PD-AAB-137 Ed HARRELL

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT PAPER FACESHEET

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

2. DOCUMENT CODE: 3

3. COUNTRY ENTITY: Jordan

4. DOCUMENT REVISION NUMBER:

5. PROJECT NUMBER (7 digits): 278-0192

6. BUREAU/OFFICE: A. SYMBOL NE; CODE 3

7. PROJECT TITLE (Maximum 40 characters): Water Management Technology

8. ESTIMATED FY OF PROJECT COMPLETION: FY 81

9. ESTIMATED DATE OF OBLIGATION: A. INITIAL FY 77; B. QUARTER 4 (Enter 1, 2, 3, or 4); C. FINAL FY 80

10. ESTIMATED COST ($000 OR EQUIVALENT $1 =)

A. FUNDING SOURCE	FIRST FY E. DX	FIRST FY F. L/C	FIRST FY G. TOTAL	LIFE OF PROJECT H. DX	LIFE OF PROJECT I. L/C	LIFE OF PROJECT J. TOTAL
AID APPROPRIATED TOTAL	520.0		520.0	1320.0		1320.0
GRANT	520.0		520.0	1320.0		1320.0
LOAN						
OTHER U.S. 1.						
OTHER U.S. 2.						
HOST COUNTRY		375.5	375.5		1330.1	1330.1
OTHER DONOR S						
TOTALS	520.0	375.5	895.5	1320.0	1330.1	2650.1

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 77 F. GRANT	E. 1ST FY 77 G. LOAN	H. 2ND FY 78 I. GRANT	H. 2ND FY 78 J. LOAN	K. 3RD FY 79 L. GRANT	K. 3RD FY 79 M. LOAN
SA	120 B	022		520		300		400	
2									
3									
4									
			TOTAL	520		300		400	

A. APPROPRIATION	N. 4TH FY 80 O. GRANT	N. 4TH FY 80 P. LOAN	Q. 5TH FY ___ R. GRANT	Q. 5TH FY ___ S. LOAN	LIFE OF PROJECT T. GRANT	LIFE OF PROJECT U. LOAN
1 SA	100				1320	
2						
3						
4						
TOTALS	100				1320	

12. IN-DEPTH EVALUATION SCHEDULED: MM 10, YY 79

13. 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: Christopher H. Russell

TITLE: Christopher H. Russell, Director, USAID/Jordan

DATE SIGNED: MM 07, DD 06, YY 77

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

AID 1330-4 (3-76)

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278 - 0192

TABLE OF CONTENTS

JORDAN

WATER MANAGEMENT TECHNOLOGY PROJECT

	PAGE
I. Project Summary and Recommendations.	i
A. Grantee	i
B. Amount of Grant	i
C. Project Cost	i
D. Project Description	ii
E. Summary Findings	ii
F. Statutory Checklist	iv
G. Issues	iv
II. Project Background and Description.	1
A. Background	1
B. Description of the Project	6
III. Project Analysis.	14
A. Technical Assistance	14
B. Financial Analysis and Plan	30
C. Social Analysis and Benefit Incidence	36
D. Economic Analysis	39
IV. Implementation Arrangements.	44
A. Government and AID Administrative Arrangements	44
B. Implementation Plan	45
C. Expediting Actions	47
D. Evaluation Plan	49
E. Conditions and Negotiating Status	51

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2

ANNEXES

to

PROJECT PAPER

JORDAN: WATER MANAGEMENT TECHNOLOGY PROJECT

		Number of Pages
A.	PRP Approval Message	2
B.	Appendix 1, Water Management Technology Sprinkle Irrigation (Jordan) Training Program	27
	Appendix 2, Incidence and Control of Diseases of Tomatoes, Cucurbits, Eggplant and Peppers Under Sprinkler Irrigation in the Jordan Valley	27
	Appendix 3, Water Rights, allocation and Distribution in the sprinkler Irrigation Projects of the Jordan Valley	3
	Appendix 4, Project Location Map	1
	Appendix 5, Intensive Irrigation Course for Extension Agents.	3
	Appendix 6, Request for services under Technical Services and Feasibility Studies Grant No. 278-12-995-181.	4
C.	Threshold Decision Based on Initial Environmental Examination	7
D.	Logical Framework	9
E.	Project Performance Tracking Network Chart	4
F.	Statutory Checklist	9

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PROJECT PAPER

WATER MANAGEMENT TECHNOLOGY

I. PROJECT SUMMARY AND RECOMMENDATIONS.

A. Grantee

The grantee is the Hashemite Kingdom of Jordan (GOJ). The project will be implemented by the Jordan Valley Authority (JVA) acting on behalf of the grantee. JVA will work with its cooperating agencies, the Ministry of Agricutlure and the Faculty of Agriculture, in carrying out the research and training elements of the project.

B. Amount of Grant

The amount is not to exceed US$ 1.32 million.

C. Project Cost

The project will cost approximately $ 2.65 million, of which $1.32 million will be from grant funds and $ 1.33 million from GOJ. Cost estimates include explicit allowances for contingencies and inflation.

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4

D. Project Description

The proposed project is aimed at carrying out applied research and farmer training activities to establish an effective irrigation technology on approximately 3000 small farms in the Jordan Valley. The project is in direct support of irrigation construction and equipment procurement projects covering approximately 9300 hectares.

USAID is proposing to assist GOJ agencies in this endeavor with grant-financed inputs over a three-year period as follows:

Resident technical assistance	71 man-months
TDY assistance	14 man-months
Participant training	39 man-months
Commodities	$271 thousand

E. Summary Findings

The JVA and the Mission are convinced that farmer training and applied research in sprinkler irrigation are absolute essentials for an effective introduction of the technique to Jordan Valley irrigated agriculture.

The training and research elements of the project have been planned as a cooperative effort by staff members of JVA, the Faculty of Agriculture, the Ministry of Agriculture, and USAID, with the assistance of TDY consultants in irrigation engineering and horticulture. These plans were reviewed at an early stage by personnel from NE/TECH and TAB/AGR.

Through its own analysis and continuing discussion with officials of the concerned agencies of the project's objectives and required resources, the Mission is convinced of its technical, economic, and financial viability.

In research, many of the technical issues are so site specific as to require an in-country research program. Further, the project will provide an initial basis for a sustained research effort necessary for the continued adaptation or development of modern irrigation technology in the Valley.

In training, the alternatives to the proposed Training Team approach (See Section II.B, below.) either fail to make maximum use of local

resources (a programmed learning approach) or would be slow to transmit knowledge of sprinkler techniques to farmers (conventional extension methods).

F. Statutory Checklist

The project meets all applicable statutory criteria (See Annex F.)

G. Issues

The AID/W committee reviewing the PRP for this project identified three issues to receive special treatment in the Project Paper. These were

1. An expansion of the training program description.
2. A description of the water rights, allocation procedures and rules to be followed in the project area.
3. Whether the project should be implemented by a single contract or by separate contracts for the research and training components.

Taking these issues in reverse order, the text of the PP leaves open the question of one or two contracts

for the project. However, assuming potential contractors are equally competent in both components, both the JVA and the Mission feel the weight of advantage lies with a single contractor. A single contract provides greater flexibility in the use of AID-funded resources over the life of the project; coordination among the contractor and GOJ agencies will be simplified; and contract negotiations will be expidited.

A description of the water allocation process is attached to the PP as Appendix 3 of Annex B. Note that water will be metered to farms almost on a free choice basis. However, also note that farmers will be asked to file a cropping plan prior to the cropping season, and based on JVA's forecast of water availability, may be limited in the quantity of water to be taken over the season. JVA officials have told the Mission that, in general, the total quantity of water delivered would be limited to that required for the cropping plan at the estimated efficiency rate of sprinklers.

The consultant's recommendation on the training model to be followed is presented as Appendix 1 of Annex B. This was elaborated upon in further planning sessions with the staffs of concerned agencies and is fully described in Sections II and III, below.

8

A fourth issue touched upon in thePRP review is that of the coordination of this project with the Sprinkler Equipment Loan. A realistic estimate of the time of delivery of equipment to farmers is late November or early December. This is a critical constraint for the training element, becuase it means that expert assistance must arrive in Jordan about September 1 to assist in the preparation of training materials and training sessions. The expert should be given at least one month's professional preparation time in the U.S. prior to his arrival. 1 August

Issue Imp Plan

The time constraint is also important for the research element in order that the fall season of plot research not be delayed for a full year.

The following actions have been taken or are proposed in order to expidite project activities.

1. The JVA has requested that the Technical Services and Feasibility Studies Grant be used to finance the services of a training expert for up to five months' work in Jordan from September 1 plus one month's preparation in the U.S. The Expert would assist in the preparation of training materials and

sessions and would assist in the initial rounds of training sessions for farmers.

The Mission has transmitted this request to AID/W for contracting actions.

2. The Mission is proposing that procurement of project commodities be done by the JVA in consultation with the Mission's project manager and the contractor's staff.

3. The Mission will request waivers to permit local procurement of project commodities to the extent they are locally available. Other commodities will be obtained from U.S. suppliers.

II. PROJECT BACKGROUND AND DESCRIPTION

A. Background

The East Jordan Valley, extends from the Yarmouk River to the Dead Sea and contains approximately 420,000 dunums[1/] of arable land capable of supporting a program of sustained irrigated agriculture. While 360,000 dunums of this area are amenable to irrigation by surface methods using open water courses, there will not be sufficient water from all available sources if surface methods are used.

There are currently four irrigation projects, designed to utilize sprinkler systems, under construction in the Jordan Valley encompassing an area of 93,100 dunums including about 29,000 dunums (10,000 from the East Ghor Canal and 19,000 from the base flow of side wadis in the project areas) currently irrigated by surface methods. These projects are: (1) The East Ghor Canal Extension (Loan 278-H-009), 35,000 dunums; (2) The Zarqa Triangle Project (Loan 278-T-011), 15,000 dunums; (3) The North East Ghor Irrigation Project (International Development Association), 27,600 dunums; and (4) the Hisban-Kafrein Irrigation Project (FRG), 15,500 dunums. A description of each of these projects is presented below with locations noted on map, Annex B.

a. East Ghor Canal Extension (AID Loan 278-H-009)

This project will provide permanent irrigation water for a total of 35,000 dunums of currently unirrigated land. The source of water will

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1/ One dunum equal ¼ acre. Ten dunums equal 1 hectare.

be a 48 million cu.m reservoir behind the King Talal Dam due for completion in 1977. The project consists of:

i. Extension of the existing East Ghor Canal for a distance of 18 Kms;

ii. A diversion weir and a 2 Km long carrier canal on the Zarqa River to divert water released from King Talal Dam to the East Ghor Canal;

iii. Four pumping stations on the extended portion of the East Ghor Canal to attain the pressure head needed to operate the sprinklers;

iv. A pressure pipe network to deliver water to the farms.

v. A network of maintenance and farm roads.

The project is currently under construction and is due for completion in Dec. 1977. The cost estimate of the project is $12.6 million.

b. <u>Zarqa Triangle Irrigation Project (AID Loan 278-T-011).</u>

This project will provide permanent irrigation water from the King Talal Dam reservoir for 15,000 dunums of land. The project consists of:

i. A diversion weir on the Zarqa River 3 Km upstream from the point where the East Ghor Canal crosses the Zarqa River.

12

ii. Main carrier pipes to deliver water under pressure to areas north of the Zarqa River (9,500 dunums), south of Zarqa River (500 dunums) and to the Zarqa Zor area (5,000 dunums);

iii. A network of pressure pipes to deliver water to the farms for sprinkler operation;

iv. A network of operation, maintenance and farm roads.

The project is currently under construction and is due for completion in December 1977. The cost estimate of the project is $9.6 million.

c. North East Ghor Irrigation Project (IDA)

This project will provide permanent irrigation water for 27,600 dunums of land. The sources of water are the base flows of Wadis Arab and Jurum and the reservoir of the existing Ziglab dam. The project consists of:

i. Two diversion weirs and siltation reservoirs on Wadi Arab and Wadi Jurum;

ii. Three main carrier pipes each taking off at the diversion of each wadi to carry water to a main north-south distributary pipe;

iii. A pressure pipe network to deliver water to the farms for sprinkler operation;

iv. Conversion of about 10,000 dunums from surface to sprinkler irrigation;

v. A network of operation, maintenance and farm roads.

The project is currently under construction and is due for completion in December 1978. The project cost estimate is $14.5 million.

d. Hisban-Kafrein Irrigation Project (KFW)

This project will supply permanent irrigation water for 15,500 dunums located in the southern Jordan Valley. The sources of water are Wadi Hisban where waters will be diverted to the existing Kafrein reservoir, and the Kafrein reservoir itself. The project consists of:

i. A diversion weir on Wadi Hisban and a carrier pipe to deliver its waters to Kafrein reservoir;

ii. A main carrier pipe taking off from Kafrein dam;

iii. A network of pressure pipes to deliver water to the farms for sprinkler operation;

iv. A network of operation, maintenance and farm roads.

The Notice to Proceed has been issued to the contractor with work commencing on September 1, 1976. The project is expected to be completed in February 1978. The cost estimate for the project is now $6 million.

e. Sprinkler Irrigation Equipment (AID Loan 278-K-018)

The project provides for the procurement of portable on-farm irrigation equipment for 93,100 dunums of land. The materials to be procured include

14

portable pipes, filters, pressure gages, couplers, valves, fittings and sprinkler heads to be distributed to farmers in the project areas described above. The Jordan Valley Authority (JVA) will store, manage and distribute the equipment to farmers _____ following the execution of credit or cash sale agreements between the Agricultural Credit Corporation (ACC), and eligible recipients.

The JV Ais developing an operation and maintenance capability utilizing the AID participant training program. Five officers (three from JVA and two from the Ministry of Agriculture) have completed training in on-farm irrigation practices, and training has been requested in hydrology and hydraulics engineering. The Invitation for Bid for the equipment specifies that the vendor must provide training in equipment assembly and maintenance.

_____

However the JVA judges that the above mentioned supporting programs will be inadequate to ensure orderly and efficient start-up of the sprinkler system. They have proposed an applied research and farmer training of the project areas. A major technical assistance program in applied research and training is expected to accelerate the utilization of equipment and establish a high level of productivity for the project areas.

B. Description of the Project. (See Annex D, Logical Framework.)

To establish sprinkler irrigation technology in the Jordan Valley it will be necessary to confirm or adapt operating practices for the equipment and to establish a farmer training capability for efficient field operation of the equipment. The three-year project will establish a limited program of adaptive research on sprinkler operations for the equipment, crops and localities now under development by sprinkler systems. Similar research on drip irrigation, in which a number of Valley farmers have already invested, will also be carried out. The adaptive research facilities, and training facilities provided under the project, will also be used in an innovative technology transfer program to establish good system operation practices at the farmer level. The investments in this project are designed for the immediate needs of establishing sprinkler irrigation technology on 9,300 of the valley, but these facilities can be developed further as a research and training base for continued improvement of water management technology.

The JVA will be the implementing agency for the Project. However, at the operational level responsibilities for research will be delegated to the Ministry of Agriculture (MinAg) and Faculty of Agriculture (Fac-Ag) through agreements between these two agencies and the JVA. Training will be the responsibility of the JVA in cooperation with the Ministry and Faculty. Research will be carried out at the University's farm in the Valley, at two stations there owned by the Ministry of Agriculture and on private farms. Another station may be established in the South as project needs require. (see Map, Annex B). The sites are in good proximity to the capital projects listed above.

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16

Training sessions for farmers will be held at these same locations. The first sessions will concentrate on mechanical aspects of sprinkler use and maintenance, and on elementary water and crop management practices transferred from research and experience elsewhere. Site-specific information will be fed into the training program as the results from project related research become available. Further training sessions on more advanced aspects of water and crop management will be held in the course of project activities.

An additional research element will be the monitoring of progress with adoption and use of sprinkler systems in the Valley. It involves three related activities:

1. The evaluation of water delivery and central system management. This activity will monitor water delivery practices to a sample of farms, identify delivery problems, and feed information back into JVC for solution.
2. The evaluation of farm water use efficiencies, on-farm management practices and production results. This activity will monitor sprinkler irrigation practices, problems, crop water requirements, and cropping results on a sample of farms adopting sprinkler equipment. Water and crop management deficiencies will be identified so that immediate remedial steps can be taken, or if no remedies exist, problems can be fed into the applied research program.
3. The examination of on-farm allocation and use of resources in cropping with sprinkler irrigation. This activity will contribute to an understanding of farmers' management of the on-farm system, providing information to

the design of applied research projects and extension work and to the analysis of resource and product markets.

Similar monitoring activities will be done on drip/irrigation systems and other which a number of farmers in the Valley are using.

The agencies concerned in the research program, JVA the Faculty of Agriculture, and the Ministry, have determined this monitoring activity to be of prime importance to the research program. JVA is already preparing to monitor water use efficiency, on a total farm basis, by recording cropping patterns and the metered water delivery to farms. It is agreed that this will be integrated into the broader set of monitoring activities listed above.

USAID will fund a resident expert in research on irrigated farm management for up to 36 months as part of its contribution to the research portion of the project.

A related research element involves the economics of investment in sprinklers and their use. JVA recognizes that this technique can have profound impacts on resource and product markets and will be assigning one of its agricultural economists to the task of systematically monitoring the progress of its adoption. The project will assist in this activity by providing seven man-months of TDY services in agricultural economics. The Mission is currently exploring the possibility of greater assistance to this element through TAB's program of research in agricultural economics and sector planning.

The project outputs are to be proven farming practices for sprinkler irrigation of selected crops for about one-fourth of the Jordan Valley. Starting

with the existing system design for use of the sprinkler irrigation equipment, the adaptive research program will confirm the production potential and necessary practices under prototype farming operations. Problems encountered will be subjected to intensive study in order to expedite their resolution in developing practical farming recommendations. The program will be limited to the major crops and the soil/climate of the sprinkler system in order to maximize immediate utility.

The proven farming practices are to be conveyed to the farmers of the project area in a specialized training program coordinated with the installation of equipment. The Training unit will be built around four-man Training Teams (one team leader, three trainers), each team dealing with about 18 farmers. The basic training method is a combination of demonstration and supervised practice. Audio-visual material will supplement the basic method, but written material and lectures will be minimized.

It is estimated that two days' training will be sufficient to impart mechanical and elementary water and crop management practices to farmers.

Four Training Teams, dealing with 72 farmers per session, can provide this first round of instruction to approximately 1400 farmers in two month's time. This will satisfy the needs for the East Ghor Canal Extension and Zarqa Triangle projects due for completion in 1977. Approximately the same schedule holds for the Hisban-Kafrein and North East Ghor projects scheduled to be completed in 1978.[2/]

2/ See Annex B, Appendix 1 for Water Management Technology Sprinkler Irrigation (Jordan) Training Program.

The Training Teams will be backstopped by a Core Staff whose role is to prepare training packages for presentation to farmers, both by the Training Teams and by regular Extension personnel on a one-to-one basis with farmers. The Core Staff will also monitor the work of the Training Teams and regular extension activities related to sprinklers.

This monitoring work will analyze the effectiveness of the training program as an instrument in the adoption process. USAID will fund a training expert for up to 35 months' work with the Core Staff.

The core staff/training team approach is regarded as providing good technical assistance to farmers, on a one-time, "set program" basis, as well as for a sustained effort of transferring new knowledge to farmers. However, it is anticiapted that this approach will be insufficient to address the immediate problems farmers will encounter in setting up and putting their systems into operation during the first two or three months in which sprinklers are first being introduced. As a supplement to the work of the Core Staff and Training Teams the Training Unit will assume operational responsibility for a temporary (two to three months), massive injection of technical assistance to farmers.

The relationship of this assistance to the overall training program is as follows:

1. At the time the farmer receives his equipment, a technicial will be available, upon request, to help him install the equipment on his farm.
2. A small (three person) technical staff will be at each of three prominently publicized locations to provide "on-call" assistance in trouble shooting farmers' problems in using the equipment.
3. Roving technicians will visit each farmer on a one week or 10 day schedule to review progress and provide assistance.

The precise combination of the supplementary actions and the estimation and commitment of personnel and logistical needs will be worked out by the JVA and the Ministry of Agriculture well before the training program gets underway.

The JVA, the Ministry, and the Faculty have recognized the importance of training for technicians in advance of the farmer training phase. The JVA is taking the lead in designing a four-week, intensive course in water management technology to be presented to Extension and other related personnel during the spring or early summer. (See Annex B, Appendix 5) Once the project is formally underway, this course and further technician training activities will be integrated into the Training Unit.

The first of these additional training activities for technicians is to be a short course, one week in duration, focusing on the mechanical aspects of sprinkler irrigation, but also giving practical training in basic water and crop management related to sprinklers. This course is to use exactly the same training techniques as will be used in the farmers' training sessions in order to familiarize the trainers with the teaching methodology to be used. Both the members of the Training Teams and technicians in the supplementary technical assistance portion of the program will take this course which will have to be offered two or three times.

Project inputs will be three research and three training sites with specialized research and training equipment for each (See Annex B for details). Pumped water supplies at some of the sites may be necessary at the early stages to the programs. Sprinkler equipment for the research and training elements will be provided from that equipment purchased from Loan 018. The JVA has indicated it would request air

shipment of a portion of the equipment in order that the research and training programs can begin promptly. USAID's Capital Development office estimates there are sufficient funds in the loan to allow for air shipment of the necessary equipment.

Staff members of JVA, the Ministry and the Faculty are preparing estimates of the kinds and quantities of sprinkler equipment required for the research and training programs. Quantity estimates will be generous. A vital part of the demonstration and training program will involve the farmers' gaining a full appreciation of the structural limitations of the equipment. Each training session will, therefore, require some intentional bending of pipe, damage to couplers and threaded fittings, destruction of sprinkler heads, etc.

III. PROJECT ANALYSIS

The analytical foundation for the choice of sprinkler equipment has been reported in the documentation of the Sprinkler Irrigation Equipment Loan (AID Loan 278-K-018) and the East Ghor Canal Extension (AID Loan 278-H-009). The following analysis relates to the supporting program of adaptive research and farmer training on sprinkler irrigation practices. The analytical questions refer to the alternatives for the establishement of full operational performance of the installed equipment.

A. Technical Analysis

1. General

Sprinkler equipment, to be purchased under Loan 018, is projected to arrive and be ready for distribution to farmers in late 1977. This is well into the irrigating season, but most of the land to which sprinklers will be applied is not now irrigated, and major use of equipment probably won't begin until early 1978.

Prior to that time, research activities, to which this project will contribute, but which can commence prior to its inception, must get underway. Farmer training in the use of sprinklers must coincide fairly closely with equipment delivery to farmers.

A working group, composed of representatives of the JVA, Ministry of Agriculture, and Faculty of Agriculture, has recently (early February 1977) begun meeting to lay plans for research and training. An early

decision of the group was to accept the Training Team concept as a basis for reaching farmers.

Further planning for both research and training will be done by these committees of the three agencies, but much of the final content and methodology of the training program will be developed with the assistance of the U.S. experts funded under this project.

2. Applied Research

Research plans to date call for experimental sites to be set up at the University's farm near Damya, in proximity to the East Ghor Canal Extension project (See Map, Annex B); at the Ministry's Research Station at Deir Alla, in the Zarqa Triangle project area; at the Ministry's Sub Station at Wadi Yabis, near the North East Ghor project area; and possibly at a site to be acquired by the GOJ in the Hisban-Kafrein project area. One or two additional sites, possibly on land rented for the purpose, may be acquired as the needs of the project dictate.

A preliminary list of applied research projects has been developed and is presented below. These will be amended, dropped, or supplemented as the needs of the project dictate.

a. Irrigation and Water Management Aspects.

1) Evaluation of Project water delivery and management practices when starting Sprinkler Irrigation in Jordan Valley.

Duration: 2 years .... This study will monitor farm water delivery practices on selected farms, identify delivery problems, and cooperate

with JVC directly to find solutions to problems should they be found during the early years of Sprinkler Irrigation in Jordan Valley.

2) Evaluation of Farm Water Use Efficiencies, management practices, and production results on selected farms using Sprinkling Irrigation.
Duration: 3 years .... This study will monitor sprinkler irrigation practices, problems, crop water requirements, and cropping results on selected farms in Jordan Valley during the sprinkler irrigation development years.

3) Management and Water requirements, and water use efficiency, for sprinkling selected crops in Jordan Valley.
Duration: 3 years .... This investigation will evaluate water-input practices requirements and water-use efficiencies under Sprinkler Irrigation on selected crops in Jordan Valley..

4) A study of Irrigation Methods and Practices that optimize water use from the pressurized Water System in Jordan Valley.
Duration: 3 years .... This study will evaluate alternate methods of irrigation that optimize water use from pressurized water supplies ... especially sprinkling and Drip irrigation ... to guide soundest future water supply use in Jordan Valley.

5) Evaluation of Methods and Practices for applying irrigation water in Plastic Tunnels and Greenhouses, and under plastic mulches.
Duration: 3 years .... This study will establish basic irrigation information on practices, costs, and micro-climate impact, for use of

alternate irrigation methods under plastic-modified environments as are rapidly developing in Jordan Valley.

b. Frost Control Aspects

Frost Control with Sprinkler Irrigation in Jordan Valley.

Duration: 3 years .... This tudy will develop the necessary practices for preventing frost damage on bananas and selected vegetable crops in Jordan Valley with sprinkling.

c. Socio-Economic Aspects

Socio-Economic change in Jordan Valley during transformation to sprinkler irrigation use and extended irrigation development.

Duration: 3 years .... This study will monitor the social and economic transformations that are expected to occur as a result of irrigation, and irrigation technology advancement, in Jordan Valley as sprinkler irrigation is adopted.

d. Disease Control Aspects

Disease and Quality management practices for successfully irrigating selected crops in Jordan Valley with the sprinkling method.

Duration: 3 years .... This investigation will identify disease hazards under sprinkler irrigation in Jordan Valley and develop practices for satisfactory handling disease problems .... including introduction and testing or resistant varieties. Specific studies on disease and quality management are listed in Annex B, Appendix 2.

e. Insect Management Aspects.

Insect Epidemiology and Control practices under Sprinkler Irrigation in Jordan Valley.

Duration: 3 years .... These studies will identify insect problems and develop suitable control measures for producing important crops in Jordan Valley with Sprinkler Irrigation.

f. Fertilizer and Salt Management Aspects.

Optimizing commercial fertilizer use on selected crops, and Salt Balance management under sprinkler irrigation in Jordan Valley.

Duration: 3 years .... These studies will seek to optimize fertilizer use under sprinkler irrigation and to monitor and control nutrient and salt movement with controlled sprinkler irrigation practices .... in Jordan Valley.

g. Weed Management Aspects.

Weed hazard identification and weed control under Sprinkler Irrigation in Jordan Valley.

Duration: 3 years .... This investigation will describe the weed hazards under sprinkler irrigation and develop the needed control measures to manage the important weed problems within the J.V. project area.

h. Varietal Selection and Management

Duration: 3 years .... This program will expand the ongoing program of varietal selection for major crops in the Valley and their performance under alternative management regimes. Emphasis will be on the selection of those varieties best adapted to sprinklers and other modern irrigation methods.

Estimated staff and equipment requirements for this research program are shown in Tables 1 and 2. Under even the most optimistic circumstances US equipment ordered for this project will not be available on-site before six to nine months after funds become available. Waiver will be sought from AID/W for local procurement, if possible, of items deemed most critical.

None-the-less, both the Faculty of Agriculture and the Ministry will be undertaking demonstration-cum-research activities with equipment at hand and with sprinkler sets provided under the loan. The Ministry has patched together, from various sources, sufficient equipment to start sprinkling crops on its Deir Alla Station in early April. The Faculty is working with a private farmer in the Valley to set up a sprinkler and a drip irrigation installation in his citrus orchard. They are giving him technical assistance in return for using his orchard in experimental work.

Table 1.

Professional and Sub-Professional Researchers,

and Vehicles, Needed

At each Professional Staffing Location*

(by Project NO)

Project No.	Full Time Equivalents (FTE's)** Professional Researchers	Graduate Research Assts*** or Experimental Aides	Vehicle Equivalents
1	0.5	0.5	0.5
2	0.5	0.5	0.5
3	0.5	0.5	0.5
4	1.0	0.5	0.5
5	0.5	0.5	0.5
6	0.5	0.5	0.25
7	0.5	0.5	0.25
8	1.0	0.5	0.5
9	0.5	0.5	0.5
10	1.0	1.0	0.5
11	0.5	0.5	0.5
12	0.5	1.0	0.5

* Assuming availability of Professional Staff back-up for collaboration throughout each study.

* ** One Graduate Research Assistant is 0.5 F.T.E.'s whereas one full time Experimental Aide is 1 F.T.E.

** Salaries of Professional Researchers are estimated at JD 300 per month and those of Graduate Assistants and Experimental Aids at JD 150 per month.

Table 2.

Supplementing Equipment and Materials
Identified Equipment Needs and Estimate of Costs
(Each Professionally Staffed Location)

Item No.	Item	No.	Unit Cost, US$	TOTAL COST, US$
1.	Microscopes (oil immersion)	2	1500	3000
2.	Binoculars (Steriozoom Research)	4	900	3600
3.	Incubators	2	750	1500
4.	Drying Ovens	3	750	2250
5.	Spectrophotometers	3	2700	8100
6.	Flame photometers	1	2000	2000
7.	Hygrothermographs	6	500	3000
8.	24-point remote-sensing potentiometer recorders	2	4000	8000
9.	Research plots sprinkler systems	3	15000	45000*
10.	Research plot drip irrigation systems	2	11000	22000
11.	Fertilizer injectors	3	1000	3000
12.	Insecticide-fungicide injectors	6	1000	6000
13.	Water meters (totalizing)	6	600	3600
14.	Soil Moisture measuring and sensing equipment	Miscel.	-	8000
15.	Crushers, blenders, stirrers, sieves	2 sets	750	1500
16.	Shakers	2	750	1500
17.	Glass ware	Asst'd		5000
18.	Chemicals	Asst'd		5000
19.	General laboratory operation supplies	Asst'd		3000
20.	Standardize evaporation pan assembly	3	2000	6000
21.	Psychrometers	3	100	300
22.	Max-Min thermometers, anemometers, etc.	Asst'd		1000
23.	Dusters - Sprayers	3	750	2250
24.	Vehicles	5	10000	50000
			Total	$194600
	Less cost of research plot sprinkler system			45000
				$149600

* To be supplied through Loan 018.

3. Training

The training program is aimed at providing farmers with basic mechanical, water management, and crop management skills in the use of sprinkler irrigation. Farmers' greatest need for technical assistance will be at the outset, when sprinklers are first being put into use. The model of a Training Unit with a Core Staff, Training Teams and supplemental, individualized assistance has been selected as the most effective means of imparting these skills during that critical period.

As local applied research and experience and results of research and experience elsewhere provide a body of relevant knowledge, the Training Unit will prepare extension materials and short courses for continued upgrading of farmers' capabilities.

Estimated personnel and equipment [illegible] for the training program are shown in Tables 3 and 4. The four-week, intensive course in water management technology will be conducted using personnel, facilities, and equipment from the JVA, Natural Resources Authority, Faculty of Agriculture and Ministry of Agriculture. The series of one-week practical courses must begin no later than October 1977, and waiver will be sought from AID/W for local procurement, as possible, of equipment items deemed critical.

Table 3. Personnel Requirements for Training Unit Under Water Management Technology Project.

Position	Number Required	Minimum Educational Requirements	Annual Salary a/ (J.D.)	TOTAL COST (J.D.)
Director	1	MSc	3000	3,000
Deputy Director	1	BSc	2400	2,400
Drivers	4	-	1080	4,320
Core Staff				
Extension Specialist	4	BSc	2160	8,640
U.S. Expert	1	MSc	-	-
Training Teams				
Team Leaders	4	BSc	2160	8,640
Trainers	12	Secondary Technical	840	10,080
Supplementary Technical Assistance				
Extension Agents	28	BSc	1440	10,080 b/
	Total Personnel Costs			47,160 c/ ($ 141,480 @ JD1.000 = $3.00)

a/ Includes technical and other non-basic salary allowances

b/ Required only during first three months of project, projected to be November, 1977 through January, 1978.

c/ After the first year Extension workers under "Supplementary Technical Assistance" will not be directly involved with the Training Unit. Annual personnel costs will fall to JD 37,080 ($111,240).

Table 4. Equipment items for training element of Water Management Technology Project.

Item	Number Required	Unit Cost ($)	Total Cost ($)
Movie camera, 16 mm sound	1	2,100	2,100
Movie camera, 8 mm sound	1	300	300
Still camera, 35 mm	2	180	360
Sound projector, 16 mm	4	1,000	4,000
Sound projector, 8 mm	2	475	950
Slide projector, 35 mm	4	230	920
Overhead projector	2	270	540
Projection screens	4	90	360
Loud speakers, portable	8	100	800
Sound system for auditorium	1	1,600	1,600
Tape recorders, portable	4	110	440
Generator, 3 KVA, portable	2	600	1,200
Lighting sets, portable	2	300	600
Electronic calculators, portable	4	60	240
Farm tool sets	4	250	1,000
Mechanic's tool sets	4	250	1,000
Black boards, portable	4	50	200
Vehicles			
(a) Bus	1	30,000	30,000
(b) Station Wagon	5	6,000	30,000
Miscellaneous equipment			5,000
TOTAL			81,610

The working staff of the training unit will be drawn primarily from the Ministry of Agriculture's Extension Division. Exceptions are the Director, to be an official of the Jordan Valley Authority, and a U.S. expert to work as a member of the Core Staff.

4. Alternatives

a. To research program

The adaptive research program is designed to establish the optimum operational practices for the project areas. Alternatives to the planned research program would be

1) Straight use of foreign handbooks, to the extent that this information could be disseminated, with trial and error followed by farmers for establishing better practices;

2) Reliance on the university research stations to develop a local handbook using professional judgement regarding foreign practices, local conditions and local experiments; or

3) Supervised farmer trials of various practices.

The local adaptive research program has been selected as the best course of action because:

1) It will reduce the farmer's cost in the trial and error refinement of technology.

2) The location of research stations in the project areas will accelerate the local adaption process as well as provide replication benefits for certain research programs.

3) The use of research stations rather than farmers fields minimizes farmers' risk, allows greater flexibility in experimental design and has been found to produce results more rapidly.

We must rely on intuitive judgement in quantification of these benefits. It is estimated that conventional California irrigation practices would produce at least 60% of optimum crop production in the Jordan Valley with local variation on the order of ± 20%. A farmer trial and error improvement process cannot be expected to raise production more than 5% per year. The university station might quickly raise the appropriateness of irrigation practice to optimum, perhaps at 10% per year, but would not eliminate the ± 20% variation due to location in the valley. The reliance on farmers' fields for local experiments requires a compromise between the rate of production increase of 10% typical as a result of systematic adaptive trials and the 5% rate of improvement achieved by progressive farmers through trial and error. The economic analysis below illustrates the economic soundness of the adaptive research programs.

b. <u>To training program</u>

The farmer training program is designed to transmit to farmers the operational practices of good sprinkler irrigation as recommended by the research program. Alternatives to the Core Staff/Training Team approach are two:

1) No training and reliance on the demonstrative effect of the adaptive research program as supplemented by available extension services.

2) A "programmed learning" approach, involving the use of teaching machines and "canned" teaching programs.

The Core Staff/Training Team approach was selected as providing the best means of practical, hands-on training for large numbers of farmers within a relatively short period of time. Specific considerations in the choice were

a) The time and coordination required in the preparation of canned material for a programmed learning approach farmer training.

b) The selected approach makes maximum use of available personnel in the design and execution of training sessions and in the preparation of training materials.

c) The selected approach has superior institution-building potential in that it (i) builds competence and self-confidence in the technicians and agencies involved, (ii) puts farmers into intimate contact with technicians in a setting which forces competence to be displayed, and (iii) encourage inter-agency cooperation in an endeavor of great mutual concern.

5. Environmental Assessment

The Initial Environmental Examination is presented in Annex C. Based on that examination the Mission is recommending a negative determination, be made with respect to this project.

This project and related activities will develop modern agriculture enterprises in areas now abandoned or under utilized for agriculture. There are no sport game or wildlife populations of significance in the area. Further the water to be utilized for irrigation is now lost through unregulated stream flow. The present stream flow does not support fish or wildlife to any extent and the

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reduced flow rates after project implementation are deemed adequate for sustanence of the stream environs.

The most serious detremental effects could be either localized water ponding or salinization resulting from poor operating technique by the farmers. Neither of these effects would be a permanent degradation and display readily apparent evidence at an early stage.

This project will minimize such effects by education of farmers. The JVA through its water regulation and system monitoring will also monitor farmer operations to detect any mismanagement at an early stage. The JVA has the authority and the capability to take corrective action on behalf of or in cooperation with the farmer. The JVA is arranging for technical assistance on solutions to present and potential drainage problems in the Valley. Adquate drainage can alleviate soil salinity with periodic over-irrigations. There will also be extension officers of the Ministry who will assist in the upgrading of the farmers command of the technology and thereby minimize recurrence of such effects.

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A possible cumulative effect is the increase in plant insect and disease problems from extensive use of sprinkler irrigation and/or cultivation of the proposed crops. The JVA and the University are now establishing research programs to monitor such phenomena and explore the potentials and alternatives corrective actions. While these effects may be more subtle in development and moderately intractable in correction, there is no evidence to suggest the possibility of a permanent degradation. The results of research on irrigation practices to minimize the detremental cumulative effects may restrict the farmers choice of crops and farming methods, but there is no evidence that such practices would be a crucial constraint on the viability of the area.

The Environmental Examination leads to the conclusion that implementation of the project is consistent with good practice in environmental management. There appears to be no conditions warrenting further investigation through an Environmental Assessment or Environmental Impact Statement.

6. Technical Soundness

This project is in direct support of capital projects currently underway in the Jordan Valley, and particularly of the Sprinkler Equipment Procurement project (Loan number 278-0195). US assistance in this technical assistance activity has been requested by the Government of Jordan.

During the course of planning sessions with technicians of the Jordan Valley Authority, the Faculty of Agriculture and the Ministry of Agriculture and in review sessions with high officials of these agencies, the Mission has become convinced of the seriousness with which the Government views the problems this project is designed to address and of the seriousness of the agencies commitments to the projects activities.

In the Mission's view, planning thus far for the project's execution has resulted in the technical issues being sufficiently well-defined to permit its implementation on an orderly schedule. Technical planning and the estimation of costs to the U.S. Government are adequate to meet the requirements of Section 611 (a) and (b) of the Foreign Assistance Act.

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B. Financial Analysis and Plan

1. Financial Analysis

A benefit-cost analysis of the project as a whole is presented in part D, below. The JVA estimates that the introduction of sprinkler irrigation and improved technology to areas now irrigated will increase net cash income on 30 dunum owner-operated farms from JD447 annually to JD 1767 within five years (See Table 7). The benefit-cost analysis is based upon the argument that these increases may take up to 20 years to realize without the sprinkler-specific research and training program that this project proposes and ten years with the project. These durations are purposely conservative for the benefit-cost analysis. The resulting cash flow and net present value (NPV) are shown in Table 8 of part D. At a 12 percent discount rate NPV is estimated to be JD 2.2 million.

2. Host Government Budgets

Research and extension personnel account for the bulk of host government project costs. These will be provided from the budgets of the Faculty of Agriculture and Ministry of Agriculture.

The Mission is concerned with Jordanian capacity to sustain a research and extension effort beyond the life of this project. Table 5 shows the Ministry's budget allocations in recent years to research and extension, in absolute amounts and as a percent of the total. It also shows the Faculty of Agriculture's estimated expenditures on research, both capital and recurring.

Note that both have been increasing substantially. Increases in the Ministry's allocations to research and extension are, in part, inflationary due largely to increased salary costs. The table does not show the substantial salary increases given all civil servants in 1977.

Table 5. Budgetary Allocations to Research and Extension.

A. MINISTRY OF AGRICULTURE

ITEM	1971-1973	1974-1976
	JD 1000	
Annual average budgeted expenditures:		
Total Ministry	1,483	2,567
Research and Extension	298	593
Research & Extension as percent of total	20%	23%

Source: HKJ. Budget Law, Annual 1971-1976.

B. FACULTY OF AGRICULTURE

ITEM	1974-1977 Actual	1977-1979 Planned
	JD 1000	
1. Capital		
Capital Expenditures, Aggregate	991	986
Percent allocated to research	62	60
From University budget	(675)	-
From foreign loans and grants	(316)	-

2. Recurring expenditures on research

Year	Amount (JD 1000)
1974	13.7
1975	29.1
1976	55.8
1977	98.5
TOTAL	197.1

Source: Subhi Qasem, Sami Sunna' and Hasan Gharaybeh. "Scientific Research Studies in the Agriculture Sector". Working paper presented at the seminar on Science and Technology Policy. Amman. May, 1977.

41

Increased expenditures by the Faculty are partly inflationary and partly due to the fact that, it is a young institution, in the process of building up its physical plant, its staff, and its program.

The Mission is reasonably confident that both institutions have a serious commitment to the process of technological change in the Jordan Valley. Both the Faculty and Ministry are attempting to build up their competence in agricultural research in Jordan. The Ministry is also increasingly concerned about improving the quality of extension work in the Kingdom.

3. Financial Plan.

The financial summary for the three year life of this project is shown in Table 6. Life of project inputs are estimated at $1320 thousand from AID and $1330 thousand for Jordanian inputs.

The costs of Jordanian inputs were taken from the itemized personnel estimates of tables 1 and 3. To these were added the estimated cost of acquiring land for an additional research and training site, construction of on-site facilities, and an allowance for operating expenses.

The cost of AID-supplied equipment was taken from the itemized equipment lists of tables 2 and 4. Resident U.S. personnel costs are estimated at $100,000 per man-year. This includes salary and benefits; transportation of the employee and family; transportation of household,personal effects, and automobile; in-country maintenance; and contractor overhead. TDY and participant training cost estimates are those currently being used by the Mission.

A contingency allowance of 5 percent and an allowance for inflation of 10 percent annually were made. These allowances apply to both AID and Jordanian costs.

4. Summary.

The financial requirements of this project are based upon careful consideration of the physical and organizational needs for research and farmer training in sprinkler irrigation. Personnel requirements are adequately accounted for. Equipment inventories for both research and training, shown in tables 2 and 4, have been

Table 6 . Water Management Technology Project, Financial Summary. Costs in $ 1000.

	FISCAL YEAR				
	1978 a/	1979 a/	1980 a/	1981 a/	Total
I. US INPUTS					
A. Research Component					
1. Commodities b/	150.0	-	20.0	-	170.0
2. Personnel					
a. Resident					
Man-months funded	12	12	12	-	36
Man-months on board	9	12	12	3	36
Cost	100.0	100.0	100.0	-	300.0
b. TDY					
Man-months	3	2	2	2	9
Cost @ $8000/mm	24.0	16.0	16.0	16.0	72.0
c. Local administrative					
Man-months	8	12	12	3	35
Cost	4.0	6.5	6.5	2.0	19.0
3. Participant Training					
Man-months	2	6	8	8	24
Cost @ $3800/mm	7.6	22.8	30.4	30.4	91.2
Research Total Cost	285.6	145.3	172.9	48.4	652.2
B. Training Component					
1. Equipment b/	82.0	-	19.0	-	101.0
2. Personnel					
a. Resident					
Man-months funded	12	12	11	-	35
Man-months on board	8	12	12	3	35
Cost	100.0	100.0	92.0	-	292.0
b. TDY					
Man-months	2	-	2	1	5
Cost @ $8000/mm	16.0	-	16.0	8.0	40.0

Table 6 (Cont'd)

	1978 a/	1979 a/	1980 a/	1981 a/	Total
3. Participant Training					
Man-months	3	4	4	4	15
Cost @ $3800/mm	11.4	15.2	15.2	15.2	57.0
Training Total Cost	209.4	115.2	142.2	23.2	490.0
C. Summary					
Research Component	285.6	145.3	172.9	48.4	652.2
Training Component	209.4	115.2	142.2	23.2	490.0
Sub-Total	495.0	260.5	315.1	71.6	1,142.2
Contingencies (5%) & Inflation (10% annually)	25.0	39.5	84.9	28.4	177.8
Total Cost	520.0	300.0	400.0	100.0	1,320.0
II. JORDANIAN INPUTS					
A. Personnel					
1. Research c/	108.0	108.0	108.0	108.0	432.0
2. Training d/	141.5	111.2	111.2	111.2	475.1
Total Personnel	249.5	219.2	219.2	219.2	907.1
B. Land Acquisition	48.0	-	-	-	48.0
C. Construction	30.0	-	-	-	30.0
D. Fuel, supplies and miscellaneous	30.0	30.0	30.0	30.0	120.0
Sub-Total	357.5	249.2	249.2	249.2	1,105.1
Contingencies (5%) & Inflation (10% annually)	18.0	40.0	67.0	100.0	225.0
TOTAL COST	375.5	289.2	316.2	349.2	1,330.1

a/ US funds obligated in preceding year
b/ Equipment listed on tables 2 and 4 to be purchased from funds provided the first year. Equipment purchased in subsequent years to be identified in the course of project execution.
c/ Derived from Table 1. Does not include costs of sub-professional workers: clerks, drivers, laborers, etc.
d/ From Table 3.

review by all persons involved in planning for this project. They represent the best estimate of requirements that can be made in advance of project experience. Allowance has been made of supplementing this list as experience proves necessary.

The economic analysis has been based on a relatively conservative estimate of improvements in on-farm production and incomes, and these are regarded as being attainable with the level and type of inputs being applied. The Mission, therefore, judges the project to be financially sound.

C. Social Analysis and Benefit Incidence

The technical assistance provided by the Water Management Technology Project will be delivered to approximately 3,000 [3/] more-or-less uniformly-sized farms of less than 4 hectares. These farming units are being created by realignment and redistribution of property in the areas under development by the new sprinkler irrigation systems. The land allocated to each farmer has been determined to be a reasonable quantity for providing an adequate standard of living with the agricultural technology available for the Jordan Valley. The Jordan Valley Commission has estimated that the net farm incomes for owner-operators will range between $4,500 and $6,000 per year when the project is fully operational. Tenant farmers on units of this size will have incomes approximately half those of owner-operators.

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The utility of improved irrigation is already well established in the Jordan Valley. The technology of sprinkler irrigation is an innovation for the East Bank, but the

3/ This is the approximate number of farms to be served in the four project areas. The initial recipients of sprinkler equipment from Loan 018 number about 1400.

farmers of the project area are aware of sprinkler usage on the West Bank. The Jordanian farmers are industrious and progressive as demonstrated in the intensive cultivation of a number of fruits and vegetables for export and by their use of tractors and modern inputs to maximize production. There is no known socio-cultural inhibition to the establishment of sprinkler irrigation technology.

The most serious obstacle will be the difference in farming back-ground and experience for the farmers of the project. Roughly 1/3 of the farmers will have had some experience with surface irrigation, another 1/3 will have been experienced dryland farmers, and another 1/3 will have been farm laborers either on dryland or irrigated land. These backgrounds will have some effect on the farmers' ability to assimilate and utilize sprinkler technology. By using technology transfer techniques that provide some flexibility and a generous amount of time, it is intended that the less-experienced farmer can be adequately assisted in adopting the sprinkler technology.

It is necessary to train up to 700 farmers per month in the simple skills of using sprinkler equipment. The training team approach is well suited to this situation. The JVA and GOJ Extension Service concur that this method will be adequate to transfer the basic operating techniques to the farm operations level in sufficient numbers to enable efficient system start-up.

This project is designed to provide a high degree of equity in enabling the farmers of the Jordan Valley to utilize sprinkler irrigation technology. All farmers are to be assisted in this project. The relatively high degree of regimentation proposed for installation of sprinkler equipment requires some limitation of the freedom of the individual farmer. On balance, the JVA has struck a reasonable

compromise between regementation and farmer independence in order to rapidly establish the complete system at a reasonable working efficiency.

This project creates new employment and expands the earning capacity of small farmers and laborers already employed. The primary changes in employment will be noticed for as many as 500 farmers who will be able to expand their earning power as the irrigation of their land is improved. Approximately 2,500 additional farmers will realize the benefits of well irrigated land rather than unirrigated land.

There appears to be significant opportunities for hired labor on these enterprises, but that quantity of employment has not yet been estimated. The JVA has estimated the new opportunities for off-farm employment for the project area as equal to 1/3 of the number of farms or 1,000 jobs in the agricultural service industries. The rate at which the off-farm employment develops will be significantly influenced by the rate that farm productivity expands under the sprinkler irrigation. Thus the indirect impact of this project on employment is not considered remote and inconsequential.

The individual's role in social participation is expected to follow his development of economic opportunity in the project areas. These economic opportunitie will be equalized by greater uniformity of land holdings and the equality in skill training. In concurrent activities of the JVA the farmers are being organized into an Association for collective management of certain service enterprises such as input procurement and commodity marketing. It is possible to anticipate any number of pit-falls in the implementation of these programs which will limit the diffusion of power or breadth of participation. However, even imperfect implementation will be a positive effect on the equity of power and the opportunities for participation.

D. Economic Analysis

Benefit-cost analyses of irrigation projects being planned or under execution in the Jordan Valley have shown rates of return ranging from 13 percent (Zarqa Triangle Project) to 17 percent (Maqarin Dam - prefeasibility study). The benefit-cost analysis of the East Ghor Canal Extension project projected a benefit-cost ratio of 2:1 at 6 percent.

In each of these studies projected increases net farm income ranged from 25 percent to over 200 percent, depending upon the assumed crop mix and whether or not the farm was irrigated prior to the project.

Project benefits arise from higher yields, expansion of the irrigated area, and extension of the irrigation season. Realization of these benefits is dependent upon skilled use of new irrigation techniques and a knowledge base and transmittal system capable of anticipating and addressing farmers's technical problems with the new methods. This project is designed as an approach to both issues.

The sprinkler irrigation system to be supported by this adaptive research and training program is estimated to cost $50.7 million. The cost of the research and training operatio is estimated at about $2.6 million, or 5% of the investment.

The projected establishment of design production levels is illustrated in Table 7, below. This table assumes a relatively trouble-free process of adoption of new irrigation methods and, therefore, implies the existence of the research and training program in setting the target of five years for full development of the individual farms. The farm budget analysis of Table 7 was prepared in 1975 for the 1976-82 Jordan Valley Development Plan. More recent analyses would show net cash income estimates somewhat greater than those given, largely due to inflation.

The comparative analysis of alternatives for research and training require bold assumptions and simplifications. Unfortunately, there is no previous experience from which one can determine the analytical coefficients and intuitive judgements must be relied upon. Hence the comparative economic analysis should be considered an order of magnitude rather than precise indication of relative benefits.

Table 7. Projected Net Cash Income of 30 Dunum Owner Occupied Vegetable Farm in New Areas Utilizing Sprinkler Irrigation System.

(In Jordanian Dinars)

	Year 1	Year 2	Year 3	Year 4	Year 5 Full Development
Income 1/	862	1486	2110	2556	2972
Costs					
Repayment of short-term production loan 2/	239	394	573	746	785
Repayment of sprinkler investment 3/	65	143	143	143	143
Irrigation water charges 4/	111	166	222	277	277
Total Above	415	703	938	1166	1205
Housing mortgage payments 5/	240	240	240	240	240
Total Costs	655	943	1178	1406	1445
Net Cash Income	207	543	932	1150	1527
Net Cash Income Excluding House Mortgage Payments	447	783	1172	1390	1767

1/ Based on farm gate price average for 1974/75. Income growth to full development in year 5 based on the general relationship utilized in Annex 15, Table 1 of "Northeast Ghor Irrigation and Rural Development Project," Report No. 339a-JO, May 10, 1974, EMENA Projects Department, IBRD. Gross farm income was assumed to increase as follows: Year 1 - 29%, Year 2 - 50%; Year 3 - 71%; Year 4 - 86%; and Year 5 - 100%.

(footnotes continued on page 41.)

2/ In order to be conservative, it was assumed that production costs for fertilizer, pesticide, hired labor, etc., will increase at faster annual rate (relative to Year 5 full development) than farmers gross income. The percentage used are as follows: Year 1 - 40%; Year 2 - 60%; Year 3 - 80%; Year 4 - 100%; and Year 5 - 100%. Repayment of short-term production loan is assumed as equivalent to production costs including an 8% interest rate.

3/ Assumes $2,800 loan (JD 934 at JD 1 = $3.00) at 7% interest rate, ten year maturity and one year grace period. The equivalent annual payment used from Year 2 on was 0.15349 multiplied by the $,800 loan.

4/ The Year 1, the water charge for sprinkler irrigatio is 6 fils/m^3. This water charge is increased by 1 fil/m^3 per annum in Years 2 through 5, reaching 10 fils/m^3 in Year 5. This escalation generally accords with the GOJ plan to increase water charges to meet projected water costs over time. The annual quantities of water used during the development phase was the same as for production costs.

5/ Assumed at JD 20 per month based 7% interest rate at 20 years for a $8,000 loan. This assumes an average 20% downpayment (or owner investment) in a $10,000 house. According to the JVA, only about 50% of the farmers are likely to borrow funds for house construction.

6/ Net cash income excludes the payment to the GOJ for land charges and water rights, if applicable. The land charge (a purchase price) for a 30 dunum farm is JD 40 per dunum or JD 1,200 to be repaid over 20 years at 4%. The annual equivalent payment for land charges is JD 88 (0.07358 x JD 1,200). The per dunum charge for water rights is JD 20 per dunum or JD 600 for a 30 dunum farm to be paid over 20 years at a 4% interest rate. The annual equivalent payment for water rights is JD 44 (0.07358 x JD 600). On the basis of current information it is uncertain that percentage of the conversion model farms will be responsible for either type of payment.

Source: "Jordan Valley Development Plan," The Jordan Valley Authority, The Hashemite Kingdom of Jordan.

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Without the research project, the time required to achieve full production will be greatly extended, perhaps by as much as 20 years. At the same time, even with the project the development schedule of table 7 is optimistic. It will likely take longer, perhaps 10 years, to reach the income level projected there.

Table 8, below, shows the resulting cash flow and net present value of the project assuming

1. A ten year development period with the project;
2. A seventeen year development period without the project;
3. AID project inputs for the first four years, GOJ inputs continuing thereafter;
4. Fourteen hundred farms in the project areas
5. There are no further benefits, i.e., prevention of productivity decline, from GOJ expenditures on research and extension; and
6. A 12 percent discount rate.

The data of Table 8 are based on bold assumptions regarding the project's impact on farm production and incomes. Never-the-less the estimated net present value of JD 2.2 million at 12 percent creates a strong presumption of economic viability with reasonably conservative projections of increases in net farm production

Table 8. Cash flow and net present value of investments in research and training program for sprinkler irrigation in the Jordan Valley

Year	Net Cash Income per farm from table 7 (1) With Proj.	(2) Without Proj.	(3) Difference	(4) Difference Col(3) by 1400farms	Project Costs a/ (5) AID	(6) GOJ	(7) Total	(8) Cash Flow, Col(7) less Col.(4)	(9) Present Value at 12 per cent
	(JD)				(JD 1000)			(JD 1000)	(JD 1000)
1	447	447	0	0	173	125	298	-298	-266
2	447	447	0	0	100	96	196	-196	-156
3	783	447	336	470	133	105	238	232	165
4	783	447	336	470	33	116	149	321	204
5	1172	783	389	545	0		116	429	243
6	1172	783	389	545				429	218
7	1390	783	607	850				734	332
8	1390	783	607	850				734	297
9	1767	1172	595	833				717	259
10		1172	595	833				717	231
11		1172	595	833				717	206
12		1172	595	833				717	184
13		1390	377	528				412	94
14		1390	377	528				412	84
15		1390	377	528				412	75
16		1390	377	528				412	67
17 and on	1767	1767	0	0	0	116	116	-116	- 17
Total	23487	16935	6552	9174	439	1950	2389	6785	2220

a/ Converted from US dollars at JD1.000 = US $3.00

53

IV. IMPLEMENTATION ARRANGMENTS

A. Government and AID Administrative Arrangments

1. Government

The Jordan Valley Authority (JVA) has been assigned the responsibility for and authority to develop and administer activities aimed at the economic and social development of the Jordan Valley.

The JVA was created from the Jordan Valley Commission (JVC) in May 1977 and given operating authority over a number of activities for which the JVC had only a coordinating role. These include the Jordan Valley activities of the Ministry of Public Works and the operation and maintenance of the existing irrigation system there, formerly performed by the Natural Resources Authority.

Much of its mandate is still carried out through direction and coordination of other government agencies. In agriculture, its principal agent is the Ministry of Agriculture, but it also works with such other government agencies and with autonomous bodies as the Faculty of Agriculture of the University of Jordan. This will also include the Jordan Valley Farmers Association when the organization of that body is complete, expected in late 1977 or early 1978.

In planning this project the JVA has established effective, cooperative relationships with the Ministry of Agriculture's Research and Extension Department and with the Faculty of Agriculture of the

University of Jordan. Both institutions are eager to participate in the acticities planned.

JVA will assign one of its senior staff to be overall Director of the project. He will have specific responsibility for coordinating the research program. JVA will also assign a staff member to be Director of the Training Unit. Its Deputy Director will be named from the Ministry's Extension Division.

2. Mission

The Ambassador has recently agreed to the employment of a second US officer in the Mission's Agriculture Division. This person will be the Deputy Food and Agriculture Officer and have specific management responsibility for the Division's projects in the Jordan Valley. Recruitment for the position is underway, and the Mission hopes to have the employee on board before the end of FY 1977.

B. Implementation Plan

Host government contract or contracts will be used to provide US assistance to the Government in undertaking the research and training activities. The JVA will act as grantee and contracting agent for the Government. The

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two activities, research and training, will be advertised separately, but combined bids will be accepted, and a single contract may be awarded.

JVA will work with its cooperating agencies, the Ministry and Faculty, in allocating project resources among activities and institutions. The US resident technical assistance staff (two persons, one in training and one in research) and the USAID Project Manager will participate fully in this process.

The Ministry of Agriculture, under JVA's direction, will bear the primary responsibility for staffing the Training Unit and carrying out its functions. The Ministry and the Faculty of Agriculture will cooperate fully with JVA in accomplishing the research program.

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This project will be under considerable time pressure in order to coordinate with the construction and equipment installation schedules of other projects. The JVA recognizes this pressure and has shown considerable concern and interest in expediting matters to synchronize activities as much as possible.

The present construction schedule anticipates that the pressure system will be complete, and ready for on-farm equipment in October 1977 for the East Ghor Canal Extension and in December for the Zarqa Triangle. The sprinkler equipment is now scheduled to arrive

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and be ready for distribution to farmers in late November.

Training of farmers should begin approximately two weeks prior to their receipt of equipment. Prior to that time, approximately three months before training of farmers begins, the Core Staff will begin assembly and preparation of training materials and will train technicians in both irrigation techniques and instructional methodology.

The Ministry of Agriculture has assembled a set of sprinkler equipment for its Station at Deir Alla and has already begun using it in demonstration work, primarily for familiarization of its technicians and extension workers in the Valley.

C. Expediting Actions.

The Mission and the JVA are concerned that project resources be in place as quickly as possible. This applies to both equipment and personnel and is particularly critical in the case of the training component, where deadlines are imposed by the pace of completion of the related capital projects.

The research component must also get underway as quickly as possible. Double cropping will be a part of the research program in order to provide a knowledge basis for its adoption by

farmers. Since, however, the fall season is materially different from the spring season, a few month's delay in start-up of experimental work implies a year's delay for that season.

1. Commodities

Mission experience with the Faculty of Agriculture project has shown that US procurement of laboratory and field equipment requires six to nine months for on-site delivery. The Mission, therefore, will be seeking waivers for local procurement of AID-financed commodities to the extent they are available in Jordan.

In general grant-funded commodities will be procured through JVA's purchasing mechanism, in consultation with Mission staff and, upon their arrival, with contractor staff. The Mission is not well set up to do the procurement for this project, and the contractor is not likely to be established soon enough to do this job effectively. Commodities not available locally will be obtained from US suppliers. The Mission's Project Manager will continuously monitor this process to ensure efficiency.

2. Personnel.

The Mission and JVA regard it as essential that a US training expert be on the ground in Jordan by September 1, 1977 in order to assist

in the preparation of the training program and carry out the first round of farmer training. It is highly unlikely that contracting procedures under this project can be completed in time to provide this assistance.

The JVA has therefore requested, through the NPC, that the Technical Services and Feasibility Studies Grant be used to finance up to six months' (includes one month's preparatory time in the U.S.) TDY by a training expert for this purpose. The requesting letter, with terms of reference, is attached to this paper as Appendix 6 of Annex B. The Mission has requested AID/W to execute a contract for these services.

D. Evaluation Plan

This project, as an innovative training approach, will receive careful evaluation to maximize the value of the activity to AID and to GOJ. The contractor will be required to set up his own procedure for monitoring the effectiveness of the training and for identificatio of improvements. The contractor will be expected to include reports of such activities in his report of the training program.

There is provision in the Mission's evaluation plan for a comprehensive review and modification of the training activity at the mid-point of the project. This will be somewhat more thorough than the usual feedback process, but will be

fully within the contractor's operations. Nonetheless, the report of this review will provide interesting insights on the effectiveness of the project.

The routine contractor's reports, Mission and JVA monitoring, and other reviews and appraisals of the project will provide regular reporting on the progress of work and the effectiveness of the activity.

A comprehensive evaluation of the methodology will be undertaken at the completion of the activity. This evaluation should provide an opportunity to observe the residual value of training after one or two years, the comparative merits of the variations followed, the interrelationships of research and training, the interdependence of the project activities and other institutions, and many other factors. This evaluation will provide an analysis of the utility of the training approach for other agricultural production technology in the Jordan Valley. The scope of work for the final evluation will be drawn up jointly by JVA and AID, in consultation with the Ministry, Faculty, and other agencies which become directly involved in the project. The evaluation staff selection will be undertaken following agreement on the scope of work.

It is anticipated that students of rural sociology will be interested in the proposed technology transfer process and undertake independent analysis of this activity. Such study will be encouraged and the results used as independent assessments of the activity. Such independent work is expected to be an invaluable evaluation resource which minimizes the internal evaluation arrangements which are required.

E. Conditions and Negotiating Status

Planning of the research and training activities of this project has been done by staff members of JVA, the Ministry of Agriculture, the Faculty of Agriculture and USAID. Verbal agreement on the programs has been reached, along with substantial agreement on input levels by participating agencies.

JVA and the Mission regard September 1, 1977 as the critical date for the establishment of the Training Unit- with i.. Director, Deputy Director, and core staff assigned on a full-time basis. It is anticipated that members of the Training Teams will be identified in the course of the advance training sessions for technicians.

The Project Agreement, itself, will include statements which

1. Define the role of each of the participating Jordanian agencies in the project.
2. Spell out the methods for coordinating their activities, and
3. Commit each to the provision of necessary project inputs as planned, including both personnel and material inputs.

A proposed condition precedent to the disbursement of grant funds is the establishment, at an appropriate site in the Jordan Valley, of the Training Unit, with its Director, Deputy Director, and Core staff assigned on a full-time basis.

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TAGS:

SUBJECT: WATER MANAGEMENT TECHNOLOGY - 0192

1. NE ADVISORY COMMITTEE APPROVED PRP IN MEETING OF NOVEMBER 18, 1976.

2. FOLLOWING ASPECTS RECOMMENDED FOR ANALYSIS, DISCUSSION OR ELABORATION IN PP:
A. TRAINING PROGRAM - OUTLINE TRAINING PROGRAM WITH SYLLABUS, LIST OF TEACHING AIDS, ANALYSIS OF LITERACY CONSTRAINT, PLANS FOR TRAINING SITES, AND BUDGET. (SEE ITEM 4 BELOW).
B. RESEARCH PROGRAM - PREPARE LIST OF EXPERIMENTS, WI BRIEF DESCRIPTIO', PLOT PLANS, EQUIPMENT LISTS AND BUDGE
C. TRAINING SCHEDULE - REVIEW BOTH CONSTRUCTION SCHEDUI FOR THE FOUR IRRIGATION PROJECTS AND CROP SEASONAL RE-QUIREMENTS IN DEVELOPING THE DESIGN OF FARMER TRAINING SCHEDULE FOR EACH SUB-PROJECT AREA.
D. JVC ADMINISTRATIVE ARRANGEMENTS - DESCRIBE MEANS OF MANAGING OR ADMINISTERING COMPLETION OF IRRIGATION SYSTEMS INCLUDING FARMER SERVICES SUCH AS INPUTS, MAR-KETS AND EXTENSION. ALSO INCLUDE DESCRIPTION OF OPERATION-AL INTERRELATION BETWEEN THE TRAINING AND RESEARCH UNITS AND THE VARIOUS ADMINISTRATIVE OFFICERS. PP SHOULD ALSO

INCLUDE JVC PLANS FOR ASSIMILATING OR RE-ASSIGNING TRAINING AND RESEARCH OPERATIONS UPON COMPLETION OF THE PROJECT.
E. PREPARE DRAFT GRANT AGREEMENT FOR LIFE OF PROJECT FUNDING AND WITH SCOPE OF WORK FOR HOST GOVERNMENT CONTRACTING. PROPOSE THAT THIS MODE OF IMPLEMENTATION BE CONSIDERED AND THE MERITS OF ALTERNATIVES ANALYZED.
F. PROJECT EVALUATION PLAN IS REQUIRED IN PP.

63

3. AID/W ASSISTANCE AVAILABLE FOR PREPARATION OF PP. PROPOSE THAT FIRST DRAFT BE PREPARED IN AID/W AND POUCHED TO MISSION WITH OUTLINE OF SECTIONS REQUIRING MISSION INPUTS. ESTIMATE THAT FIRST DRAFT CAN BE POUCHED O/A DECEMBER 10.

4. KELLER AVAILABLE TWO WEEKS IN JANUARY TO ASSIST WITH REQUIREMENT 2-A ABOVE. KELLER AVAILABLE UNDER EITHER ISC OR HOST GOVERNMENT CONTRACT WITH UTAH STATE. SCOPE OF WORK SHOULD INCLUDE: ANALYSIS OF ESSENTIAL ECONOMIC CONCEPTS, ANALYSIS OF LITERACY AND OTHER CONSTRAINTS, OUTLINE OF TRAINING SYLLABUS, LAYOUT SKETCHES OF TRAINING SITES, DESCRIPTION OF TEACHING AIDS, ELABORATION OF SCHEDULES AND BUDGETS. SUGGEST THAT KELLER REPORT BE INCORPORATED IN PP AS AN ANNEX AND BE USED AS SCOPE OF WORK OF CONTRACTOR IMPLEMENTING PROJECT.

5. UNDERSTAND FROM HYSLOP-BALIS TELECON THAT JVC TO ALLOCATE LOAN-FINANCED SPRINKLER IRRIGATION EQUIPMENT FOR TRAINING AND RESEARCH SITES. ADVISORY COMMITTEE ENDORSES THIS CHANGE IN BUDGET.

6. ADVISORY COMMITTEE BRIEFLY CONSIDERED OPTIONS IN CONTRACTOR SELECTION. CONSENSUS IN SUPPORT OF COMPETITIVE SELECTION OF TWO CONTRACTS WITH THE BIDDER GIVEN THE OPTION TO BID ON BOTH RESEARCH AND TRAINING AS A COMBINED BID.

7. MISSION ADVICE REQUESTED ASAP REGARDING ARRANGEMENT OF KELLER TDY PER ITEM 4. KISSINGER
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WATER MANAGEMENT TECHNOLOGY
SPRINKLE IRRIGATION (JORDAN)
TRAINING PROGRAM

by

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Prepared under the support of the U.S.
Agency for International Development
Contract No. AID/afr-C-1140 w.o.#15

February 5, 1977

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TABLE OF CONTENTS

SUMMARY RECOMMENDATIONS 1
Training Program 1
Other Recommendations 2
INTRODUCTION 3
Input Information 3
IMPRESSIONS 5
Water Management Technology Project Review Paper 5
Quality of Farmers 5
Training Methods Desired 6
Desired Training 7
Farmers Acceptance of Sprinkle Irrigation 7
Suitability of Sprinkle System Designs 8
Trickle Irrigation 8
Obvious Research and Extension Needs 9
Installation and Repair 9
RECOMMENDATIONS 10
Immediate Tomato Irrigation Study 10
Alternate Tomato Irrigation Study 10
Trickle Irrigation Studies 11
Fabrication and Repair 12
Combining Training and Research 12
Further Study 13
TRAINING PROGRAM 14
Fabrication, Maintenance and Repair Module 15
Mechanical Operation of On-Farm Equipment Module 15
Training-Demonstration Farms 16
Basic Water Management Module 17
Advanced Water Management Modules 19
Advanced Irrigation System Design 20
Basic Sprinkle Irrigated Crop Management Modules 20
Advanced Crop Management 21
GENERAL TRAINING CONSIDERATIONS 23
Technical Staff Training 23
Additional Training 24

66

SUMMARY RECOMMENDATIONS

The Jordan Valley Irrigation Extension Sprinkle Project should be a successful venture if it is used as the planners suggest. To achieve the level of capability among the administrative and technical staff and farmer operators the proposed training program must be diligently followed.

Training Program

It is important that the farmer operator and operating staff training program be built around a "hands-on" approach where techniques and information to be transferred are first demonstrated through visual aids or in the field by the instructor. The demonstrations should be highly interesting and as true to life as possible with a minimum of lectures and standard class room work. After each demonstration, students should practice new concepts in the field undder the supervision of the instructor.

Training program modules should include:

1. Building, maintenance, and repair of portable sprinkler systems and special flow controls and watering devices
2. Mechanical operation of sprinkler laterals and on-farm maintenance and repair
3. Basic water management
   (a) for water manager and pipe (ditch) riders,
   (b) for farmers.
4. Basic sprinkle irrigation farming practices
5. Advanced water management
6. Advanced irrigation farming - crop by crop
7. Advanced irrigation design and operation: trickle, gated pipe, alternate sprinkle layouts, salinity control, cooling, and hosefed sprinklers

Training modules for the first four items on the list should be completed well before the initial on-farm settlement. A traditional separation

between engineering and agricultural training responsibility exists; engineering comprises items 1,2,3,5, and 7 and agriculture items 4 and 6.

In addition to training farmers, it is most important that similar training be given to the general staff of professionals and technicians involved in the project. These include the Training Instructors, Extension Agents, Cooperative Managers, and NRA staff. To achieve this, the Training Instructors should present the hands-on training modules (prepared for the farmers) to the general staff. This should be supplemented by additional background material presented by the Core Staff who developed the modules. This program is a relatively inexpensive, but effective, approach to general staff training which will also serve to test the modules and provide practice teaching for the Instructors.

Other Recommendations

In addition to the training program outlined above, it is important that the following activities also be pursued:

1. A special (and immediate) study to develop a "fool proof" package for tomato, cucumber, and squash production under sprinkle irrigation. This is needed because there is some question about the advisability of sprinkle irrigation of these crops
2. Study alternate irrigation systems, which are compatible with the project, for standby programs. These would include gated pipe surface systems, trickle systems and combination sprinkle and trickle or gated pipe systems. Studies should be started immediately by studying the existing trickle systems
3. Have the sprinkle equipment supplier provide detailed manuals on the mechanics of the equipment, fabrication facilities needed and technical help with fabrication. This would replace the suppliers involvement with farmer training
4. Combine the training and research activities

INTRODUCTION

The background and details for the Jordan Valley Irrigation Extension Sprinkle Projects are well documented and need not be dealt with here. The background for this specific report consisted of reviewing the pertinent documents dealing with the sprinkler irrigation extensions and the proposed training program, discussions with various government officials, and field trips to the Jordan Valley observing farming operations and visiting with farmers.

Input Information

Reports reviewed. The various written reports reviewed in detail included the following:

1. North-East Ghor Irrigation and Rural Development
   Final Design and Design Notes
   Dar Al-Handasah/NEDECO — March 1976

2. Hisban-Kafrein Sprinkle Irrigation Scheme
   Final Design Report
   Sir M. Macdonald and Partners — January 1976

3. Agro-Economic Aspects of Tenancy in the East Jordan Valley
   Economic Research Department
   Royal (Jordan) Scientific Society — 1975

4. Jordan Water Management Technology
   Project Review Paper (48 pages)
   JVC/John Balis — 1976

5. Jordan-Sprinkle Irrigation Equipment Loan
   Project Paper AID - OLC/P-2202

Contacts made. Discussions were held with the following officials:

1. Mr. Omar Abdullah, Director General, JVC
2. Dr. Fahd Natour, Director Engineering, JVC

3. Dr. Sami Sunna, Director Agriculture, JVC
4. Dr. Abdul-Raouf Dakkak, Engineer, JVC
5. Mr. Suleiman Ghezawi, Engineer, JVC
6. Prof. Max Jensen, Ag. Engineering, Univ. of Jordan
7. Dr. Mohammad I. Barhoum, Rural Sciologist, Univ. of Jordan
8. Abdul K. Ghezawi, Manager, Coop Jordan Valley
9. Mr. Christopher H. Russell, Direcor, USAID/Jordan
10. Mr. John Hyslop, Agriculture, USAID/Jordan
11. Mr. Gordon Pierson, Program Director, USAID/Jordan
12. Mr. Fuad Qushair, Agriculture, USAID/Jordan
13. Mr. Said Ghezawi, Under Secretary, Ministry of Agriculture
14. Mr. Mohammad Labedi, Director, Dar-Alla Ag. Exp. Station

During the study, four trips were made to the Jordan Valley and extensive interviews were held with a cross section of 10 farmers (including owner-managers, managers, tenants, renters, and irrigation laborers). This was done to develop a reasonable understanding about the farming capabilities and problems of the people who will be assisted.

IMPRESSIONS

The following are important considerations for the training and research needs of the Jordan Valley Irrigation Extension and Sprinkle Project.

Water Management Technology Project Review Paper

In general (except where otherwise indicated), the report by Balis (4) seems accurate. Therefore, it will be assumed that the Balis report is essential reading and an endeavor will not be made to repeat his general comments.

Quality of Farmers

There is good evidence that the farmers and/or farm management decision makers in the Valley are quite innovative and capable. Extensive use of new technologies such as: growing under plastic (over 2500 dunums), black plastic mulch, trickle irrigation, application of various pesticides and fungicides, good fertilization practices, and good varietal selection are evident. Although surveys indicate inefficient use of extension personnel (3)*, new technology spreads rapidly through the Valley. According to the farmers interviewed, there is an indiginous transfer mechanism at work: exchange of information and observations among farmers. Trickle irrigation also has the added support of the suppliers.

According to farmers and officials interviewed, it appeared that most of the new lands will be farmed by those having irrigated farming experience; the land will be parceled out resulting in little or no available land for farmers outside of the area who have not had some

*Numbers in parentheses indicate citation of the reports listed on Page 2.

irrigation experience. This finding is not in accord with other reports (3 and 4) which indicated that the training program would be dealing with equal numbers of farmers with some irrigation experience, farmers with only dry land experience, and farm laborers from either dryland or irrigated farms. Furthermore, it seems that most of the new land farmers will have had some experience with management decisions, all of which simplified the training task.

Training Methods Desired

Each farmer interviewed indicated a preference for demonstrations over other teaching techniques. Without exception they all said, "Show me how with a demonstration and then I can do it."

Some managers said they would teach their irrigators how to handle the pipe. When asked if they would show their neighbors and/or help them learn a new concept they said, "yes." They also indicated they would be satisfied in taking instructions from their neighbors and/or other farmers. The main point was they wanted qualified instructors.

They felt movies would be OK (but not as good as "hands-on" demonstrations*). Their response to slide presentations was neutral; however, I doubt if they have experienced well-organized film strip presentations. No farmer wanted lectures.

Farmers have little education and according to reports (3), about two-thirds of the Valley's tenant farmers are illiterate. Of those who are literate farmers, only a few have had more than a grade school education. It might be assumed that landowners have more educational opportunities, but the level of literacy and education for all the farmers is very low. Therefore, it is not surprising that they are not receptive to lectures, but want physical demonstrations which is the traditional method of learning that they are accustomed to.

*The term, "hands-on" demonstration can be interpreted as a combination of (1) a demonstration of the technique by the instructor and (2) supervised practice of the technique by the farmer.

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Desired Training

As mentioned, the farmers want demonstrations. They are very interested in learning how to handle and repair pipe plus the general fundamentals of sprinkle irrigated farming and water management.

The farmers interviewed also expressed a desire to have periodic training sessions on various new and more complex aspects of modern irrigation farming. In short, they seem eager to get qualified assistance. When asked how far they would travel on their own to go to a training session, it appeared that about 5 km would be reasonable because many would walk. There was no clear preference for a particular meeting day, but the time they chose was either morning or early afternoon (not night).

Farmers Acceptance of Sprinkle Irrigation

Several farmers were apprehensive about sprinkle irrigation. Their main concern was with sprinkling tomatoes, cucumbers, and squash. They said they feared sprinkling would result in fungus and disease problems and cracking of tomato skins. The basis for these worries, stemmed from the fact that when there were unusually heavy rains, these problems arose.

Prof. Max Jensen and this writer both understand and share this concern. There is a lack of tested and detailed viable packages for the crops under sprinkle irrigation in the Valley, and at this writing it appears risky to push sprinkling without providing the farmers with very explicit and reliable information on how to handle their three most important crops, tomatoes, cucumbers and squash. In fact, if for these crops a fool proof production package cannot be put together, then the JVC should advise the farmers to hold off sprinkling them.

On the other hand, there is agreement that the root, forage, grain, citrus, and most other vegetable crops (with the exception of eggplant) will produce very well under sprinkle irrigation with no unexpected difficulties.

73

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Suitability of Sprinkle System Designs

In general, the sprinkler systems designed by the two consultants should prove satisfactory. One doubts whether the irrigation efficiencies will be as high as the indicated 85%, but theoretically, the systems reach this very high level of efficiency if they are properly managed.

None of the farmers interviewed seemed to understand water management in terms of the depth of water applied; however, they did appreciate the need for timely irrigations. The systems designed for most of the areas, as reported in (1) should be relatively easy to manage; however, the systems as reported in (2) seem considerably more complex.

System application rates seem well within the basic infiltration capacities of the typical soils in each design area, but pressures are on the low side for good drop breakup. This could be a problem in the Hisban-Kafrein District where the soils are quite silty and the operating pressures are only 25 m (35 psi).

Usually, farmers in most areas (other than in Jordan) run their rows or furrows on the contours and across the widest dimension of their fields. This would be at right angles to the sprinkler lateral direction on most of the layouts in the Valley (1). Fortunately, most Jordan Valley farmers are accustomed to having the furrows run down slope (for surface irrigation) and the short direction across the fields. Thus, the laterals will be running with the farmers' normal row direction, which is the only practical way to operate.

Trickle Irrigation

There are already several trickle irrigation systems in the Valley. Although there was mention of clogging problems and system failures, most systems seemed to be operating satisfactorily. The best tomatoes (100 du.) observed were trickle irrigated and grew in black plastic mulch.

Many farmers are excited about trickle irrigation, and according the tomato farmer using trickle irrigation, over 100 other Valley farmers say they are going to copy him and trickle irrigate next year.

Even the best trickle irrigators are not well informed about the water management aspects of irrigation. They use crop color to decide when to irrigate and guess when to turn the system off.

Obvious Research and Extension Needs

There are many and severe fungus and disease problems with the tomatoes and cucumbers. In addition, there are obvious nutrient problems, with many signs of iron chlorosis, low phosphorous, and nitrogen. Weeds are another problem.

With sprinkle irrigation and the emphasis for higher density plantings, the problems with pests and nutrition will be multiplied. The needed practicies to cope with these problems must be developed, tested and extended.

Installation and Repair

After reviewing the various project-related documents and discussions with officials, it becomes apparent that little consideration has been given to installation and repair of the portable sprinkle equipment. The original equipment bid specifications required considerable modification, and there seemed to be little understanding about the needed fabrication, delivery, and repair facilities.

Most likely the low bidder will utilize press-on couplers. Thus presses will be required. Furthermore, to handle damaged pipe and fittings plus service the farmers' needs, certain equipment should be on hand. This equipment might include such items as aluminum welding capability, steel braising capability, a mechanical saw, a pipe threading machine, small hand tools and pipe delivery vehicles. These items are in addition to spare parts and suitable storage and service buildings.

RECOMMENDATIONS

Immediate Tomato Irrigation Study

Since tomatoes are probably the most important crop in the whole Valley, it is imperative that a viable tomato irrigation package be developed. Since it is now impossible to gain full crop season experience (tomatoes have been planted for 2 to 4 months), expert advice is needed. Hopefully, an expert can either present a "fool proof package" or advise on the probabilities for various degrees of failure of a "best package."

The expert should also design the precise research studies to be undertaken. He should also tackle cucumbers, squash, melons, and eggplants in a similar but less detailed manner.

In addition, it would be very worthwhile to get a sprinkle irrigation system immediately into operation for tomatoes, even if this requires buying a crop which has already been planted or changing the experimental goals on the existing tomato plots at Dar Alla Experimental Station.

Alternate Tomato Irrigation Systems

If an expert advises that sprinkle irrigation of tomatoes is too risky, new project management discussions are needed. Either the farmers should be told not to sprinkle irrigate tomatoes or they should be given the technical assistance to use alternate methods for irrigation. These could include surface and/or trickle irrigation.

For surface irrigation, special outlet orifices will be needed in the risers to dissipate pressure and control flow. Also, some aluminum pipe could be used to convey the water from the risers to the furrows (gated pipe).

The permanent pipeline network design would be an ideal delivery system for trickle irrigation. Farmers could (and should) have a

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combination of sprinkle and trickle irrigation equipment since each system will have its "best crops." Sprinkling is also a good method to periodically leach the salts which tend to accumulate between row under trickle irrigation.

Even if alternate methods of irrigation are used on certain crops, each farm should be required to have at least one sprinkler lateral line. Since the present operation calls for a dry and a wet line, only one-half of the sprinklers should be in operation at any given time. If some of the crop area is not sprinkled, one lateral would be sufficient.

Trickle Irrigation Studies

As previously stated, there are already various types of trickle irrigation systems operating in the Valley. This presents the opportunity for immediately beginning significant trickle irrigation research and gaining experience.

To speed up the research, it is recommended that the existing operating trickle irrigation systems be thoroughly studied. Items needing study are:

1. Filtration - possibly some farmers will allow tinkering with their present filtration facilities, especially if they are experiencing clogging problems.
2. Clogging - this would include studies of slow clogging by mineral deposits and siltation as well as blockage by organic growth.
3. Effects of chlorination on the clogging problem.
4. Salinity and leaching.

These trickle irrigation studies should be undertaken regardless of whether or not expert judgment on sprinkling tomatoes is available. The farmers in the Valley are interested in trickling and obviously will continue pursuing this technology regardless of the JVC input.

77

(For example, sprinkle irrigation is impractical for growing under plastic and surface irrigation is difficult.) Although some trickle irrigation systems are operating well, there have been many failures. Therefore, it is obvious the farmers need (and are eagerly seeking) technical assistance in trickle irrigation. Prof. Max Jensen would be an ideal advisor.

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Fabrication and Repair

It would seem advisable that the sprinkler equipment supplier provide the following services in place of the suggested farmer training assistance.

1. A detailed manual (4 copies with glossy photographs) covering mechanical operation, repair and maintenance of the equipment.
2. A manual covering the equipment and facilities needed in each of the four districts for the fabrication, delivery, and repair of the portable sprinkle systems and valves. These facilities should be simple and be only the minimum facilities needed to carry out the work at hand and provide the farmers with repair and maintenance services.
3. Send a technician to help set up the pipe fabrication operation and advise on the mechanical aspects of the training programs for farmers and pipe riders (3 to 6 months).

Combining Training and Research

The Water Management Technology training and research programs should be combined under one unit (and contract). This is especially necessary for the general water management aspects and the special crop packages.

To develop the training program, research findings are needed. Where research has not yet been conducted, the training program must

use expert judgment to develop the water management programs and crop packages. This is precisely the same input needed to design the research experiments, that is, the testing and improvement of the best packages.

Research and training should be combined at the same facilities. Special demonstrations or training farms are not necessary. However, it is important that the quality of the facilities and activities at the research-training sites be stressed so the limited financial and people resources are not dissipated.

Further Study

The time available was not sufficient to get thoroughly acquainted with the Jordan Valley and farming community. It is hoped that whoever takes on the task of developing the final training-research program would spend at least a month of diligent effort talking with farmers and learning their characteristics and problems before proceeding.

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TRAINING PROGRAM

For the successful implementation and operation of the projects a comprehensive training program should include the following:

1. Fabrication, maintenance, and repair of portable sprinkler systems and special flow controls and watering devices.
2. Mechanical operation of sprinkler laterals and on-farm maintenance and repair.
3. Basic water management.
   (a) for water manager and pipe (ditch) riders,
   (b) for farmers.
4. Basic sprinkle irrigation farming practices.
5. Advanced water management
6. Advanced irrigation farming - crop by crop.
7. Advanced irrigation design and operation: trickle, gated pipe, alternate sprinkle layouts, salinity control, cooling, and hosefed sprinklers.

The most immediate needs are the first four items on the list. A separation between engineering and agricultural training responsibility exists. Engineering traditionally involves items 1,2,3,5, and 7 on the list and agriculture is concerned primarily with 4 and 6. For the most part, the engineering tasks are not site specific but the agricultural tasks are.

In addition to training farmers, it is most important that similar training be given to the general staff which includes the Training Instructors, Extension Agents, Cooperative Managers, and NRA staff. They technicians should not only go through the farmer training programs, but also receive some additional background instruction. This is important s they can assist the farmers who still have questions or are in need of additional instruction. By taking advantage of and using the farmer

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training programs for much of the general staff's training program, considerable time and money can be saved.

Fabrication, Maintenance and Repair Module (1)

Fabrication, maintenance and repair is part of the training program the supplier is best equipped to handle. If detailed manuals are provided as earlier recommended, this can be translated into Arabic and become the basis for this part of the program.

The technician provided by the supplier should be capable of setting up the fabrication procedures and supervising the initial fabrication operations. He can also give hands-on training (in conjunction with a JVC counterpart) to the fabrication, delivery, and repair-maintenance personnel.

The scope and design of this phase should be under the leadership of the Water Management Technology training Core Staff.

Mechanical Operation of On-Farm Equipment Module (2)

The Extension Agents, Co-ops managers, pipe riders, and managers, as well as the farmers, should be at least knowledgeable of the skills involved. These skills are rather simple, but they should be understood in terms of "why" as well as "how."

The first task will be to train approximately 1000 farmers between September and November 1977 in the basic operational skills for moving, maintaining and managing their sprinkler lateral lines. Half of the farmers will be settling the Zarqa Triangle District, and the other half will be settling a portion of the East Ghor District.

The training team approach suggested is to have a training manager with three assistants (assistants can be selected from local farmers) assigned to each district (2 teams). Each training team should be able to handle 18 farmers per day.

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First the training managers will present some general material including basic water management concepts and basic practices for sprinkling individual crops to the entire group of 18 farmers. After the general instruction (which may or may not use films or films strips), the farmers should be divided into six-man crews for sessions using "hands-on" individual demonstration instruction. Each crew of six farmers should be instructed by an assistant trainer, and the assistant trainer should have the back-up support of the training manager when necessary.

With such a program, two training teams could each handle 500 farmers in a two month period. In addition, some back-up training and assistance for basic water management and crop irrigation practices should be available from the Extension Agents.

The two training team leaders should be young, interested professionals who have the ability to instruct other parts of the training program. The text and materials which they use should be organized, developed, and field tested by a central training coordination staff. This Core Staff should include engineering, agriculture, and extension methods and be assisted by expatriate experts.

Training-Demonstration Farms

Farmer training should not begin until the project is close to operation and the sprinkler pipe is on hand. The equipment training sites can be ordinary farms centrally located in the districts which are to be settled. These sites can be temporary since the main activities will be in the field using sprinkler laterals that will be left for the farming operation.

Once this initial stage of the farmer training program has been completed, further field training can be carried out in "a corner" set aside at each of the anticipated (four) agricultural experiment stations. This will conserve human and financial resources.

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There is an alternate to government controlled and operated training-demonstration farms. That is to single out a few of the more receptive (and better) farmers in each district, giving these farmers extra assistance in setting up and managing the more desirable practices. By doing this, most benefits of local demonstration farms can be achieved with less expense and manpower. There is good reason to believe that this scheme is workable since much of the present agriculatural technology transfer system is already from farmer to farmer. Furthermore, there are obviously some innovative and good farmer-managers already in the valley and it will be difficult to outclass these excellent farms. In addition, such farmer-managers represent valuable human resources which should not be overlooked.

The training areas set aside at the four research stations should be adequate for any special field demonstration which might be required. The Der Alla and University Stations are suggested sites since they have lecture halls, food, and living accommodations. It will be less expensive to transport the farmers to the facilities having the multipurpose use of research, training, and demonstration rather than to duplicate training facilities elsewhere.

Basic Water Management Module (3)

The sprinkler systems are generally the same for each crop mix throughout each district. By taking advantage of this, it will be practical to instruct farmers on how to manage irrigation without going into abstract detail.

A very simple water management program would include giving the farmers a weekly estimate of the number of hours of sprinkling required to off-set the previous week's water use. This estimate could be given for a few reference crops, Then the only instruction needed would be to tell farmers how to modify this in accordance with their own crops and stages of development. For example, when looking down at the crop (and weeds) the ground is only 50% shaded, then only 50% of the sprinkle time

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given for the associated reference crop should be used. The important reference crops might be alfalfa, citrus, vegetables, bananas, and small grains.

Instructing farmers how to utilize the above budget scheduling can be done with an audio film strip and some slides. After the film strip and a discussion lead by the training instructor, the farmers should be divided into groups of six and look at a series of still pictures (slides in a teaching machine) of eye level plan and side views of the crops of interest at various growth stages. An assistant trainer should work with each small group of farmers. Each farmer should be asked to judge the proper sprinkler set time for each case after being given the series of reference crop set times. Thus, each farmer will obtain "direct experience" in judging required irrigation set times for himself. Actually, a simple test could be given to "graduate" each farmer. This portion of the program should take approximately one-half day. (However, trial runs should be made during the technician training sessions to determine the time required.)

Some research would be useful for perfecting the reference crop set time estimate. However, this is not essential since equations and/or equipment are available giving predictions within ± 10% accuracy. This is possible since water use estimating techniques are transferable (not site-specific) and only require a little on-site tuning.

At the beginning the estimates can (and should) be made on the high conservative side. The scheduling program can be fine tuned at the research stations with little expense. Prof. Max Jensen is an outstanding expert in this area and plans to work at perfecting a practical approach for estimating weekly sprinkler set times for the reference crops.

Providing the farmers with the reference crop set time (perhaps through the extension agents and pipe riders) is a normal engineering function in the U. S. For example, the USBR provides an Irrigation Management Service (IMS) in Bureau projects.

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Advanced Water Management Modules (5)

In addition to learning how to budget irrigation set times, farmers should also be instructed how to check soil moisture. The simplest way is by digging a hole and feeling the soil wetness to make certain the scheduling is on target. Instructions can begin with a film strip and discussion. Following this presentation, groups of six farmers accompanied by an assistant instructor, should go in the field and be instructed on how to "feel for moisture" and how the moisture changes with depth. It is important that the farmers learn how to estimate the moisture in soils which are identical to their own. Therefore, the field portion of the soil moisture estimation training program may need to be conducted at neighboring farms. This portion of the study should take about one-half day at a central training station, plus another hour with each farmer in his own field. Here again it is important that the technicians such as Pipe Riders and Extension Agents go through the same training program as the farmers. They should also have added instruction so they can follow through and help the farmers as needed.

Other methods for estimating the soil moisture status include tensiometers and gypsum blocks. Tensiometers probably provide the best means for determining when to start and stop irrigating growing crops under plastic. They are also useful for monitoring the irrigation of sprinkle irrigated crops. Eventually a film strip plus hands-on field demonstrations should be developed for instructing farmers in the use and maintenance of tensiometers.

Other items to include in advanced water management are: soil-plant-water relations, rooting depths, soil moisture holding capacity, irrigating at a faster or slower interval than once per week, etc. The extension specialists and supervisory personnel should have short courses in all pertinent aspects of on-farm water management; however, probably for the present, only a few farmers will be interested in this level of rather abstract knowledge. Therefore, except for the feel and tensiometer

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methods of soil moisture monitoring, the advanced water management programs can be carried in a traditional classroom-lecture fashion.

The timing of irrigation is not too great a problem since the systems are designed for once per week applications. As the farmers become more sophisticated, they will no doubt want to alter the weekly applications (perhaps in new seedings they are already accustomed to more frequent applications). This requires a more fundamental knowledge of the irrigation process or a more complex scheduling strategy than the simple sprinkler set time strategy. It will require additional training programs which need not be dealt with at present.

Advanced Irrigation System Design (6)

Only a few technical specialists on the project will need training in this area at present. Such training can best be gained through formal professional agricultural engineering programs, field trips, and follow-up seminars.

As the farmers themselves become better developed and qualified, they may begin modifying their system and utilizing other irrigation techniques (such as trickle irrigation). When this begins to happen, the Extension Agents and more innovative farmers and suppliers will need (and hopefully desire) instruction in irrigation system design fundamentals. This can be done in a two or three day short course held at the research stations.

Basic Sprinkle Irrigated Crop Management Modules (4)

The basic crop management training program should concentrate on instructing the farmers in the changes in irrigation practices required (or advisable if any) for sprinkling as compared to surface irrigation. This will be the best instruction since most of them will already have had some surface irrigation experience.

The "best production packages" for each of the important crops should be worked out using expert judgment. Super-expert judgment is essential for critical crops such as tomatoes, cucumbers, and squash as has already been discussed. These packages should then be modified to fit the farmers. The training committee should separate out the portions of each crop package which differ from current surface irrigation practices and make this material the heart of the crop management training program.

Each crop package will require a special training program, consisting of a film strip followed by a discussion and a hands-on demonstration. Hands-on demonstrations might include planting seed, planting sets, spraying, etc. (Extension Agents will be needed to carry the initial burden of advising on pest controls practices as the need arises.) Each crop training package will take from one quarter to one full day depending on the crop. Besides the hands-on demonstrations, a field trip or visit to plots in the experiment farm may be in order.

The essential task of the basic crop management training is to get the farmers started with safe and reasonably productive techniques for their sprinkle irrigation systems.

Advanced Crop Management (6)

The advanced crop management portion of the training will be a endless program for both the Extension Agents and the farmers. Hopefully, the farmers will strive to overcome each new production problem. Advanced crop management training can be carried out by special crop field days and short courses.

The farmers and farms selected for demonstration farms can be used in an informal way. In fact this will happen naturally. The same thing will happen on the research farms. Interested farmers can drop by to see what is going on. Perhaps a periodic busing schedule should be set up so farmers throughout the valley have better access to visits to the

research farms. In addition, certain research experiments can be carried out in a manner which will increase visual appeal and impact of research. For example, "line-source" sprinkler plots with a fertility variable across the rows give a dramatic three-dimensional crop development profile. Such plots are not only powerful research tools, but also show the Extension Agents and farmers the interacting effects of water and fertility. At any rate there are several innovative approaches to interest the Jordan Valley farmers in advanced irrigated crop management practices.

GENERAL TRAINING CONSIDERATIONS

The outline and text for each basic training program should be developed by experts. The actual training program modules should be completely designed and tested by a Core Staff made up of high-level Jordanian professionals and consultants. The instructors should be well-versed in delivering the text and given adequate background to understand the important elements of each text.

Technical Staff Training

All of the general staff of professionals and technicians (Training Instructors, Extension Agents, Cooperative Managers, and NRA staff) involved in the project should be well acquainted with the training materials and should be given intensive instruction for use of these materials. This is needed to supplement their professional training and focus on the particular training needs of the project.

To achieve the above (and also test the training programs) the professional and technical project personnel should be given the same hands-on training modules which will be given to the farmers and service personnel. In addition, each one of the training modules should be expanded (about doubled in time) by lectures. These added lectures can be presented by the core staff and should cover the background materials used in developing each training module.

It is neither necessary nor particularly desirable to have the typical 4 to 10 weeks "Short Course On General Water Management" for the entire professional and technical staff. This can be expensive, inefficient, and counter-productive. Having the entire professional and technical staff take each training module (with the added background lectures) as they are developed for presentation will be more effective. This will be less expense and considerably less disruption to their on-going work activities.

The training modules should first be presented to the Training Instructors by the Core Staff. (By presenting the modules, the Core Staff can test the modules one at a time and modify them as needed.) In addition,

the Training Instructors should be given an expanded version of the added lextures covering the background materials as discussed earlier, plus further instruction in how to best present the modules.

The Training Instructors should then present the modules to the other professional and technical staff members. This should be done in several sessions, keeping the size of the groups the same and using hands-on techniques. In this way the Training Instructors can learn to work as a team and the Core Staff can test and further improve the training modules. Furthermore, the staff can work their schedules around the program and have several optimal dates to participate. However, to save the Core Staff's time, the background lectures should only be presented one or two times, in addition to the special presentations to the Training Instructors.

The above program will accomplish several goals simultaneously. For example, it will:

(1) Be relatively inexpensive, but should be to the point and highly informative;

(2) Provide an opportunity to test the training modules;

(3) Be relatively convenient for the professional and technical staff to participate; and

(4) Provide experience in practice teaching for the Instructors

Additional Training

At the beginning, the project needs must be served by the existing expertise in Jordan plus supplemental expatricate consultants. This should be easy since Jordan has a history of development effort and a considerable number of well-educated professionals in the soil - plant - water - irrigation areas. Some expert training is recommended to upgrade the technical level of the general staff, however, this is not essential as part of the initial program. Certain members of the management and professional staff should have the opportunity to participate in short courses and field trips to upgrade their technical knowledge and skills. Special courses need not be set up for the Jordan Valley Irrigation Extension Sprinkle Project, because advantage should be taken of existing and potential training opportunities.

Some possibilities for upgrading the general staff might be to

select promising professionals and:

(1) Give four to six fellowships to specific graduate training programs in the U.S.;

(2) Have one to three professionals spend time working with selected crops on irrigation research stations in the U.S.;

(3) Have two to four work projects in the U.S. and Europe. This work should include on-farm as well as project level activities; and

(4) Have four to six spend a few days at each of several sprinkle irrigated project areas and research stations in the U.S. and/or Europe.

INCIDENCE AND CONTROL OF DISEASES OF TOMATOES, CUCURBITS, EGGPLANT AND PEPPERS UNDER SPRINKLER IRRIGATION IN THE JORDAN VALLEY

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INTRODUCTION

The Jordan Valley is attractive for production of vine crops because it is possible to produce the warm season crops during the winter when the only effective means of production in most other areas is in heated greenhouses. This winter production provides a year round supply of fresh vegetables for Jordan as well as potential for a profitable export market to the oil-rich countries and Europe. The weather conditions which exist in the Jordan Valley during the months of December, January and February are far from ideal for the production of tomatoes, cucumbers and other vine crops. The temperatures are lower and the humidity higher than the optimums for these crops. However, with careful management it is possible to produce good yields of high quality vegetables in the Valley during the winter months.

Tomatoes and other vine crops are susceptible to a wide range of fungal and bacterial diseases and production of these crops is best under conditions of low humidity. The long term, average relative humidity in the Valley during December, January, February and March is between 60 to 65 percent and there are a number of days during these months when the relative humidity is above 75 percent. Under the conditions which exist in the Jordan Valley during these months, fungal diseases have, occasionally, been serious problems.

Sprinkler irrigation will increase the frequency and severity of diseases that are promoted by high humidity and free water. Only experience and research will define whether or not the

increased incidence of diseases likely to result from sprinkler irrigation can be effectively controlled with proper management procedures. The introduction of improved application techniques and the most effective control compounds will improve chances of controlling the diseases.

Dr. Jack Keller's report on the Farmer Training Program, which pointed out concerns of Jordan Valley farmers about the effects of sprinkler on disease problems, prompted belated efforts to appraise the effects of sprinklers on tomatoes and other vine crops and to recommend control measures.

GENERAL OBSERVATIONS

Production of vine crops is difficult with sprinkler irrigation, particularly when temperatures are relatively low and humidity is high. The importance of these crops in the Jordan Valley dictates that serious consideration be given to widespread use of drip irrigation for their production. Drip irrigation combines the advantages of water use economy with no promotion of disease problems caused by free water on the foliage and increased humidity. The technological problem associated with widespread use of drip irrigation may be easier to overcome than the increased disease problems associated with sprinkler irrigation. Drip irrigation is being used very successfully on large areas under conditions of highly saline water and saline alkali soil. Problems of clogging by simple cell organisms and salt can be solved.

My contacts with professional members of the Ministry of Agriculture and Faculty of Agriculture indicates that they are well aware of potential problems from sprinkler irrigation.

The professional plant protection people indicated an opposition to immediate, widespread use of sprinklers on tomatoes and other vine crops, primarily because of the likelihood of increased problems with the blight diseases.

The only way to precisely determine the effects of sprinkler irrigation on the prevalence of disease is research in the Valley. However, there can be little question that sprinkler irrigation will increase the incidence and severity of those diseases that have been problems in the past during periods of extended rainfall.

There are two serious questions regarding the control of disease under a sprinkler irrigation regime. These are economic and technological. The effectiveness of a control program will depend to a large extent on application methods, timeliness of applications and efficacy of the compounds used.

The application of fungicides and pesticides in the Jordan Valley at present is not effective. Mostly the spray is put on with low pressure hand-pump back-packs and it is usually applied only on the upper surface of the leaves. Coverage of the foliage must be complete for effective control. The compounds now being used are generally not the most effective ones available.

The serious prevalance of powdery mildew is a good example of ineffective disease control. This disease can be controlled with effective application of the proper fungicide, but the frequent improper application of less effective compounds by Jordan Valley growers is not controlling the disease.

There appears to be lack of effective extension method in the Valley. The growers are relying on chemical company representatives for information on chemicals to be used for insect,

weed and disease control. Plant protection people from the Ministry and Faculty told me that they had tested compounds which are more effective than those currently being used but there is a lack of dissemination of new information to the growers.

The second important question relative to the feasibility of an intensive spray program is economics. If disease problems become serious frequent applications of control compounds will be essential. This will be expensive and unless production is good the costs will be prohibitive. An extreme example is the tomato yellow leaf curl virus disease problem, until this disease is controlled it is questionable that an intensive spray program will be economically feasible. Proper management of the virus coupled with effective application methods of efficient fungicides will contribute to profitable production of tomatoes.

The most serious threat to profitable tomato production in the Jordan Valley is the yellow leaf curl virus. Every field we observed was seriously affected with this disease. The earlier plantings, September and October, were essentially 100% affected and yields were severely reduced. I was told that the plantings remaining were the ones which had less serious problems with the disease. The more seriously affected fields had been plowed under by the growers. This disease is being managed elsewhere and it should be possible to triple average tomato yields with partial control of this disease. The economic success of production of tomatoes with any irrigation system will be based on management of this disease. Tomatoes will not be a profitable crop under any condition until this disease is managed.

Management techniques are discussed in the disease control section of this report.

Training on disease control should be an integral part of the education process. Perhaps effective application techniques and equipment and information on better compounds for control of important diseases could be integrated into the training program on sprinkler irrigation.

If this is not possible an intensive effort must be made to assure that the information gets to the farmers. This will not be easy as one is left with a clear impression that the information pipeline between the research people and the farmers does not function adequately.

DISEASES OF VINE CROPS

This section contains a very brief description of the major disease problems of tomatoes, cucurbits, eggplants and peppers in the Jordan Valley. Since temperature and humidity are major limitations for production of these crops in the Valley, particularly with sprinkler irrigation, the temperature and moisture responses of these diseases have been stressed here.

FUNGUS DISEASES

LATE BLIGHT (*Phytophthora infestans*) (tomato). This disease can be breath taking in its destructiveness and the quickness with which it will destroy a crop. Enough fog, mist or rain to keep the air saturated with water for about 15 hours permits this pathogen to reproduce. Temperature is very important for production of late blight. Cool nights and reasonably warm days

97

prove ideal. Infection will be greatest at 20 to 21°. The conditions which exist in the Valley during January and February with sprinkler irrigation will be ideal for epidemics of late blight.

EARLY BLIGHT (Alternaria solani) (tomato). This disease has been a serious problem, at times, on tomatoes in the Valley. It is a weak pathogen, as a consequence, its effect is greatly influenced by the vigor of the crop. Any cultural or disease problem which reduces the vigor of the crop makes it more susceptible to this disease. The wide spread occurence of the yellow leaf curl virus can contribute to the frequency and severity of this disease. This disease is usually more severe on older plants but it can also be serious on young plants if their condition is not good. Any reasonable amount of moisture, such as prolonged dews, is sufficient to keep this fungus reproducing. It requires rains for more than a day however for infection of epidemic proportion. The spores of this fungus germinate over a wide temperature range but actual penetration of mycelium into the tomato does not occur much below 15° or above 32°, the optimum is 25 to 30°. Sprinkler irrigation will increase problems with this disease.

SCLEROTINIA (Sclerotinia sclerotiorum) (cucurbits, eggplant, peppers, tomatoes). This disease is currently a serious problem in the Jordan Valley. It was particularly severe on eggplants. This fungus requires abundant moisture thriving best where there are continuous rains or fogs or under sprinkler irrigation. Sclerotinia is a very low temperature organism being able to

cause infection from 0 to 28°. The optimum for infection is between 15 and 21°. This disease could be particularly serious in the valley on sprinkler irrigated crops. The added hours of wetness which are going to result from sprinkler irrigation may be enough to make the difference between a mild infection and an epidemic. The major problem with sclerotinia is a lack of effective control measures for the disease. In general it has been recommended that if possible sprinkler irrigation be avoided where this disease is a problem.

POWDERY MILDEW (Sphaerotheca fuliginea) (cucurbits)
This fungus is a serious problem in the Valley at the present time and this likely occurs because it can reproduce under fairly dry conditions. Infection occasionally taking place when the relative humidity is as low as 46%, however infection increases as humidity increases, but there is none when actual water films or drops cover the leaf. The optimum temperature for this fungus is about 27 to 28°.

POWDERY MILDEW (Oidiopsis taurica) (eggplant, pepper, tomato).
Temperatures during the growing season in the Jordan Valley are usually within the required range for development of this pathogen. This disease can be a problem over a wide range of humidity conditions. The succeptibility of the crops to this disease changes as the plant matures. Young plants are usually much less affected than mature plants, which tend to be highly susceptible to powdery mildew attack.

This disease is very prevalent in the Jordan Valley and it appeared that presently used control measures were not effective.

Virtually every eggplant field observed was seriously affected. Sprinkler irrigation probably will not increase problems with this fungus.

DOWNEY MILDEW (Pseudoperonspora cubensis) (cucurbits). This disease can seriously affect cucumbers and muskmelons. It is usually less severe on squash and it rarely affects watermelon. Most fungi of this group require cool weather for reproduction, but this is not the case with this pathogen. It causes infection in the wide range of 10 to 30° with an optimum at 15 to 22°. It requires weather so that the leaf tissues have free water for at least short periods. The severity of this disease will probably increase under sprinkler irrigation.

FUSARIUM WILT (Fusarium oxysporum) (cucumber and tomato). The strains of Fusarium that affect these two crops are different. It can be a serious disease on both of these crops but it is particularly devastating to tomatoes. Fusarium is a soil borne organism which lives from season to season in the soil. Damage which occurs to the roots of seedlings during transplanting is sufficient to allow this organism to infect the plant and it slowly progresses through the conductive tissue to all parts of the plant. This disease causes more serious problems at higher temperatures. It causes little infection below 18° and is most virulent between 25 and 31°. Fusarium is now so wide spread that control measures such as seed bed sterilation, crop rotation and other cultural practices are of little value. The best means of controlling this disease is planting resistant varieties. Solar heating with plastic mulch also appears promising.

VERTICILLIUM WILT (Verticillium dahliae) (tomato and eggplant) This wilt disease is a serious problem on tomatoes and eggplants. It is very common in the Jordan Valley and can be very damaging to these crops. The optimum temperature for growth of this pathogen is about 24° but it can be a problem from 13 to 30°. There are tomato varieties which are resistant to this disease but eggplant varieties with resistance have not yet been developed. Sprinkler irrigation will have no effect on the prevalence of this disease.

GREY LEAF SPOT (Stemphylium solani) (tomato). This disease is favored by hot wet weather and is more prevelent on plants which are weakened by poor cultural practices, other disease or by a heavy fruit load and fertilizer depleted soil. Although this fungus causes infection from 15 to 32°, the optimum is 25 to 28° This disease is more apt to be a serious problem later in the spring and it will probably be increased with sprinkler irrigation.

ALTERNARIA BLIGHT (Alternaria cucumerina) (melons). This disease rarely infects young, vigorously growing plants. If a crop has been weakened in any way then great losses may result. Even well grown plants, when they bear heavily, become weakened as harvest progresses and then become extremely susceptible to infection. This disease can be a problem over an extremely wide temperature range, but temperatures for infection are mostly between 15 and 32°. It is not likely that the frequency or severity of this disease will be increased by sprinkler irrigation.

BACTERIAL DISEASES

BACTERIAL CANKER (Corynebacterium michiganense) (tomato). This bacteria is frequently carried on and in the seed. It can live from one season to the next on diseased tomato refuse. The fertilizer, moisture, temperature conditions that are optimum for tomato growth also appear to be optimum for bacterial canker development. Infection is caused most readily at 2[illegible] to 27° and the pathogen is reduced in virulence rapidly as the temperatures go below 10° or above 32°. In general the pathogen does most damage when the temperatures range between 20 to 25°. In most areas sprinkler irrigation has increased the severity and frequency of this disease and it can be presumed that the same will occur in the Jordan Valley.

LEAF SPOT (Xanthomonas vesicatoria) (pepper and tomato). This bacterial disease requires moisture and a fairly high temperature for maximum infection. After a heavy rain or sprinkler irrigation when plants are gorged with water the disease becomes more prominant. Infection takes place under a wide range of temperatures from about 15 to 35°. The optimum is between 25 and 30°. When summer temperatures are above 37° for several days the bacterium is killed.

BACTERIAL SPECK (Pseudomonas tomato) (tomato). This organism causes infection when the tissues have been filled with water and the temperature range from 15 to 32°. The optimum is 20 to 25°. This disease will be a more serious problem with sprinkler irrigation.

OTHER PROBLEMS

TOMATO YELLOW LEAF CURL VIRUS (TYLCV). This disease is currently the most serious threat to profitable tomato production in the Jordan Valley. This disease has been a problem in the valley for many years. TYLCV is transmitted by the white fly (Bemisia tabaci) and is a serious threat because alternate hosts are available when tomatoes are not being produced. There has been considerable research on this disease, including widespread searches for natural resistance. It has been reported that LA121 (Lycopersicon pimpinellifolium) has natural resistance to this disease, but this resistance has not yet been transfered to commercial varieties. There are now efforts to transfer resistance from L. peruvianum. This will be a difficult long-term effort and the tomato industry in the Valley cannot wait for possible success in a breeding program.

Efforts with this disease should concentrate on cultural practices which minimize the impact of the disease. The prevalence of this disease coincides with the size of the Bemisia population. Tomatoes planted in the fall are severely infected but plantings made in December are much less affected. Sprinkler irrigation will not affect this disease except as it complicates control measures for the vector.

CRACKING OF TOMATO FRUITS. Cracking of fruits can be a serious problem with sprinkler irrigation. Cracking is only a problem in fruits which have started to ripen; green fruits usually do not crack. Fruit cracking will likely be a serious problem with the varieties currently being used. They are

generally very susceptible to cracking; they have an indeterminate growth habit and the fruit production occurs over a relatively long time period. To realize maximum production from these varieties it is necessary to irrigate them after the fruits begin to ripen. With sprinkler irrigation this will result in cracked fruits.

ROOT-KNOT NEMATODE (Meloidogyne species) (all vine crops). Nematode is a serious pest in the Jordan Valley. Temperature is extremely important to the effects of this organism. There is some pentration of plants at all temperatures between 10 and 35°, but the optimum temperature is about 27°. As a consequence this organism is a more serious pest during the spring months. The frequency and severity of damage caused by this organism will not be affected by sprinkler irrigation.

DISEASE CONTROL

This section contains recommendations for control of important diseases of vine crops in the Jordan Valley.

APPLICATION METHODS

The lack of effective application of pesticides and fungicides presently places serious limitations on insect and disease control in the Jordan Valley. The prevalent method of applying chemicals appeared to be hand-pump back-pack sprayers. The low and erratic nozzle pressure usually obtained with these sprayers makes good coverage very difficult. Good

coverage can be obtained but only with great care and usually with excessive use of chemical.

Motorized back-pack sprayers are available which are well suited to the small farms in the Valley. These units give high, consistent pressure at the nozzle and permit effective coverage of the plants coupled with efficient use of chemicals. The additional costs of the motorized sprayers will soon be repaid by more effective disease control and more efficient use of chemical.

The control of the added disease load likely to be caused by sprinkler irrigation is largely dependent on effective application of chemicals.

TOMATOES

Late blight, early blight, grey leaf spot, anthracnose.

Spray with

(1) Difolitan (4F) 500 ml/dunam applied weekly

or (2) Mancozeb (80% wettable powder) 350 g/dunam applied weekly

or (3) Bravo (7.2F) 200 to 400 ml/dunam applied weekly

or (4) Maneb (80% wettable powder) 220 to 350 g/dunam applied weekly

or (5) Antracol (70% wettable powder) 250 g/dunam applied weekly

Some varieties have resistance to grey leaf spot (Stemphyllium)

Bacterial spot, bacterial speck and bacterial canker.

Sow only hot-water treated seed (25 min. at 50°).

Grow seedings in soil fumigated with Vorlex or Mylone or 98% methyl bromide.

If disease becomes problem spray weekly with fixed copper at 250 to 375 g/dunam (Kocide, C.O.C.S., Copper-count-N, Tri-basic copper and other can be used).

Fusarium wilt, Verticillium wilt

Plant resistant varieties

Solar sterilize for soil pathogens.

MUSKMELONS, CUCUMBERS, WATERMELON, SQUASH

Downey mildew, Alternaria leaf blight

Spray with weekly or as needed

(1) Maneb (80% wettable powder), zinc ion maneb (80% wettable powder) or zineb (75% wettable powder) at 225 g/dunam.

or (2) Bravo (6F) 200 to 250 ml/dunam

or (3) Difolitan (4F) 1 liter/dunam

Powdery mildew

Spray with the following as soon as the disease appears at 12 to 14 day intervals.

(1) Morestan (25% wettable powder) at 80 g/dunam

or (2) Pyrazophos (30% wettable powder) apply 0.01 to 0.03% active ingredients.

or (3) Morocide (50% wettable powder) at 60 g/dunam

or (4) Bravo (W75) 375 g/dunam

or (5) Benlate (50% wettable powder) at 80 g/dunam

Annular leaf spot

Use resistant varieties

Spray with fixed copper fungicide at 150 to 225 g copper (active ingredient) per dunam, repeat at weekly intervals.

Fusarium wilt of muskmelon

Plant resistant varieties

Avoid heavily infested ground

Sclerotinia

Spray with

Benlate (50%) 80 g/dunam

Solar sterilization

EGGPLANT

Powdery mildew

Spray with

(1) Californian mixture 1 liter/dunam

or (2) Morestan (25% wettable powder) 20 to 70 g/dunam

or (3) Dust with sulfur (75% powder)

Verticillium wilt

Avoid heavily infested ground

Rotate with resistant crops

Solar sterilization

Soil fumigation (expensive)

PEPPER

Leaf Spot

Purchase and use only disease free seed.

Spray through flowering with fixed copper at 100 to 160 g/dunam

After fruit set, spray with

(1) Maneb (80% wettable powder) at 220 g/dunam

or (2) Zineb (75% wettable powder) at 220 g/dunam

Powdery mildew

See eggplant

SOLAR HEATING BY POLYETHYLENE MULCHING FOR CONTROL OF SOIL-BORNE DISEASES.

The Jordan Valley is an ideal location for using this technique to control soil borne diseases. In hot areas this procedure has proven extremely effective against Verticillium wilt, Fusarium wilt, nematodes and sclerotinia. These are all serious pests in the Valley and this procedure will probably be very beneficial.

The chief advantage of this procedure is that it is relatively inexpensive (compared to fumigation) and it is nonhazardous.

The procedure is as follows.

1. A drip system is laid on tilled soil.
2. The soil is mulched (covered) with transparent polythylene plastic sheets (0.03 mm).
3. Immediately after mulching the soil is irrigated and is kept wet by repeated irrigation at 3 to 6 day intervals. Good soil moisture is essential for the purpose of increasing thermal sensitivity of the resting structures

10%

of the organisms.

4. The mulch should be left in place for at least 2 to 3 weeks.

This procedure must be done during the hottest month as it kills soil organisms by raising the soil temperature. Excellent results have been obtained with a wide range of soil pathogens.

TOMATO YELLOW LEAF CURL VIRUS

At present it is not possible to control completely this devastating disease. Management is based on preventing infection of seedlings before they are transplanted and minimizing infection as long as possible after transplanting. If plants are permitted to gain considerable growth before becoming infected they will have the vigor to produce a good crop. The key to success is to eliminate the white flies from the tomatoes as long as possible.

Elimination of the vector is based on the use of yellow plastic or straw mulch to attract them away from the tomatoes and frequent sprays with insecticides.

Bemecia tabaci is strongly attracted to the color yellow and straw or yellow plastic are used to attract the insect and keep it away from the tomatoes. The procedure which appears to be working best at present is as follows.

1. Surround the nursery where the tomato seedlings are grown with a fence of yellow plastic. In some cases this fence is sprayed with a sticky compound to held the white flies.
2. Spray very frequently with insecticide. The present procedure is to spray every 2 to 3 days with a 0.5% of volume solution of 20% Guthion. Other chemicals, such

109

as Methamidiphos, have also been effective.

3. Plant only healthy vigorous seedlings to the field.
4. Plant seedlings into a straw mulch of about 20 cm pieces of straw or a yellow plastic mulch. The yellow plastic has been more successful.
5. Continue spraying every three days with a 1% of volume solution of 20% Guthion as long as possible to keep the white fly population down.

Using these procedures it has been possible to produce high yields (up to 8-9 tons/dunam) even on tomatoes planted in September and October.

FRUIT CRACKING OF TOMATOES

The preferred solution to fruit cracking problems is to use varieties which do not require irrigation after the fruits begin to ripen. A determinate variety with a more concentrated fruit set could produce maximum yields with little or no irrigation after the first fruits begin to ripen. These varieties would produce their crop over a shorter time period than the ones currently being used. If this shorter time span of production is undesirable it can be overcome by making more plantings. Generally the use of determinate varieties for unstaked tomato production has resulted in increased productivity of fruits of greater visual quality.

A second possibility for minimizing problems with fruit cracking is to use varieties which have crack resistance. There are a number of varieties that have good crack resistance. The following varieties should be tested under sprinkler irrigation.

110

Variety	Plant Habit	Disease Resistance
Campbell 1327	large determinate	VF
Campbell 17	determinate	VF
Calmart	determinate	VFN
Floradel	indeterminate	FSC
MH - 1	determinate	F(1&2)VSC
Heinz 1370	determinate	F
Heinz 1439	determinate	VF
Manapal	large indeterminate	FSC
Marglobe select	indeterminate	F
Walter	determinate	F(1&2) S

V - verticillium wilt
F - fusarium wilt
N - nematode
S - Stemphyllium
C - cladosporium

With proper management and varieties, the fruit cracking problem can be minimized or eliminated.

RESEARCH PROGRAM

The following research projects have the potential to contribute to profitable vegetable production in the Jordan Valley.

Tomato yellow leaf curl virus (TYLCV)

The current fundamental and practical research program on this problem should be intensified. The efforts of Dr. Khaled Makkouk of the Faculty of Agriculture should be supplemented with additional personnel and resources because of the severity of this disease. The best hope for short range control of this disease is the cultural practices which partially control the vector but there is a need for additional research on the vector and the virus.

Although I believe it holds little promise, screening efforts for natural resistance to this disease should continue. The heavy natural infestation which occurs, in the Valley, on tomatoes planted in September and October provide good conditions for screening populations of tomatoes for natural resistance. Intensive screening for resistance to this disease has already occurred at other locations and the scientist involved in this project should inform themselves of possible resistance found in these other programs.

Using the recommendations made in this report for management of TYLCV as a starting point efforts should be made to improve the cultural practices which will control this disease. Experiments using the technology recommended here should be done on growers fields to demonstrate to them the advantages of using the plastic mulch and intensive spray programs for control of Bemicia. Joint efforts by virologist and entomologist will probably result in the greatest progress in understanding and controlling this disease.

Varietal screening

Large numbers of new varieties have been tested on Experiment Stations in the Jordan Valley in the past. However, the prevalent tomato varieties currently being used in the valley are related to the Marmant which has been used for a long time period. There has been essentially no shift by growers in the Jordan Valley to newer varieties which will probably be more productive and will certainly be better suited to sprinkler irrigation. The desire for fruits of the Marmant type is very strong in the area, but experience elsewhere has shown that when newer varieties, which have different

fruit shapes and flavors, are produced these are soon accepted by the consuming public. A shift to new varieties which have firmer fruits and are better suited for shipping will result in improved returns for the growers and higher quality tomatoes for the consumer. Fruits of the Marmant type are not well suited for export because they become soft very rapidly after they are ripe and losses in transit are usually very great.

The lines which have been top preformers in previous variety trials in the Valley should be selected for experiments in growers fields. The only way that the farmers of the Jordan Valley are going to be convinced that new varieties should be grown is to see the preformance of those that are clearly superior. A sufficient data base already exists, from experiments done earlier, to provide the initial information needed to begin the introduction of new varieties into the Valley.

The current varietal screening program can be streamlined to permit more effective evaluation of new genotypes. The initial screening should simply eliminate varieties which are not adapted to the Valley. This initial screening need not be replicated at each location. Rather, large numbers of varieties should be evaluated in nonreplicated trails at several locations. Those that perform well in the initial screening are then advanced to replicated trails. The varieties which perform best in the replicated trials should be planted in plots in growers fields so that they will have an opportunity to observe them.

The screening program should concentrate on varieties which have multiple disease resistance. For example, large numbers of fresh market varieties now have resistance to Verticillium wilt,

race 1 and race 2 of Fusarium wilt, tobacco mosiac virus, nematodes and Stemphillium. The varieties which have resistance to these diseases should be given priority evaluation for possible use in the Valley.

Nematode resistant

Apparently there is essentially no use of nematode resistant tomato varieties in the Jordan Valley. It has not yet been determined with certainty that nematode resistant varieties developed elsewhere will be effective in the Valley, although there is every reason to believe that they will perform well there. An effort should be made to collect the full range of nematode resistant varieties now available in the United States and elsewhere. These should be tested in the Valley under conditions of high infestation. The efficiency of the solar sterilization procedure for control of nematodes should be tested.

Comparative studies of sprinkler and drip irrigation

Based on experience elsewhere there is every reason to believe that eventually drip irrigation will become more important than sprinkler irrigation for production of the vine crops in the Jordan Valley. Immediate comparative studies of the relative advantages of sprinkler and drip irrigation for production of tomatoes, cucurbits, eggplant and pepper should be undertaken. These studies should be designed to compare the following parameters.

1. Economics of production - A comparison of the costs of producing vine crops using the two irrigation methods.
2. Water use efficiency.
3. Disease control efficiency.
4. Productivity

114

Experience in other areas indicates that because of less disease problems and greater productivity drip irrigation is superior to sprinkler irrigation for production of vine crops. However, these questions can best be answered by research in the Jordan Valley. If drip irrigation is used how often will it be necessary to leach the soil with sprinkler irrigation or will this leaching process not be essential?

Testing of fungicides

It is crucial that immediate experiments be done on the efficacy of the various fungicides which are recommended in this report and new compounds continually becoming available for controlling the important diseases under sprinkler irrigation. All of the fungicides which are recommended here have been tested in other areas of the world and have been shown to be effective against the diseases, but testing of these chemicals must be done under the unique conditions which exist in the Jordan Valley. This is particularly important since the disease pressure from sprinkler irrigation is apt to be great. Here again, once initial screening of fungicides have been done at the Experiment Stations it is recommended that experimental plots be established in growers fields so that they will have an opportunity to observe application methods and the effectiveness of promising fungicides.

Frequency of irrigation studies

Experience has shown that generally when new land is put under irrigation for the first time there is excessive irrigation of the crops being produced. Experience has shown that it is possible to produce yields of high quality crops with much less water than

is normally being used by most growers. For example, excellent yields of tomatoes have been produced with only three irrigations. An initial irrigation to get the transplants established. A second irrigation at the time most of the plants are in bloom and a third irrigation at the time when the first fruits have reached full size. Reducing the number of irrigations will not only increase water use efficiency but will also reduce disease problems. Experiments should be undertaken to determine which irrigation practices give the best combination of yield, disease control and water use efficiency.

Solar heating by polyethylene mulching for control of soil-borne diseases.

Experiments should be done using this technique in the Jordan Valley. It's efficacy has been proven elsewhere but it is a relatively new procedure and should be tested immediately in the Valley.

Use of hormones to improve tomato fruit set

The temperatures which exist in the Jordan Valley during the winter months are not conducive to good fruit set in tomatoes. The yield of winter produced tomatoes in the Jordan Valley will probably be increased by using hormones to increase fruit set. Hormones are widely used in other winter tomato production areas.

A typical procedure would be as follows:

Spray once or twice with 4-CPA (para-chlorophenoxy acetic acid) at the 12 - 14 cluster stage of plant growth with 2 - 4 g/dunam of active material. This chemical stops plant growth and can have an adverse effect on fruit shape and quality if it is misused.

One of the effects of the tomato yellow leaf curl virus is to diminish fruit set. It is possible that this hormone will overcome this problem. The above procedure should be tested in the Valley and then promoted to the growers.

EXTENSION BULLETIN

A bulletin outlining the cultural practices that are most likely to succeed under sprinkler irrigation should be prepared in concert with experts from Jordan. If I work closely with people who are aware of disease, insect and cultural problems and of the potential of local growers to deal with these problems, the information will be more meaningful and more likely to benefit vegetable production in the Valley.

The areas that should be considered in the Extension Bulletin include.

- Soil preparation
  - Solar sterilization and fumigation for disease control
  - Pre-plant weed control
  - Seedbed preparation
- Fertilization practices
- Production of seedlings
- Planting
- Plant populations
- Cultivation
- Irrigation practices
- Insect control
- Disease control
- Harvesting

Preparation of a bulletin for the vine crops will be a sizeable undertaking, but if it is done correctly it could be of considerable value.

COPY

(Transmittal note from Dr. Fahd Natour, JVC Director of Irrigation, to Fuad Quashair, USAID Agriculture Division.)

Mr. Fuad Oushair

Dear Fuad:

Attached are two copies of a brief note on water rights, allocation and distribution as envisaged for the Sprinkler Irrigation Projects that are under construction now. This is in accordance with your request earlier for the paper on Water Management Technology/Training and Research.

Regards,

Fahd Natour

Water Rights, allocation and
Distribution in the sprinkler
Irrigation Projects of the
Jordan Valley

1. Water Rights

In Jordan, Water Rights belong to the state. Irrigable lands in the sprinkler projects will be given irrigation water on the bases of crop requirements and availability of supplies. Allocation and distribution of this water will be governed by the Jordan Valley Authority Law to be passed soon. A water ordinance will be enacted based on this law.

2. Water Distribution

Water will be distributed to farm units by the O. & M. Division of the Irrigation Department of the Jordan Valley Authority, in accordance with rules and regulations set by the Authority.

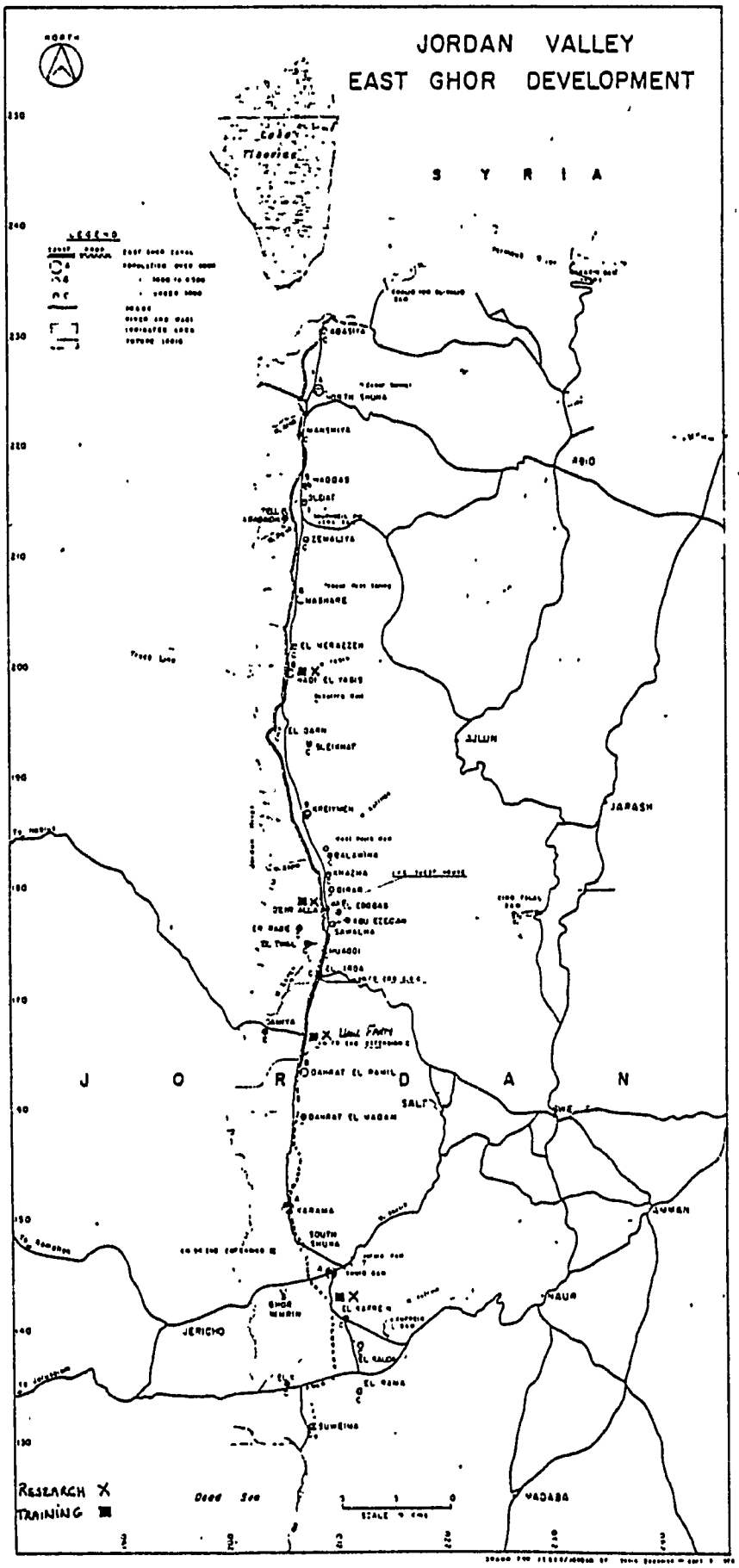
For purposes of seasonal planning the project farmers will be required to file with the O. & M. Division before the start of the season applications for water during the season indicating crops and areas they plan to have and volumes of water they request monthly during the coming season. Forecasts of demand and supply are made by the O. & M. Division and plans of operation are set. The farmers will be advised of the water situation according to these forecasts, and they are expected to plan their farming accordingly.

Farmers will receive water on a modified demand-rotation basis. They can get the water for up to 6 days a week, and at a discharge of up to 4 liters/second. Although they will have a fixed weekly rotation, they will be able

../2

to get the water for any time they desire within the 6 day total allowed for them. The O. & M. staff will be responsible for operating the valves up to and including the farm unit turnout, and the farmer will operate his sprinkler equipment withinthe farm unit.

Water delivered to each farm unit will be metered at the farm turnout and the Farmer will be charged for the volume of water he consumes at a rate that will be set by the JVA. Water charges are intended to cover the O. &. M. cost and an annual recovery of a certain percentage of the Capital Cost.


JORDAN VALLEY
EAST GHOR DEVELOPMENT
S Y R I A
J O R D A N
JERICHO
AMMAN
MADABA
Dead Sea
RESEARCH X
TRAINING

122

4. Scheduling Irrigation.

   When to irrigate
   how much water to apply
   rate of application
   Methods of scheduling irrigation

5. Irrigation efficiencies.

6. Water quality and soil salinity

   a) General
   b) in the Jordan Valley.

7. Drainage of Agricultural lands.

8. Methods of irrigation.

   Surface (Brief)

9. Sprinkler Irrigation. (Detailed)

   Adaptability
   System design
   System operation
   System maintenance

10. Sprinkler irrigation in the Jordan Valley.

    Design
    Operation and handling
    Equipment
    Maintenance, storage
    Spare parts and maintenance facilities
    How the farmers get their equipment
    Farmer training
    Working with farmers ontheir farms for
    the proper operation of the sprinkler systems.
    Where the trainees can go for further help on
    sprinkler irrigation.

11. Sprinkler irrigation of Major crops in the Valley.

12. Crop diseases under sprinklers - how to control them.

13. Sprinkler irrigation and the environment.

14. Fertilizer and chemical application with sprinkler systems.

../3

15. Irrigation efficiency evaluation under sprinkler Irrigation.

16. Evaluation of one farm costs of operation of sprinkler Irrigation.

17. The fixed pipe network in the Jordan Valley sprinkler irrigation projects (Brief)

    General description
    Design
    Types of pipes
    pressures
    fittings and valves
    measuring devices
    farm turnout structures

18. Operation of the Irrigation Systems.

    Rules and Regulations
    O. & M. Responsibilities
    Farmer responsibilities
    Operation procedures
    Maintenance of the system.
    Water charges.

A suggested list of specialists that could be approached to prepare and give parts of this course is the following:

1.	Prof. Max Jensen	Faculty of Agr.
2.	Dr. Othman Judeh	" "
3.	Dr. Fahd Natur	JVC
4.	Dr. Abdul Raouf Dakkak	JVC
5.	Mr. Mohammad Hanbali	JVC
6.	Mr. Ismail Matirah	NRA
7.	Mr. Ali Hammad	Dar Al-Handasah
8.	Mr. Khalil Khayat	NRA
9.	Dr. Nizar Sha'sha'a	Ministry of Agr.
10.	Dr. Yousof Rushdi	Faculty of Agr.
11.	Any other persons suggested by the Committee, the Ministry of Agriculture or the Faculty of Agriculture.	

بسم الله الرحمن الرحيم

المملكة الأردنية الهاشمية
المجلس القومي للتخطيط
عمان

THE HASHEMITE KINGDOM
OF JORDAN
NATIONAL PLANNING
COUNCIL
AMMAN
Tel. 44455 44470
P. O. B. 555
Teleg. NPC — Amman

JUN 20 1977

الهاتف : ٤٤٤٧٠ - ٤٤٤٥٥
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Other Action

RETURN TO USAID C&R

No. 105/3/2660
Date 19/6/1977

Mr. Christopher Russell,
Director,
USAID / Jordan,
American Embassy,
Amman.

Subject: Request for services under Technical services and feasibility studies Grant No. 278-12-995-181.

Dear Mr. Russell,

The Jordan Valley Authority is in need of the services of a qualified expert to assist the Jordan Valley Authority and Cooperating agencies in initiating a training program for technicians and farmers in the efficient use of sprinkler irrigation equipment.

Enclosed herewith, is a detailed description of the services to be performed by the expert.

I would appreciate it if you would take whatever steps are necessary to obtain the services of the required expert whose costs will be charged to the above project.

Sincerely yours

President

c.c. Jordan Valley Authority.

125

REQUEST FOR SERVICES UNDER TECHNICAL SERVICES AND FEASIBILITY STUDIES GRANT NO.278-12-995-181.

A. OBJECTIVES

The training program will be developed and technicians trained in September and October 1977. This will be followed by the training of up to 1,400 farmers (roughly the number of farmers to be in the Zarqa Triangle and East Ghor Canal Extension Project areas) during the period of November 1977 through January 1978 .

Three broad areas of training are to be covered in this program:

1. Basic mechanical operational skills on the use, maintenance, and repair of sprinkler lateral lines and other on-farm equipment.
2. Basic water management, covering equipment, water and soil relationships.
3. Basic agronomic/horticultural practices as affected by the use of sprinklers on a crop-by-crop basis.

Training will be practical, emphasizing the what and how, rather than why. Priority will be given to demonstrations and supervised practice. Visual aids will be used. Portable equipment for training purposes will be provided from that to be procured under the Sprinkler Equipment Loan.

B. TERMS OF REFERENCE

The expert will work as a member of a Core Staff of approximately five extension specialists within a Training Unit organized under Jordan Valley Authority auspices. The task of the Training Unit will be to prepare training and extension materials in sprinkler irrigation and to design and carry out training sessions and extension programs to get this information to farmers .

Primary contact with farmers will be made by specialized Teams of the Training Unit holding training sessions for farmers. This will be augmented by extension workers following up the work of the Teams in some combination of:

1. Helping the farmer install sprinkler equipment on his own farm and put it into operation.
2. Providing on-call trouble shooting assistance when demanded.
3. Making periodic visits to each farmer during the first few weeks in which sprinklers are being used.

It is intended that these training activities will lead into a longer term research and training program which will provide an on-going mechanism for continuously upgrading the skills of Jordan Valley farmers in modern irrigation techniques.

C. SCOPE OF WORK

As a member of the Core Staff, the expert will report to the Director of the Training Unit and his Deputy. His principal duties will be to:

1. Work with other members of the Core Staff in the design of training sessions for technicians and for farmers.
2. Collaborate with them in the preparation of training and extension materials related to water and horticultural crop management under sprinkler irrigation.
3. Carry out, with other members of the Core Staff, the training sessions for Training Teams and extension agents.
4. Assist the Director and his Deputy in managing the farmer training program, including field monitoring of the work of the Training Teams and extension agents.
5. Assist in liaison between the Training Unit and other agencies doing work relevant to the Mission of the Unit.

6. Prepare a report at the end of his assignment which, in substance, will be a critique of the training program carried out, pointing toward improvement in the design and execution of an on-going program.

Prior to his departure from the US, the expert will gather and review all available, relevant research and extension literature on the on-farm engineering and horticultural aspects of sprinkler and drip irrigation. He will arrange for its shipment to Jordan for use by the Training Unit. Its shipment will be timed so that its arrival in Jordan is no later than September 1,1977.
USAID is to be requested to contract for this service, using funds available in the Technical Services and Feasibility Studies Grant No. 278-12-995-131.
The duration of the expert's services is to be for a period not to exceed five months in Jordan plus up to one month's preparation time in the US. He is to arrive in Jordan on or about September 1,1977. Total costs are not to exceed $56,500, as given in the estimated budget, below.

1.	Consultant fee 154 days @ $160	$24,640
2.	Indefinite Quantity Contract Factor (if needed), 80%	19,712
3.	Travel and Transportation	1,800
4.	Per diem in Jordan, 153 days @ $62	9,486
5.	Per diem in US, 5 days @ $50	250
6.	Other direct costs	500
	Total	$ 56,388
	Rounded to	($ 56,500)

The Jordan Valley Authority will support this activity through the provision of interpreter services and in-country transportation. Technical staff support will be provided through the Training Unit. The Jordan Valley Authority requests USAID to provide the clerical services necessary for the preparation of the expert's report.

128

THRESHOLD DECISION BASED ON
NITIAL ENVIRONMENTAL EXAMINATION

Project Location: Jordan

Project Title: Water Management Technology

Funding (Fiscal Year and Amount): ($1000) FY77, $520; FY78, $390; FY79, $279; FY80, $88

IEE Prepared By: John D. Hyslop Date: 02/15/77

Environmental Action Recommended:
(Environmental Assessment, Negative Determination, etc.) Negative determination

Mission Decision:
(Approval/Disapproval of Environmental Action Recommended in the IEE)

APPROVED: [illegible]

DISAPPROVED: _____

DATE: 4/27/77

Clearances:
Environmental Coordinator: [illegible] Date: [illegible]
Other Mission Offices: [illegible] Date: 4/27/77

INITIAL ENVIRONMENT EXAMINATION
NARRATIVE DISCUSSION

1. Project Location: Jordan

2. Project Title: Water Management Technology

3. Funding (Fiscal Year and Amount): ($1000) FY77, $520; FY78, $390; FY79, $278; FY80, $28

4. IEE Prepared By: John D. Hyslop Date: 02/15/77

5. Action Recommended: Negative determination. Implementation of the project is consistent with good practice in environmental management.

6. Discussion of Major Environmental Relationships of Project Relevant to Attached Impact Identification and Evaluation Form:

Sprinkler and other improved techniques of irrigation are being introduced into the agriculture of the Jordan Valley. The area to come under sprinkler irrigation during 1977-79 is approximately 9,300 hectares, of which 6400 ha. are not now irrigated and 2900 ha. are irrigated using surface methods. Because of their potential for more efficient water application, they will contribute both to an expansion of the irrigated area in the Valley and to an extension of the irrigation season into the summer on land now irrigated by surface methods.

The purpose of this project is to minimize the sub-optimal use of the new techniques by assisting the Government of Jordan in

1. Applied research aimed at adapting and/or developing water management and cropping practice technologies appropriate to the new methods, and
2. Training activities in order that they be adopted by farmers.

Intended results of the project include

1. Greater water use efficiency;
2. Increased crop yields;
3. Reducing soil erosion by minimizing the extent of land leveling and other soil disturbing practices required for efficient surface irrigation;
4. Reducing the incidence of plant diseases, weeds, and other crop pests; and
5. Reducing the incidence of soil salinization.

(Continued on attached sheets)

An effect of this project will be to minimize the environmental effects of the new irrigation practices being introduced in the Valley.

The draft memorandum of July 6, 1976 from the Environmental Working Group Subcommittee on IEE Guidelines indicates that research and training projects do not ordinarily have significant effects on the environment if the training is "not designed to result in activities directly affecting the environment" and if research is "controlled experimentation exclusively for the purpose of research which is confined to small areas and carefully monitored".

The research elements of this project fall into this category, even though some of the experiments will be carried out on farmers' fields. Research results, however, will be fed into farmer training programs intended to induce behaviour having potential environmental effects. It is these "secondary" effects which were considered in preparing the IEE form.

The following annotations should be examined in conjunction with the form:

A. LAND USE

1. Changing the character of the land through:

d. Changing soil character: A moderate impact is expected. On presently irrigated land, the need for land leveling and soil disturbing actions to direct the flow of irrigation water is eliminated with sprinkler irrigation. On land not now irrigated, cereal crops, often in rotation with fallow, and grazing of sparse and indifferent quality vegetation will be replaced with year-around vegetable and forage production. An increase in soil disturbance through more frequent tillage is to be expected.

Irrigation water to be used is of moderate salinity and some salt build-up in the soil can be expected if precautions are not taken. The Jordan Valley Commission is receiving technical assistance on solutions to present and potential drainage problems in the Valley. Adequate drainage can alleviate soil salinity with periodic over-irrigations.

B. WATER QUALITY

2. Chemical and biological states:

Some increase in the level of pollution in groundwater from agricultural chemical can be expected as the intensity of agricultural production on land not now irrigated increases. Subsurface drainage will flow into the Jordan River whose water is already too saline for irrigation or domestic purposes.

C. ATMOSPHERIC

1. Air additives:

Some of the research will involve the application of agricultural chemicals through the sprinkler system, a practice which some farmers may adopt.

F. SOCIOECONOMIC

1. Changes in economic/employment patterns:

Greater intensity of crop production in the Valley will have a significant impact on the earnings of farmers there.

I. OTHER POSSIBLE IMPACTS

1. Microclimatic effects:

The use of sprinklers will raise the humidity and lower slightly the air temperature. This, along with greater cropping intensity, will encourage insect populations and plant diseases. The research and training activities of this project are intended to develop and/or adapt corrective management practices and impart them to farmers. The results may be some restrictions on farmers' choice of crops and farming methods, but there is no evidence that these would unduly constrain agricultural development in the area.

On the other hand, failure to carry out the research and training activities may result in crop pest problems so serious as to severely retard development.

2. Visual:

A high visual impact is expected as the grays and browns of the non-irrigated or seasonally irrigated areas are changed to the green of year-round cropping.

IMPACT IDENTIFICATION AND EVALUATION FORM

Impact Areas and Sub-areas	Impact Identification and Evaluation 1/
A. LAND USE	
1. Changing the character of the land through:	
a. Increasing the population	N
b. Extracting natural resources	N
c. Land clearing	N
d. Changing soil character	M
2. Altering natural defenses	N
3. Foreclosing important uses	N
4. Jeopardizing man or his works	N
5. Other factors	N
B. WATER QUALITY	
1. Physical state of water	N
2. Chemical and biological states	M
3. Ecological balance	N
4. Other factors	N

1/ N - NO environmental impact
L - LITTLE environmental impact
M - MODERATE environmental impact
H - HIGH environmental impact
U - UNKNOWN environmental impact

IMPACT IDENTIFICATION AND EVALUATION FORM

C. ATMOSPHERIC

1. Air additives	L
2. Air pollution	N
3. Noise pollution	N
4. Other factors	N

D. NATURAL RESOURCES

1. Diversion, altered use of water	N
2. Irreversible, inefficient commitments	N
3. Other factors	N

E. CULTURAL

1. Altering physical symbols	N
2. Dilution of cultural traditions	N
3. Other factors	N

F. SOCIOECONOMIC

1. Changes in economic/employment patterns	H
2. Changes in population	N
3. Changes in cultural patterns	N
4. Other factors	N

IMPACT IDENTIFICATION AND EVALUATION FORM

G. HEALTH

1. Changing a natural environment	N
2. Eliminating an ecosystem element	N
3. Other factors	N

H. GENERAL

1. International impacts	N
2. Controversial impacts	N
3. Other factors	

I. OTHER POSSIBLE IMPACTS (not listed above)

1. Micro-climatic effects	L
2. Visual: Increase in vegetation	H

Prepared By: John D. Hyslop Date: 02/15/77

Project Location: Jordan

Project Title: Water Management Technology

ROBINSON

LOGICAL FRAMEWORK

I. NARRATIVE STATEMENTS

A. Goal.

To support the Government of Jordan's sector goals of increasing agricultural yields and production, improving farmers' welfare through increased incomes, and increasing foreign exchange earnings.

B. Purpose.

Upgrade agricultural productivity in the Jordan Valley by systematically raising the efficiency of water utilization.

C. Outputs.

1. Research and extension activities, related to new irrigation techniques, being carried out in the Jordan Valley involving cooperative effort by the Jordan Valley Commission (JVC), the Ministry of Agriculture, and the Faculty of Agriculture.

2. Research projects aimed at adapting and/or developing new crop varieties and cropping practices. Research findings being fed into farmer training/extension programs within 18 months after the project's inception.

3. Training/extension program for farmers on water management and cropping practices related to new irrigation techniques. A minimum of 40 technicians (extension and quasi-extension) trained

in sprinkler and other improved irrigation techniques. One thousand farmers trained in the mechanics of sprinkler irrigation, elementary water management, and elementary cropping practices within three months of receipt of on-farm sprinkler equipment provided from AID loan. This number increases to 3000 upon completion of additional capital projects in 1978.

Additional training/extension sessions will be carried out as crop and water management packages are developed.

D. Inputs.

1. Jordanian: Personnel (research and extension) and land, facilities, and equipment for research and training activities.

2. U.S.: Personnel, resident and TDY, and equipment to supplement Jordanian resources in research and training. Participant training to upgrade Jordanian staff capabilities.

II. GOAL LEVEL

A. Goal Statement.

To support the Government of Jordan's sector goals of increasing agricultural yields and production, improving farmers' welfare through increased incomes, and increasing foreign exchange earnings.

B. Indicators (Measures of Goal Achievement).

Rising crop yields and overall production. Increasing GDP originating in sector. Rising agricultural exports and/or falling agricultural imports.

C. Means of Verification.

Periodic statistical reports of the Government of Jordan.

D. Assumptions:

Government assigns high priority to agricultural development through

1. Appropriate policies providing incentives to farmers, and
2. Support to institutions serving agriculture.

III. PURPOSE LEVEL

A. Purpose Statement.

Upgrade agricultural productivity in the Jordan Valley by systematically raising the efficiency of water utilization.

B. Indicators (EOPS).

1. Sprinklers and other advanced irrigation techniques in effective use in Valley areas and crops to which they are well-adapted.

2. Greater water-use efficiency permitting year-around irrigation to all irrigable areas in the Valley.

3. Farmers crop yields significantly greater with improved irrigation and cropping technology than with surface irrigation and traditional technology.

4. Specialized project Training Unit disbanded and functions absorbed by regular Extension service.

C. Means of Verification.

1. Sample surveys and census reports.
2. Farm records
3. Project progress and appraisal reports.

D. Assumptions.

1. Incentive policies carried out by Government.
2. Service institutions developed and given adequate support.
3. Capital projects in Valley completed and in operation.

IV. OUTPUT LEVEL.

A. Output Statement.

1. Research and extension activities related to new irrigation techniques being carried out in the Jordan Valley involving cooperative effort by the Jordan Valley Commission (JVC), the Ministry of Agriculture, and the Faculty of Agriculture.

2. Research projects aimed at adapting and/or developing new crop varieties and cropping practices. Research findings being fed into farmer training/extension programs within 18 months after the project's inception.

3. Training/extension programs for farmers on water management and cropping practices related to new irrigation techniques. A minimum of 40 technicians (extension and quasi-extension) trained in sprinkler and other improved irrigation techniques. One thousand farmers trained in the mechanics of sprinkler irrigation, elementary water management, and elementary cropping practices within three months of receipt of on-farm sprinkler equipment provided from AID loan. This number increases to 3000 upon completion of additional capital projects in 1978.

   Additional training/extension sessions will be carried out as crop and water management packages are developed.

B. <u>Indicators (Magnitude of Outputs).</u>

1. Four research stations (of which one, that of the Faculty of Agriculture, is outside the project but whose work is coordinated with that of the other three.) conducting adaptive research on significant problem areas in irrigated cropping.

2. Close coordination between research and training/extension activities.

Research findings being fed into training/extension element, and with feedback into research problem identification.

3. Three thousand farmers in project areas trained in basic mechanical, water management, and cropping practices. More advanced techniques being presented through training sessions and regular one-on-one extension activities.

C. Means of Verification.

1. Project progress reports.
2. Official reports of JVC and other Government agencies.
3. Project evaluation, analysis and appraisal studies and reports (AID, Government, and others.)

D. Assumptions.

1. Major production problems encountered during progress of project amenable to solution by adaptive research.
2. Training methods acceptable to farmers are available.
3. Cooperation among concerned Jordanian agencies can be maintained.
4. Loan-financed sprinkler equipment ready for distribution in November 1977
5. Reservoir of King Talal dam fills sufficiently to provide water for Zarqa Triangle and East Ghor Canal Extension project areas by November 1977.
6. Farm land in project areas surveyed and titles given to eligible farmers by November 1977.

V. INPUT LEVEL

A. Input Statement.

1. Jordanian: Personnel (research and extension) and land, facilities, and equipment for research and training activities.

2. U.S.: Personnel, resident and TDY, and equipment to supplement Jordanian resources in research and training. Participant training to upgrade Jordanian staff capabilities.

B. Indicators (Implementation Target).

Life of Project totals are

	US$ x 1,000
Jordanian Inputs.	
Personnel	907.1
Land, facilities, equipment	198.0
Contingencies & Inflation	225.0
TOTAL	$ 1,330.1
U.S. Inputs.	
Personnel, U.S. (Resident, 71 mm; TDY, 14 mm)	704.0
Personnel, host country non-prof. (35 mm)	19.0
Equipment	271.0
Participant training (39 mm)	148.2
Contingencies & Inflation	177.8
TOTAL	$ 1,320.0

C. Means of Verification.

1. Mission and contractor records.

2. Government records.

3. Project progress and appraisal reports.

D. Assumotions.

1. US and Jordanian inputs in place at end of summer 1977.

2. Construction projects completed and on-farm sprinkler equipment provided under AID loan 018 available for use by October-November 1977.

E. Beginning of Project Status.

1. Sprinklers not now used in Jordan Valley, though they are in limited use on Ministry of Agriculture projects elsewhere in the Kingdom.

2. A few farmers have invested in drip irrigation equipment and are gaining experience in its use. Results so far have been mixed, though with assistance technical problems encountered could likely be overcome.

3. No research has been conducted on the efficiancy of either sprinkler or drip irrigation in the Jordan Valley.

4. The Faculty of Agriculture is in the early stages of developing a research and teaching capability in irrigation.

5. The Ministry of Agriculture is beginning to show an active interest in research and extension programs in sprinkler irrigation in the Valley and is eager to cooperate with the JVC and the Faculty in these activities.

X

Jordan 278-0192 Water Management Technology 06/30/77

1. 8/77. TRAINING: Training Unit formed with Director, Deputy Director, and Jordanian members of Core Staff. (JVA, Min Ag)

2. 9/77. TRAINING: Training expert, financed from Tech Services Grant, on board (AID/W, USAID, JVA)

3. 9/77. COMMON ELEMENTS: ProAg, PIO/T for WMT project signed (USAID, NPC, JVA, Min AG, Fac Ag)

4. 10/77. COMMON ELEMENTS: Sprinkler Equipment installed on three research and training sites (JVA, Fac Ag, MinAg)

5. 1/78. TRAINING: Training sessions in basic sprinkler skills for farmers in Zarqa Triangle and East Ghor Canal Extension areas completed. 1400 potential, 500 critical (Training Unit)

6. 2/78. COMMON ELEMENTS: WMT project contractors' staff on board for three-year assignment: One training/extension expert, one research expert to lead monitoring research project(s). (Contractor, JVA, AID/W, USAID.)

7. 3/78. TRAINING: Ninety percent of training equipment from FY77 AID funds in place. (JVA, Min Ag)

8. 3/78. COMMON ELEMENT: Fourth research and training site established and ready for use. (JVA, Min Ag)

9. 6/78. RESEARCH: Ninety percent of research equipment from FY77 AID funds in place. (JVA, Fac Ag, Min Ag)

10. 8/78. RESEARCH: Reports of preliminary results of first year's experimental research work delivered to Training Unit (Fac Ag, Min Ag, Training Unit)

11. 10/78. EVALUATION: Review of first year's research and training activities. (USAID, JVA, Fac Ag, Min Ag, Contractor)

12. 11/78. TRAINING: Redesign of training program based on first year's review and incorporation of first year's research results (Training Unit)

13. 1/79. TRAINING: Two supplementary training sessions completed on intermediate water and crop management skills for farmers in Zarqa Triangle and East Ghor Canal Extension areas. 1400 potential, 500 critical (Training Unit)

14. 4/79. TRAINING: All of FY77 funded and 90 percent of FY79 funded training equipment in place. (JVA, Min Ag.)

145

15. 4/79. RESEARCH: Reports of preliminary results of first year's monitoring research work prepared, copies in hands of Training Unit (JVA, Fac Ag, Min Ag, Contractor)

16. 5/79. TRAINING: Training sessions in basic sprinkler skills for farmers in North East Ghor and Hisban-Kafrein areas completed. 1600 potential, 700 critical, (Training Unit).

17. 5/79. RESEARCH: All of FY77 funded and 90 percent of FY79 funded research equipment in place. (JVA, Fac Ag, MinAg)

18. 8/79. RESEARCH: Reports of second year's experimental research results prepared, copies in hands of Training Unit. (Fac Ag, Min Ag, Training Unit)

19. 10/79. EVALUATION: Review of second year's research and training activities (AID/W, USAID, JVA, Fac Ag, Min Ag, Contractor)

20. 1/80. TRAINING: Two more (cumulative 4) supplementary training sessions on intermediate water and crop management skills completed for farmers in four project areas. 3000 potential, 1000 critical. (Training Unit)

21. 4/80. RESEARCH: Reports of results of second year's monitoring research work prepared, copies in hands of Training Unit. (JVA, Fac Ag, Min Ag, Contractor)

22. 1/81. TRAINING: Three more (Cumulative 7) supplementary training sessions on water and crop management skills completed for farmers in four project areas. 3000 potential, 1000 critical. (Training Unit)

23. 1/81. RESEARCH: Comprehensive reports of research work to date, both experimental and monitoring, completed (Fac Ag, Min Ag, JVA, Contractor)

24. 2/81. COMMON ELEMENTS: Completion of technical services.

End of Project Status.

1. An effective sprinkler and other modern irrigation technology established in Jordan Valley.
   a. Firm knowledge basis established through applied research.
   b. Farmers trained in equipment use and in water and crop management. 3000 potential, 1000 critical.
2. Training and extension methods established and under continuing review and redesign for further improvements in farmers' skills.
3. Research work continuing for improved irrigation technology.

140

X

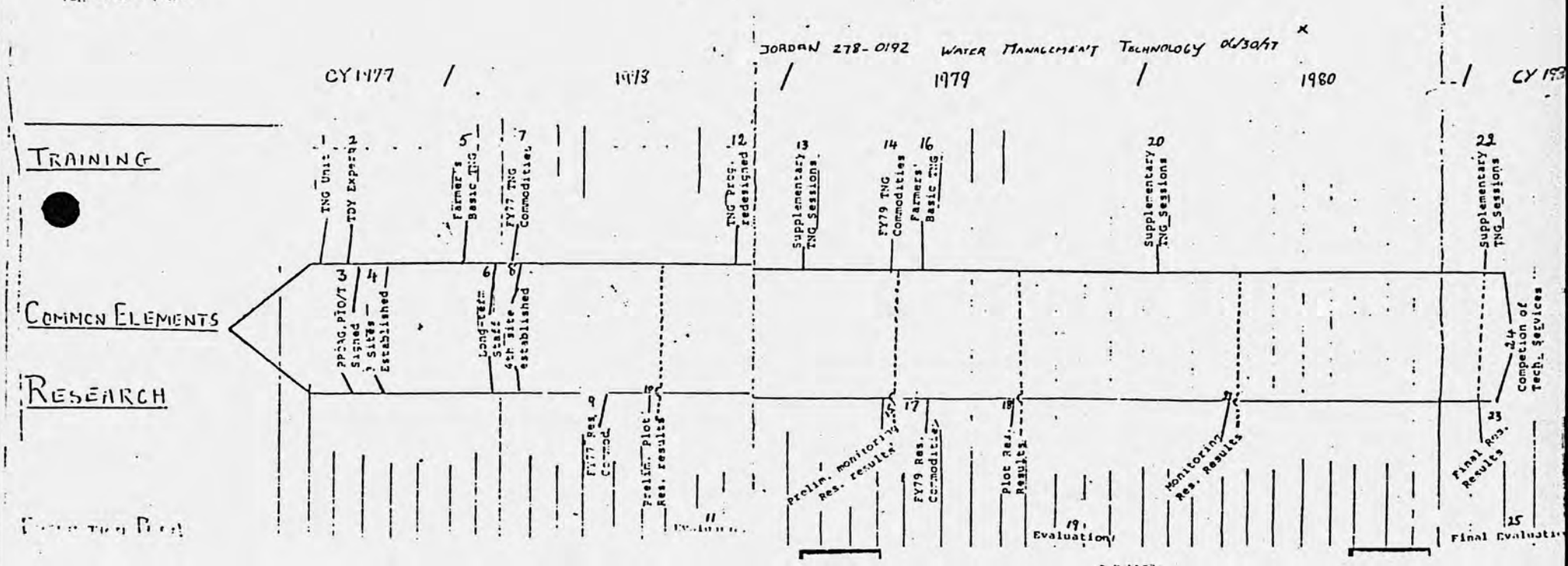
JORDAN 278-0192 Water Management Technology 6/30/77

25. 2/81. EVALUATION: Final review of research and training activities (AID/W, USAID, JVA, Min Ag, Fac Ag)

147

Annex E
Page 4 of 4 pages

JORDAN 278-0192 WATER MANAGEMENT TECHNOLOGY 06/30/77



148

6C(2) - PROJECT CHECKLIST

Listed below are, first, statutory criteria applicable generally to projects with FAA funds, and then project criteria applicable to individual fund sources: Development Assistance (with a sub-category for criteria applicable only to loans); and Security Supporting Assistance funds.

CROSS REFERENCES: IS COUNTRY CHECKLIST UP TO DATE? IDENTIFY, HAS STANDARD ITEM CHECKLIST BEEN REVIEWED FOR THIS PROJECT?

A. GENERAL CRITERIA FOR PROJECT.	
1. App. Unnumbered; FAA Sec. 653(b)	a) The Project is in the FY78 Congressional Presentation.
(a) Describe how Committees on Appropriations of Senate and House have been or will be notified concerning the project; (b) is assistance within (Operational Year Budget) country or international organization allocation reported to Congress (or not more than $1 million over that figure plus 10%)?	b) Yes
2. FAA Sec. 611(a)(1). Prior to obligation in excess of $100,000, will there be (a) engineering, financial, and other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?	Planning carried out by USAID and GOJ staff and TDY experts. A reasonably firm cost estimate has been made.
3. FAA Sec. 611(a)(2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance?	No further action is required.
4. FAA Sec. 611(b); App. Sec. 101. If for water or water-related land resource construction, has project met the standards and criteria as per Memorandum of the President dated Sept. 5, 1973 (replaces Memorandum of May 15, 1971; see Fed. Register, Vol 38, No. 174, Part III, Sept. 10, 1973)?	N.A.
5. FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified the country's capability effectively to maintain and utilize the project?	N.A.

A.

6. FAA Sec. 209, 619. Is project susceptible of execution as part of regional or multilateral project? If so why is project not so executed? Information and conclusion whether assistance will encourage regional development programs. If assistance is for newly independent country, is it furnished through multilateral organizations or plans to the maximum extent appropriate?	The project is not so susceptible. Jordan is not a newly independent country.
7. FAA Sec. 601(a); (and Sec. 201(f) for development loans). Information and conclusions whether project will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; (c) encourage development and use of cooperatives, credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; and (f) strengthen free labor unions.	The project will improve technical efficiency of agriculture.
8. FAA Sec. 601(b). Information and conclusion on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).	Private U.S. participation will be sought to implement this project.
9. FAA Sec. 612(b); Sec. 636(h). Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized to meet the cost of contractual and other services.	The Project Agreement will so provide.
10. FAA Sec. 612(d). Does the U.S. own excess foreign currency and, if so, what arrangements have been made for its release?	Jordan is not an excess currency country.
B. FUNDING CRITERIA FOR PROJECT	
1. Development Assistance Project Criteria	N.A.
a. FAA Sec. 102(c); Sec. 111; Sec. 281a. Extent to which activity will (a) effectively involve the poor in development, by extending access to economy at local level, increasing labor-intensive production, spreading investment out from cities to small towns and rural areas; and (b) help develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward better life, and otherwise encourage democratic private and local governmental institutions?	

b. FAA Sec. 103, 103A, 104, 105, 106, 107. [Is assistance being made available: (include only applicable paragraph -- e.g., a, b, etc. -- which corresponds to source of funds used. If more than one fund source is used for project, include relevant paragraph for each fund source.]

N.A.

(1) [103] for agriculture, rural development or nutrition; if so, extent to which activity is specifically designed to increase productivity and income of rural poor; [103A] if for agricultural research, is full account taken of needs of small farmers;

(2) [104] for population planning or health; if so, extent to which activity extends low-cost, integrated delivery systems to provide health and family planning services, especially to rural areas and poor;

(3) [105] for education, public administration, or human resources development; if so, extent to which activity strengthens nonformal education, makes formal education more relevant, especially for rural families and urban poor, or strengthens management capability of institutions enabling the poor to participate in development;

(4) [106] for technical assistance, energy, research, reconstruction, and selected development problems; if so, extent activity is:

(a) technical cooperation and development, especially with U.S. private and voluntary, or regional and international development, organizations;

(b) to help alleviate energy problem;

(c) research into, and evaluation of, economic development processes and techniques;

(d) reconstruction after natural or manmade disaster;

(e) for special development problem, and to enable proper utilization of earlier U.S. infrastructure, etc., assistance;

(f) for programs of urban development, especially small labor-intensive enterprises, marketing systems, and financial or other institutions to help urban poor participate in economic and social development.

(5) [107] by grants for coordinated private effort to develop and disseminate intermediate technologies appropriate for developing countries.

c. FAA Sec. 110(a); Sec. 208(e). Is the recipient country willing to contribute funds to the project, and in what manner has or will it provide assurances that it will provide at least 25% of the costs of the program, project, or activity with respect to which the assistance is to be furnished (or has the latter cost-sharing requirement been waived for a "relatively least-developed" country)?

d. FAA Sec. 110(b). Will grant capital assistance be disbursed for project over more than 3 years? If so, has justification satisfactory to Congress been made, and efforts for other financing?

e. FAA Sec. 207; Sec. 113. Extent to which assistance reflects appropriate emphasis on; (1) encouraging development of democratic, economic, political, and social institutions; (2) self-help in meeting the country's food needs; (3) improving availability of trained worker-power in the country; (4) programs designed to meet the country's health needs; (5) other important areas of economic, political, and social development, including industry; free labor unions, cooperatives, and Voluntary Agencies; transportation and communication; planning and public administration; urban development, and modernization of existing laws; or (6) integrating women into the recipient country's national economy.

f. FAA Sec. 281(b). Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civic education and training in skills required for effective participation in governmental and political processes essential to self-government.

31

g. FAA Sec. 201(b)(3)-(4) and -(1); Sec. 201(c); Sec. 211(a)(1)-(3) and -(4). Does the activity give reasonable promise of contributing to the development: of economic resources, or to the increase of productive capacities and self-sustaining economic growth; or of educational or other institutions directed toward social progress? Is it related to and consistent with other development activities, and will it contribute to realizable long-range objectives? And does project paper provide information and conclusion on an activity's economic and technical soundness?

h. FAA Sec. 201(b)(6); Sec. 211(a)(5), (6). Information and conclusion on possible effects of the assistance on U.S. economy, with special reference to areas of substantial labor surplus, and extent to which U.S. commodities and assistance are furnished in a manner consistent with improving or safeguarding the U.S. balance-of-payments position.

2. Development Assistance Project Criteria (Loans only) — N.A.

a. FAA Sec. 201(b)(1). Information and conclusion on availability of financing from other free-world sources, including private sources within U.S.

b. FAA Sec. 201(b)(2); 201(d). Information and conclusion on (1) capacity of the country to repay the loan, including reasonableness of repayment prospects, and (2) reasonableness and legality (under laws of country and U.S.) of lending and relending terms of the loan.

c. FAA Sec. 201(e). If loan is not made pursuant to a multilateral plan, and the amount of the loan exceeds $100,000, has country submitted to AID an application for such funds together with assurances to indicate that funds will be used in an economically and technically sound manner?

d. FAA Sec. 201(f). Does project paper describe how project will promote the country's economic development taking into account the country's human and material resources requirements and relationship between ultimate objectives of the project and overall economic development?

e. FAA Sec. 202(a). Total amount of money under loan which is going directly to private enterprise, is going to intermediate credit institutions or other borrowers for use by private enterprise, is being used to finance imports from private sources, or is otherwise being used to finance procurements from private sources?

f. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete in the U.S. with U.S. enterprise, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan?

3. Project Criteria Solely for Security Supporting Assistance

FAA Sec. 531. How will this assistance support promote economic or political stability?

This project will impact favorably on Jordan's economic and political stability and will improve the well-being of irrigated farm people.

4. Additional Criteria for Alliance for Progress

[Note: Alliance for Progress projects should add the following two items to a project checklist.]

N.A.

a. FAA Sec. 251(b)(1), -(5). Does assistance take into account principles of the Act of Bogota and the Charter of Punta del Este; and to what extent will the activity contribute to the economic or political integration of Latin America?

b. FAA Sec. 251(b)(5); 251(h). For loans, has there been taken into account the effort made by recipient nation to repatriate capital invested in other countries by their own citizens? Is loan consistent with the findings and recommendations of the Inter-American Committee for the Alliance for Progress (now "CEPCIES," the Permanent Executive Committee of the OAS) in its annual review of national development activities?

6C(3) - STANDARD ITEM CHECKLIST

Listed below are statutory items which normally will be covered routinely in those provisions of an assistance agreement dealing with its implementation, or covered in the agreement by exclusion (as where certain uses of funds are permitted, but other uses not).

These items are arranged under the general headings of (A) Procurement, (B) Construction, and (C) Other Restrictions.

A. Procurement

1. FAA Sec. 602. Are there arrangements to permit U.S. small business to participate equitably in the furnishing of goods and services financed?	Procurement of goods and services will be in accordance with established AID regulations
2. FAA Sec. 604(a). Will all commodity procurement financed be from the U.S. except as otherwise determined by the President or under delegation from him?	Yes.
3. FAA Sec. 604(d). If the cooperating country discriminates against U.S. marine insurance companies, will agreement require that marine insurance be placed in the U.S. on commodities financed?	Yes.
4. FAA Sec. 604(e). If offshore procurement of agricultural commodity or product is to be financed, is there provision against such procurement when the domestic price of such commodity is less than parity?	There will be no such procurement.
5. FAA Sec. 608(a). Will U.S. Government excess personal property be utilized wherever practicable in lieu of the procurement of new items?	Consideration will be given to the use of excess property when practical.
6. FAA Sec. 901(b). (a) Compliance with requirement that at least 50 percentum of the gross tonnage of commodities (computed separately for dry bulk carriers, dry cargo liners, and tankers) financed shall be transported on privately owned U.S.-flag commercial vessels to the extent that such vessels are available at fair and reasonable rates.	Yes.
7. FAA Sec. 621. If technical assistance is financed, will such assistance be furnished to the fullest extent practicable as goods and professional and other services from private enterprise on a contract basis? If the facilities of other Federal agencies will be utilized,	Yes.

A7.

are they particularly suitable, not competitive with private enterprise, and made available without undue interference with domestic programs?

6. International Air Transport. Fair Competitive Practices Act, 1974

If air transportation of persons or property is financed on grant basis, will provision be made that U.S.-flag carriers will be utilized to the extent such service is available?

Yes.

B. Construction

1. FAA Sec. 601(d). If a capital (e.g., construction) project, are engineering and professional services of U.S. firms and their affiliates to be used to the maximum extent consistent with the national interest?

N.A.

2. FAA Sec. 611(c). If contracts for construction are to be financed, will they be let on a competitive basis to maximum extent practicable?

N.A.

3. FAA Sec. 620(k). If for construction of productive enterprise, will aggregate value of assistance to be furnished by the U.S. not exceed $100 million?

N.A.

C. Other Restrictions

1. FAA Sec. 301(d). If development loan, is interest rate at least 2% per annum during grace period and at least 3% per annum thereafter?

N.A.

2. FAA Sec. 301(d). If fund is established solely by U.S. contributions and administered by an international organization, does Comptroller General have audit rights?

N.A.

3. FAA Sec. 620(n). Do arrangements preclude promoting or assisting the foreign aid projects or activities of Communist-bloc countries, contrary to the best interests of the U.S.?

Yes.

4. FAA Sec. 635(i). Is financing not permitted to be used, without waiver, for purchase, long-term lease, or exchange of motor vehicle manufactured outside the U.S. or guaranty of such transaction?

Financing is not permitted to be used for such purposes.

5. Will arrangements preclude use of financing:

a. FAA Sec. 114. to pay for performance of abortions or to motivate or coerce persons to practice abortions?	Yes.
b. FAA Sec. 620(g). to compensate owners for expropriated nationalized property?	Yes.
c. FAA Sec. 660. to finance police training or other law enforcement assistance, except for narcotics programs?	Yes.
d. FAA Sec. 662. for CIA activities?	Yes.
e. App. Sec. 103. to pay pensions, etc., for military personnel?	Yes.
f. App. Sec. 106. to pay U.N. assessments?	Yes.
g. App. Sec. 107. to carry out provisions of FAA Sections 209(d) and 251(h)? (transfer to multilateral organization for lending).	Yes.
h. App. Sec. 501. to be used for publicity or propaganda purposes within U.S. not authorized by Congress?	Yes.