried. A Water Users Organization, on a trial basis initially, could be the vehicle for this increased cooperation.

- JVA needs to prepare, with assistance from the WQIC Project, a comprehensive program to correct the maintenance deficiencies identified in the survey. The program should include both training of field staff and upgrading of the physical infrastructure.

- JVA needs to correct the management deficiencies identified in the survey. These deficiencies will be addressed in part by the maintenance program and by encouraging farmer involvement in management of water distribution on the lines.

- Although the survey found that most farmers would not change their practices because of an increase in water delivery fees, a fee increase would make some farmers more receptive to programs focused on improving irrigation water use

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ANNEX A

SCOPE OF WORK

Phase I. Information Survey

- Collect the information prepared for distribution to farmers regarding irrigated crop production: such as on-farm water management, irrigation practices, crop schedules, crop water use and fertigation.
- Assess the availability of this information to farmers.
- Evaluate the literature for accuracy, usefulness and appropriateness.

Phase II. Farmers Interview

- Prepare a questionnaire to collect information on farmers knowledge-levels regarding irrigated crop production practices and indebtedness to conduct "high technology" irrigated crop production.
- Submit the questionnaire to the WQIC Project for review and approval before beginning field data collection.
- Conduct a survey in the central Jordan Valley using the prepared questionnaire. All forms will be turned over to the WQIC project with the report.
- Tabulate and analyze the results of the survey.
- Prepare a report on Microsoft Word discussing the findings of the survey.

ANNEX B

CONTACTS AND SOURCES OF INFORMATION

Contacts

Jordan Valley Authority

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Companies

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Farms

DA 25 Unit 206
DA 29 Units 45, 27, 28, 29, 30, 33, 34, 35, 41, 42, 43, 44
DA 20 Unit 22

Sources of Information

Ministry of Agriculture (MOA)

Three sections in the MOA are supposed to carry out activities and services related to water management practices at the farm level:

- Department of Extension and Information.
- National Center for Agricultural Research and Technology Transfer (NCARTT).
- Division of Irrigation and Land Reclamation.

In the central Jordan Valley, the MOA has a research station at Deir Alla that includes research and extension divisions and a branch for NCARTT. The NCARTT branch is newly established and employs two irrigation engineers.

Jordan Valley Authority (JVA)

Four directorates in the JVA are dealing with water, soil management, surface water resources, operation and maintenance studies, and design in the JV:

- Operation and Maintenance Directorate,
- Lab, Soil and Environment Directorate,
- Irrigation Directorate, and
- Dams Directorate.

Jordan University

Two sources dealing with water soil and environment management in the JV and other areas:

- Faculty of Agriculture and
- Water and Environment Research and Study Center.

Private Sector

Many agriculture companies, agriculture irrigation equipment manufacturers and agricultural agents are dealing directly with farmers in providing the following services:

- Sales of irrigation equipment,
- Sales of fertilizers and pesticides,
- Sales of seeds, seedlings, hormones and other additives,
- Sales of plastic, plastic houses and other related items,
- Field demonstrations, and
- Studies and evaluations.

ANNEX C

SURVEY OF FARMERS IN THE JORDAN VALLEY WHO USE TRICKLE

Farm: Line _____ Land Classification _____
Area _____ dunums Cropped area _____ dunums

Position: **Age:** _____
Owner _____ Owner/operator _____ Renter _____
Manager _____ Share cropper _____ Worker _____
Use family labor _____ Number of persons _____ Use hired labor _____
How many full time _____ How many part time _____
From where do they come _____

Education level:
Illiterate _____ Secondary _____
Elementary _____ Higher _____ Degree _____

Type of irrigation system: Open field _____ Plastic house _____ Orchard _____

Debt: For inputs _____ Last irrigation equipment purchased _____

When _____ Borrow money to purchase _____ How much _____

For how long _____ Interest rate _____

Make payments on time _____

Where do you obtain credit: Specify whether long-term or seasonal

For irrigation equipment _____

For crop inputs _____

Crop production information:
How do you choose your crop _____
What factors would you consider in changing crops:
Net profit _____ Water quality _____
Neighbors _____ Crop Water requirements _____
Seed salesmen _____ MOA extension agents _____

Other _____
Do you use plastic mulch _____ Recycle mulch _____

Land and soil information:
Land slope: Level _____ Steep _____ Medium _____
Soil: Texture _____ Depth _____ Salinity _____
Water logging _____ Erosion _____ Fertility _____
Is the soil stony _____ Hardpan _____ Depth to hardpan ___
Use manure _____ Fermented _____ Other _____
Is the land susceptible to flooding _____

Soil, plant, & water testing:
Soil fertility _____ Who did the sample _____
Leaf tissue _____ Who did the sample _____

Soil salinity _____ Who did the sample _____
Water test _____ Who did the sample _____

Do you measure the water you use (how): _____

_____

How do you decide:
When to irrigate _____

_____

How long to irrigate _____

_____

Crops: What crops do you grow:

Summer	Area	Winter	Area

Irrigation water quality: What do you know about your crops
Salinity tolerance _____

Sensitivity to water pollution _____

_____

Irrigation water use:
How much water is lost at your turnout _____

Do you have water - That goes below the roots _____

That runs off the field _____

Do you irrigate before planting _____ Why _____

How much do you use _____

How do you determine the amount of water to use _____

_____

Do you leach _____ If not, why not _____

_____

When do you leach _____

Before leaching do you test the soil salinity level _____

After leaching do you test the soil salinity level _____

Do you allow the crop to deplete soil water during the last stage of growth _____

Crop water requirements:

1. What are the water requirements for _____: _____

Do you change the amount of water applied/ when _____

_____

2. What are the water requirements for _____: _____

Do you change the amount of water applied/ when _____

_____

3. What are the water requirements for _____: _____

_____

4. What are the water requirements for _____: _____

Do you change the amount of water applied/ when _____

_____

TRICKLE IRRIGATION SYSTEM:

Operating Head Unit:

Who designed your system _____

Who installed the system _____ When _____

Do you use: Flow regulators _____ Pressure regulators _____

Do you have a pool _____ What size _____ Lining _____

Do you use the pool _____

Do you schedule irrigation by water delivery or use the pool _____

Do you use JVA line pressure _____ Yes: What is the pressure _____

How much is the discharge _____ Is pressure reliable _____

No: Why don't you use JVA line pressure _____

_____

Pump _____ Capacity _____ lps Operating head _____ m/ bar

Do you use fertilizer injection _____

How do you set the injection rate _____

_____

Sand Filters:

Where do you get the media _____

What size do you use _____

When was it last changed _____

Who put in the media _____

How often do you back flush _____

How do you decide when to backflush _____

_____

Do you use pressure gages _____

Screen filters:

What size is the mesh _____

How often do you back flush _____

How do you decide when to backflush _____

_____

Do you use pressure gages _____

Lateral lines:

What type of emitter _____

When were the lines installed _____

How often do you replace lateral lines _____

Do you have plugging _____ Percent of each line _____

How long after new lines are installed do they start plugging _____

How often do you flush the lines _____

Where is the plugging greater Head _____ Middle _____ Tail _____

How is the uniformity of water distribution in the field _____

_____

Do you inject any chemicals to prevent plugging _____ What _____

Is your system pressure enough _____

Is your discharge enough to cover area _____

Comments about irrigation system problems _____

_____

With water fees increases will you:

Try to use less water _____

Look at different crops _____

Change irrigation methods _____

Request or accept help in irrigation scheduling _____

Continue using water as now (no change) _____

_____

_____

Crop yields:

Crop _____ Yield/dunum _____ Price/kg _____

Crop _____ Yield/dunum _____ Price/kg _____

Crop _____ Yield/dunum _____ Price/kg _____

Crop _____ Yield/dunum _____ Price/kg _____

Do you sterilize your soil _____ How _____

Information Sources:

Where do you get information on irrigation _____

Listen/watch MOA extension programs _____

Subject of last you heard/saw _____

Read the MOA magazine _____ Subject of recent article _____

What information do you need _____

_____

Water User Organization:

Do you think you could work with other farmers in managing and scheduling water from the head unit?_____

_____

Do you see a need? Why? _____

_____

No. units and farmers on line: _____ Condition of meter _____

Water sharing on line _____ Water stealing on line _____

Problems with water _____

_____

Remarks and general comments/observations:

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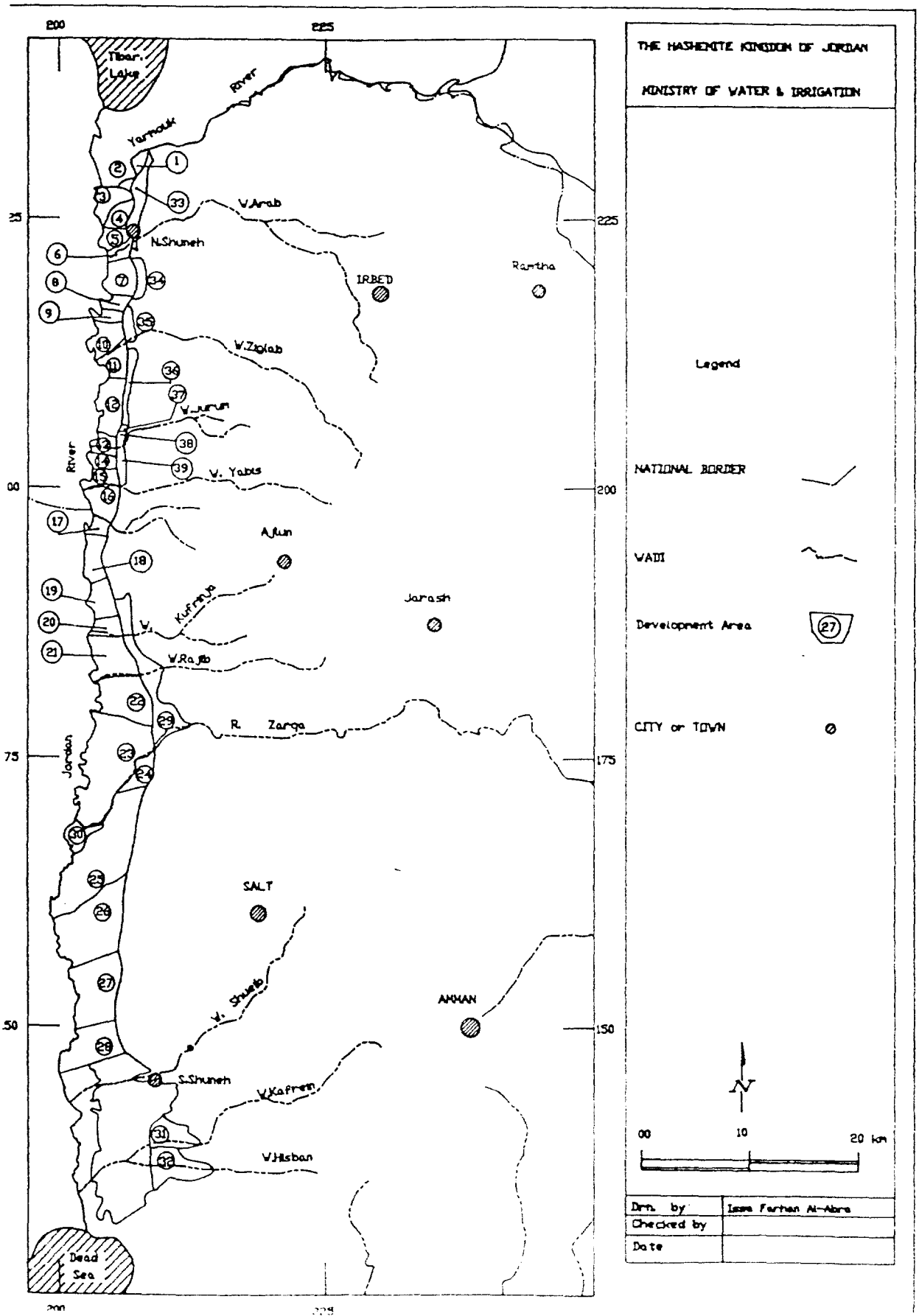
ANNEX D

LOCATIONS OF DEVELOPMENT AREAS IN THE JORDAN VALLEY