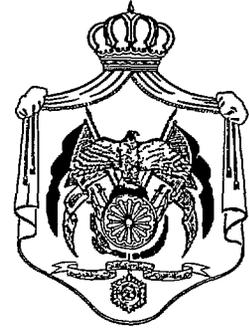


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The Hashemite Kingdom of Jordan



Ministry of Water and Irrigation

Report 3114-97-36-14

Jordan Water Quality Improvement and Conservation Project

Selection of Water
Management Extension
Titles

**Environmental Resources
Management Consultants (ERMC)**



The Technical Assistance Team Includes

Development Alternatives, Inc
Science Applications International Corp
Harza Environmental Services, Inc
Development Associates, Inc



**The Hashemite Kingdom of Jordan
Ministry of Water and Irrigation**

Water Quality Improvement and Conservation Project, WQIC
Water Management Extension Literature Project

Selection of Water Management Extension Titles

FINAL REPORT

Prepared for

Development Alternatives Inc (DAI)

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Environmental Resources Management Consultants

August 13, 1997

EXECUTIVE SUMMARY

This report is the second deliverable in the Water Management Extension Literature Project, which has as its final objective the production of extension informational pieces for farmers in the Jordan Valley. The purpose of this report is to present a list of the potential extension titles developed (53 titles) and to screen them in terms of a final ranking (25). The ranking is based upon a systematic optimization procedure involving farmers, extension agents, government officials and others. In addition, the work presents a survey of the currently available literature (studies, project reports, texts, articles, bulletins, theses) to assist the team in preparing each information piece. The survey is based on the first report, Audit of Water Management Research in Jordan.

Based on the work conducted, 25 separate titles were developed along with the accompanying references. The following is a listing of the titles, which are arranged under 5 subtopics.

Irrigation Requirements and Irrigation Systems

- 1 Irrigation Requirements for Crops in the Northern Jordan Valley
- 2 Irrigation Requirements for Crops in the Middle Jordan Valley
- 3 Irrigation Requirements for Crops in the Southern Jordan Valley
- 4 Evaluating Micro Irrigation Systems
- 5 Installation, Operation, and Maintenance of Micro Irrigation Systems

Irrigation Scheduling

- 6 Irrigation Scheduling Using Pan Evaporation, Northern Jordan Valley
- 7 Irrigation Scheduling Using Pan Evaporation, Middle Jordan Valley
- 8 Irrigation Scheduling Using Pan Evaporation, Southern Jordan Valley
- 9 Irrigation Scheduling For Citrus and Grapes Using Pan Evaporation
- 10 Irrigation Scheduling For Vegetables Grown in Plastic Houses Using Pan Evaporation
- 11 Irrigation Scheduling For Open Field Vegetables Using Pan Evaporation
- 12 Guidelines for Irrigation Scheduling Using Tensiometers
- 13 Irrigation Scheduling for Citrus and Grapes Using Tensiometers
- 14 Irrigation Scheduling for Vegetables Using Tensiometers

Low Quality Water Management

- 15 Management of Low Quality Water in Agriculture

Leaching Requirements

- 16 Leaching Requirements for Various Jordan Valley Soils

Fertigation

- 17 Injection of Fertilizers into Irrigation Systems by Pumping
- 18 Injection of Fertilizers into Irrigation Systems by the By-Pass Method
- 19 Injection of Fertilizers into Irrigation Systems Using a Dosing Device
- 20 Injection of Fertilizers into Irrigation Systems Using a Pressure Differential Device
- 21 A Comparison of Fertilizer Injection Methods used

22	Fertigation of Citrus and Grape Crops in the Jordan Valley
23	Fertigation of Vegetable Crops in the Jordan Valley
24	Mixing of Fertilizers for Injection
25	Crop Fertilizer Requirements and the Preparation of Stock Solutions

TABLE OF CONTENTS

Executive Summary	11
List of Acronyms	v
Introduction	1
Report Objectives	1
Procedure for Selection	1
Report Organization	1
Titles of Extension Information Pieces	2
Potential Titles	2
Selected Titles	4
Further Work	11
Design of Information Pieces	11
Annexes	13
Focus Group Proceedings and Findings	13
General	13
Selection Criteria Set	13
Development of Potential IPs	13
Screening Process	14
Final Results	14
Focus Group Session Agenda Document	15
Focus Group Session Agenda	16
List of Invitees to the Focus Group Meeting	16

LIST OF ACRONYMS

ACC	Agricultural Credit Corporation
AMPCO	Agricultural Marketing and Production Corporation
DAI	Development Alternatives Inc
ERMC	Environmental Resources Management Consultants
ESCWA	Economic and Social Commission for Western Asia
FAO	Food and Agriculture Organization of the U N
GOJ	Government of Jordan
GTZ	German Agency for Technical Cooperation
ha	Hectare
IP	Information Piece
JVA	Jordan Valley Authority
JVFA	Jordan Valley Farmer's Association
KAC	King Abdullah Canal
KTR	King Talal Dam Reservoir
m ³ /day	Cubic meters per day
m ³ /s	Cubic meters per second
mcm	millions of cubic meters
MOA	Ministry of Agriculture
MWI	Ministry of Water and Irrigation
NCARTT	National Center for Agricultural Research and Technology Transfer
UOJ	University of Jordan
UN	United Nations
UNDP	United Nations Development Programme
USAID	The United States Agency for International Development
WAJ	The Water Authority of Jordan
WQICP	Water Quality Improvement and Conservation Project

INTRODUCTION

Report Objectives

The WQIC Project, through the Ministry of Water and Irrigation, is implementing activities designed to improve Jordan's water quality, quantity, management and conservation. The WQIC Project has developed a program to implement a process to design irrigation management extension informational pieces for farmers in the Jordan Valley.

The purpose of this report is to present a listing of Extension Titles to be evaluated and ranked based on the need and potential benefit of the work. Fifty-three Titles were initially developed by the team for evaluation. A focus group was held for stakeholders (farmers, extension agents, government officials) in order to screen the titles and reach a consensus on the 25 most important extension pieces that are required.

Procedure for Selection

The selection of extension titles was based upon a number of elements, namely

- The initial results of the audit (Deliverable 1 under this project)
- Perceived needs (through a focus group participatory approach with farmers and extension agents)

A number of selection criteria were developed and the set was presented to the focus group for comment and to assign relative weights. Once that was done and a complete, non-redundant, non-duplicative criteria set emerged, from which the evaluation of the 53 extension titles was performed.

Report Organization

This report is organized in the following manner. Following this introduction, Section 2 presents the methodology behind the development of the potential extension Information Piece (IP) titles. The section then identifies the 25 IPs selected and presents them along with the references that will be used to adequately develop them. Section 3 concludes the report with a description of future work emanating from the audit and the selection of titles, namely the development of the IPs in terms of format, content, and actual design. The annexes contain the proceedings and findings of the focus group held for the purpose of selecting IP titles and the original agenda and documentation for the focus group.

TITLES OF EXTENSION INFORMATION PIECES

Potential Titles

A number of titles were developed based upon the team's previous experiences and work on the literature audit report. The procedure for developing irrigation water extension IPs involved two steps. First, extension requirements were categorized under either "Irrigation Water Management" or "Fertigation". Second, under each of those main headings, the key elements were discussed. For example, under the first heading, irrigation scheduling, leaching requirements, and irrigation requirements were analyzed in terms of region, crop pattern, water efficiency and other factors. Consequently, once an exhaustive set of elements was designed, the number of IPs fell out of the analysis, which was graphically presented to the focus group.

This subsection presents a list of the potential extension titles developed (53 titles) for evaluation and screening. The objective of the screening was to reduce the number of IPs to a manageable set that would adequately address farmers' needs in the Jordan Valley and produce the most benefit. For that purpose, a focus group was held for stakeholders (farmers, extension agents, government officials) in order to screen the titles and reach a consensus on the 25 most important extension pieces that are required.

The 53 potential titles are listed below in the same way they were presented to the Focus Group.

Irrigation Requirements

- 1- Irrigation requirements for the different crops in the Northern Jordan Valley
- 2- Irrigation requirements for the different crops in the Middle Jordan Valley
- 3- Irrigation requirements for the different crops in the Southern Jordan Valley

Irrigation Scheduling

- 4- Irrigation scheduling for Tomato in open fields by Neutron Probe method
- 5- Irrigation scheduling for Tomato in open fields by Class A pan method
- 6- Irrigation scheduling for Tomato in open fields by Tensiometer method
- 7- Irrigation scheduling for Tomato in open fields by Empirical Equations method
- 8- Irrigation scheduling for Tomato inside plastic-houses by Neutron Probe method
- 9- Irrigation scheduling for Tomato inside plastic-houses by Class A pan method
- 10- Irrigation scheduling for Tomato inside plastic-houses by Tensiometer method
- 11- Irrigation scheduling for Tomato inside plastic-houses by Empirical Equations method
- 12- Irrigation scheduling for Cucumber inside plastic-houses by Neutron Probe method
- 13- Irrigation scheduling for Cucumber inside plastic-houses by Class A pan method
- 14- Irrigation scheduling for Cucumber inside plastic-houses by Tensiometer method
- 15- Irrigation scheduling for Cucumber inside plastic-houses by Empirical Equations

- Method
- 16- Irrigation scheduling for Bell-Pepper inside plastic-houses by Neutron Probe method
 - 17- Irrigation scheduling for Bell-Pepper inside plastic-houses by Class A pan method
 - 18- Irrigation scheduling for Bell-Pepper inside plastic-houses by Tensiometer method
 - 19- Irrigation scheduling for Bell-Pepper inside plastic-houses by Empirical Equations Method
 - 20- Irrigation scheduling for Potatoes by Neutron Probe method
 - 21- Irrigation scheduling for Potatoes by Class A pan method
 - 22- Irrigation scheduling for Potatoes by Tensiometer method
 - 23- Irrigation scheduling for Potatoes by Empirical Equations method
 - 24- Irrigation scheduling for Citrus trees by Neutron Probe method
 - 25- Irrigation scheduling for Citrus trees by Class A pan method
 - 26- Irrigation scheduling for Citrus trees by Tensiometer method
 - 27- Irrigation scheduling for Citrus trees by Empirical Equations method
 - 28- Irrigation scheduling for Banana by Neutron Probe method
 - 29- Irrigation scheduling for Banana by Class A pan method
 - 30- Irrigation scheduling for Banana by Tensiometer method
 - 31- Irrigation scheduling for Banana by Empirical Equations method

Irrigation Systems

- 32- Irrigation systems evaluation in the Jordan Valley
- 33- Installation, Operation, and Maintenance of drip irrigation system
- 34- Installation, Operation, and Maintenance of sprinkler irrigation system

Leaching Requirements

- 35- Leaching requirements for the Jordan Valley soils

Low Quality Water

- 36- Low quality water Management in agriculture

Fertigation

- 37- The use of Dosatron injector in Tomato fertigation under open field conditions
- 38- The use of Dosatron injector in Tomato fertigation inside plastic-houses
- 39- The use of Dosatron injector in Cucumber fertigation inside plastic-houses
- 40- The use of Dosatron injector in Bell-Pepper fertigation inside plastic-houses
- 41- The use of Dosatron injector in Citrus trees fertigation
- 42- The use of Dosatron injector in Banana fertigation
- 43- The use of Dosatron injector in Grapes fertigation
- 44- The use of Venturi injector in Tomato fertigation under open field conditions
- 45- The use of Venturi injector in Tomato fertigation inside plastic-houses
- 46- The use of Venturi injector in Cucumber fertigation inside plastic-houses
- 47- The use of Venturi injector in Bell-Pepper fertigation inside plastic-houses
- 48- The use of Venturi injector in Citrus trees fertigation

- 49- The use of Venturi injector in Banana fertigation
- 50- The use of Venturi injector in Grapes fertigation

Fertilizers

- 51- The solubility of available fertilizers in irrigation water
- 52- Calculations of fertilizers requirements and the preparation of stock solution

Injectors

- 53- A comparison between injecting methods

Selected Titles

The selection of extension titles was based upon a number of elements, namely

- The initial results of the audit (Deliverable 1 for this project)
- Perceived needs (through a focus group participatory approach with farmers and extension agents)

A number of selection criteria were developed and the set was presented to the focus group for comment and to assign relative weights. Once that was done and a complete, non-redundant, non-duplicative criteria set emerged, from which the evaluation of the 53 extension titles was performed.

Based on the work conducted, 25 separate titles were developed along with the accompanying references. The references are cited in terms of titles and year only, the complete information about each title can be found in the Audit Report. The following is a listing of the titles which are arranged under 5 subtopics as required in the Project Terms of Reference.

Crop Water Consumption, Irrigation Timing, and Duration of Irrigation Applications

IP # 1 Irrigation Requirements for Crops in the Northern Jordan Valley

- Needs Assessment for an Irrigation Management Service, 1994
- Basic Principles for Water Requirements and Irrigation Intervals, 1994
- Information Systems for Irrigation Management in the Jordan Valley, 1994
- Water Requirements for Potato by Two Irrigation Methods in Abu-Habil Agricultural Station, 1987
- Water Requirements of Squash Crop in Abu-Habil Agricultural Station, 1987
- Evapotranspiration, Yield, and Growth of Sorghum under Different Water Levels and Irrigation Cutbacks, 1983
- Basic Irrigation Scheduling, 1981

IP # 2 Irrigation Requirements for Crops in the Middle Jordan Valley

Salt Distribution and Soil-Water Management for Line Source Trickle Irrigated Sweet Corn, 1995

Opportunities and Options for Participatory Irrigation Management in Central Jordan Valley, 1995

Basic Principles for Water Requirements and Irrigation Intervals, 1994

Needs Assessment for an Irrigation Management Service, 1994

Information Systems for Irrigation Management in the Jordan Valley, 1994

Water Consumption of Forage Corn in the Central Jordan Valley, 1988

Irrigation Production Function and Crop Coefficients of Potato in the Jordan Valley, 1988

Preliminary Study on the Effects of Soil Moisture Depletions Under Black Plastic Mulch and Drip Irrigation on Root Growth and Distribution of Squash in the Central Jordan Valley, 1988

Production Function Determination of Onion as Affected by Water Amounts, Evapotranspiration, and N-fertilization Rates in the Central Jordan Valley, 1987

Water Consumption of Wheat and Barley in the Jordan Valley, 1987

Water Requirements for Cucumber Inside Plastic Houses in Deir Alla, 1987

Squash Production Under Mulch and Trickle Irrigation in the Jordan Valley, 1987

Irrigation Effect on Water Consumption and Productivity of Wheat in the Jordan Valley, 1987

Yield Response of Cucumber to Various Levels of Applied water Under Plastic Houses in the Jordan Valley, 1985

Evapotranspiration, Yield, and Growth of Sorghum under Different Water Levels and Irrigation Cutbacks, 1983

Basic Irrigation Scheduling, 1981

IP # 3 Irrigation Requirements for Crops in the Southern Jordan Valley

Basic Principles for Water Requirements and Irrigation Intervals, 1994

Needs Assessment for an Irrigation Management Service, 1994

Information Systems for Irrigation Management in the Jordan Valley, 1994

Evapotranspiration, Yield, and Growth of Sorghum under Different Water Levels and Irrigation Cutbacks, 1983

Basic Irrigation Scheduling, 1981

IP # 4 Evaluating Micro Irrigation Systems

Surface Irrigation Performance, 1996

Sprinkler Irrigation, 1994

Proper Use of Irrigation water, 1994

Irrigation Management and Water Quality in the Central Jordan Valley - A Baseline Survey, 1994

Economics of Irrigation Methods Used by Farmers, 1992

Water Management at the Farm level, 1992

Drip Irrigation, undated

Management of Irrigation Systems - A Survey of Concept Development at GTZ, 1989

Water Requirements for Potato by Two Irrigation Methods in Abu-Habil Agricultural Research Station, 1987

Trickle Irrigation and Its Effect on Squash Yield, Root Development, and Soil Salinity, 1987
Salt Distribution and Accumulation as Affected by Drip Irrigation Treatments for Tomatoes Grown Inside Plastic Houses, 1987
Delivery Performance and Efficiencies of the Jordan valley Irrigation Project, 1987
The Efficient Use of Water in Irrigation Principles and Practices for Improving Irrigation in Arid and Semi-Arid Regions, 1987
Water Requirements of Squash Crop in Abu-Habil Agricultural Station, 1987
Effect of Drip Irrigation, Furrow, and Sprinkler on Tomato Yield and Soil Salinity in the Jordan Valley, 1986
Efficiency of Jordan Valley Irrigation Systems, 1986
Salt Accumulation Under Various Drip Irrigation Treatments, 1985
Systems Analysis for Improvement of Surface Irrigation, 1981

IP # 5 Installation, Operation, and Maintenance of Micro Irrigation Systems

Surface Irrigation Performance, 1996
Sprinkler Irrigation, 1994
Drip Irrigation, undated
Water Management at the Farm level, 1992
Designing Irrigation Systems for Management, 1989
Operation and Maintenance of Small Irrigation Projects, 1988

Irrigation Scheduling

IP # 6 Irrigation Scheduling Using Pan Evaporation, Northern Jordan Valley

Optimal Irrigation Management Under Conditions of Limited water Supply in the Jordan Valley, 1996
Proper Use of Irrigation Water, 1994
Information Systems for Irrigation Management in the Jordan Valley, 1994
Basic Irrigation Scheduling, 1981

IP # 7 Irrigation Scheduling Using Pan Evaporation, Middle Jordan Valley

Optimal Irrigation Management Under Conditions of Limited water Supply in the Jordan Valley, 1996
Proper Use of Irrigation Water, 1994
Information Systems for Irrigation Management in the Jordan Valley, 1994
Basic Irrigation Scheduling, 1981

IP # 8 Irrigation Scheduling Using Pan Evaporation, Southern Jordan Valley

Optimal Irrigation Management Under Conditions of Limited water Supply in the Jordan Valley, 1996
Proper Use of Irrigation Water, 1994
Information Systems for Irrigation Management in the Jordan Valley, 1994
Irrigation water and Agriculture in the Jordan Valley and Southern Ghors The Possibility of Cultivating Substitute Crops, 1993
Basic Irrigation Scheduling, 1981

IP # 9 Irrigation Scheduling For Citrus and Grapes Using Pan Evaporation

The Effect of Irrigation Scheduling on Citrus Yield Under Drip Irrigation in the Jordan Valley, 1996

Crop Water Requirements Guide, 1994

IP # 10 Irrigation Scheduling For Vegetables Grown in Plastic Houses Using Pan Evaporation

Crop Water Requirements Guide, 1994

Irrigation Management of Plastic House Cucumbers, 1990

Optimal Irrigation Management for Protected Tomato in the Jordan Valley,

Irrigation Scheduling of Snap beans Grown in Plastic Houses in Jordan, 1990

Water Requirements for Cucumber Inside Plastic Houses in Deir Alla, 1987

Vegetable Yield and Irrigation Scheduling Model for the Jordan Valley, 1987

IP # 11 Irrigation Scheduling For Open Field Vegetables Using Pan Evaporation

Water Requirements and Irrigation Scheduling for Tomatoes Using the Methods of Spotting Irrigation for Exposed Planting in the South Ghors region, 1996

Water Requirements and Irrigation Scheduling for Sugarbeet for Exposed Planting in the Jordan Valley and the Eastern Heights, 1995

Salt Distribution and Soil - Water Management for Line Source trickle Irrigated Sweet Corn, 1995

Irrigation Water Management of Trickle-Irrigated Onion, 1994

Crop Water Requirements Guide, 1994

Irrigation Method and Water Quantity Effects on Sweet Corn, 1994

Irrigated Sweet Corn Production Functions and Efficient Water Use, 1994

Determination of Actual Water Consumption and Crop Coefficient of Mature Banana in the Central Jordan Valley, 1993

Water Consumption of Okra in the Jordan Valley, 1989

Water Consumption of Cauliflower and Watermelon in the Jordan Valley, 1989

Irrigation Production Function and Crop Coefficients of Potato in the Jordan Valley, 1988

Vegetable Yield and Irrigation Scheduling Model for the Jordan Valley, 1987

Irrigation Scheduling of Squash Under Drip Irrigation and Black Plastic Mulch in Central Jordan Valley, 1987

Determination of Crop Coefficients for Potatoes in the Jordan Valley, 1985

Determination of Crop Coefficient for Fall Potato for some Direct and Indirect Methods of Estimating Evapotranspiration in the Jordan Valley, 1984

IP # 12 Guidelines for Irrigation Scheduling Using Tensiometers

Irrigation Management Under Plastic Houses for Cucumbers, Tomato, and Strawberry in the Middle Jordan Valley, 1996

Information Systems for Irrigation Management in the Jordan Valley, 1994

Irrigation Scheduling for Bean Crop Inside Plastic Houses in Deir Alla Agricultural Station, 1991

Irrigation and N-Fertilization Scheduling for Cucumber Inside Plastic Houses in the Jordan Valley Using Drip Irrigation System, 1991
Irrigation Scheduling of Sweet Pepper Inside Plastic Houses, 1988
Irrigation Scheduling of Squash Under Drip Irrigation and Black Plastic Mulch in the Central Jordan Valley, 1987
Irrigation Scheduling of Tomato Grown Under Drip Irrigation Inside Plastic Greenhouses in the Jordan Valley, 1985

IP # 13 Irrigation Scheduling for Citrus and Grapes Using Tensiometers

The Present Situation of the Area Planted with Trees and their Water Requirements from the Available Water Resources in the Jordan Valley for the Years 1989-1992, 1993

IP # 14 Irrigation Scheduling for Vegetables Using Tensiometers

Yield Response of Plastic House Tomatoes to Soil Moisture Tension in the Jordan Valley, 1990
Irrigation Production Function and Crop Coefficients of Potato in the Jordan Valley, 1988
Irrigation Scheduling of Squash Under Drip Irrigation and Black Plastic Mulch in the Central Jordan Valley, 1987
Tomato Yield and Consumptive Use under Different Water Stress Using Plastic Mulch, 1985
Water Utilization by Tomato Under Drip Irrigation in the Jordan Valley, 1985
Yield Response of Cucumber to Various Levels of Applied Water Under Plastic Houses in the Jordan Valley, 1985

Low Quality Water Management

IP # 15 Management of Low Quality Water in Agriculture

Sewage Effluent Reuse in Jordan, 1996
Effect of Khirbet Al-Samra Treated Effluent on the Quality of Irrigation Water in the Central Jordan Valley, 1996
Quality of Irrigation Water in the Middle Jordan Valley, 1996
Rationality of Water Use in Jordan, 1995
Effect of Water (pH) on the Stability of Pirimicarb, 1995
Water Management and Conservation Measures Under Semi-Arid and Arid Conditions, 1994
Response of Chrysanthemum Morifolium Ramatto Drip Irrigation with Treated Wastewater and Fresh Water at Different Planting Intensities, 1992
Irrigation Water Quality in Jordan, undated
Chemistry of KAC Water in the Jordan Valley Effect of Water pH on the Stability of Dimethoate, 1991
Effect of Sewage Sludge Treatments on Corn Crop, Water Consumption, and Some Natural Soil Properties, 1989
Effect of Treated Wastewater on Concentration of Nutrients and Some Heavy Metals in Soils and Irrigated Corn Plants, 1988
Safety Limits in the Use of Irrigation Water, 1985

Leaching Requirements

IP # 16 Leaching Requirements for Various Jordan Valley Soils

- Irrigation Water Management for Onion Trickle Irrigation with Saline Drainage Water, 1996
- Sewage Effluent Reuse in Jordan, 1996
- Quality of Irrigation Water in the Middle Jordan Valley, 1996
- Rationality of Water Use in Jordan, 1995
- Irrigation Management and Water Quality in the Central Jordan valley - A Baseline Survey, 1995
- Salt Distribution and Soil-Water Management for Line Source Trickle Irrigated Sweet Corn, 1995
- Water Use and Production Function of Sweet Corn Irrigated with Saline Drainage Water, 1994
- Water Quality of Irrigation Water in the Jordan Valley, 1994
- Sodicity of Drainage Water as Affected by Bicarbonate Enrichment of Irrigation Water Under Green House Conditions, 1994
- Water Management and Conservation Measures Under Semi-Arid and Arid Conditions, 1994
- The Effect of Using Semi-Saline Water on the Production of Sugarbeet in Al-Khaldieh Regional Center, 1992
- Irrigation Water Quality in Jordan, undated
- Chemistry of KAC Water in the Jordan Valley Effect of Water pH on the Stability of Dimethoate, 1991
- Salt Distribution and Accumulation as Affected by Drip Irrigation Treatments for Tomatoes Grown Inside Plastic Houses, 1987
- The Efficient Use of Water in Irrigation Principles and Practices for Improving Irrigation in Arid and Semi-Arid Regions, 1987
- Effect of Continuous Cultivation and Fertilizers Application on Soil Fertility and Salinity Accumulation Inside Plastic Houses in the Jordan Valley, 1986
- Safety Limits in the Use of Irrigation Water, 1985
- Soil and Water Management Guide for the Jordan Valley, 1984

Fertigation

IP # 17 Injection of Fertilizers into Irrigation Systems by Pumping

IP # 18 Injection of Fertilizers into Irrigation Systems Using the By-Pass Method

IP # 19 Injection of Fertilizers into Irrigation Systems Using a Dosing Device

IP # 20 Injection of Fertilizers into Irrigation Systems Using a Pressure Differential device

IP # 21 Comparison of Fertilizer Injection Methods in the Jordan Valley

Advanced Short Course on Fertigation, 1995

Use of Fertigation and Chemigation to Increase Plant Productivity, 1989

Fertigation Prospects and Problems, 1989

IP # 22 Fertigation of Citrus and Grape Crops in the Jordan Valley

Advanced Short Course on Fertigation, 1995

Use of Fertigation and Chemigation to Increase Plant Productivity, 1989

Nitrogen Movement as Influenced by Irrigation Amounts and Urea Fertilization Rates in the Jordan Valley, 1986

Fertigation Prospects and Problems, 1989

IP # 23 Fertigation of Vegetable Crops in the Jordan Valley

Advanced Short Course on Fertigation, 1995

Effects of Irrigation and N-Fertilization Scheduling on Tomato Crop in the Jordan Valley, 1994

Irrigation and N-Fertilization Scheduling for Cucumber Inside Plastic Houses in the Jordan Valley Using Drip Irrigation System, 1991

Production Function of Sugarbeet in Jordan as Affected by Irrigation and Nitrogen Fertilization, 1989

Use of Fertigation and Chemigation to Increase Plant Productivity, 1989

Fertigation Prospects and Problems, 1989

Production Function determination of Onion as Affected by water Amounts,

Evapotranspiration, and N-fertilization Rates in the Central Jordan Valley, 1987

Effect of Continuous Cultivation and Fertilizers Application on Soil Fertility and Salinity Accumulation Inside Plastic Houses in the Jordan Valley, 1986

Nitrogen Movement as Influenced by Irrigation Amounts and Urea Fertilization Rates in the Jordan Valley, 1986

Soil and Water Management Guide for the Jordan Valley, 1984

Crop Production Functions as Influenced by Irrigation Amounts and Urea Fertilization Rates on Sweet Corn in the Jordan Valley, 1983

Crop Production Function Determination and Nitrate Movement as Influenced by Irrigation Amounts and Urea Fertilization on Sweet Corn in the Jordan Valley, 1982

IP # 24 Mixing of Fertilizers for Injection

Advanced Short Course on Fertigation, 1995

IP # 25 Crop Fertilizer Requirements and the Preparation of Stock Solutions

Advanced Short Course on Fertigation, 1995

Use of Fertigation and Chemigation to Increase Plant Productivity, 1989

Fertigation Prospects and Problems, 1989

FURTHER WORK

Design of Information Pieces

According to the project scope of work, 25 information pieces will be prepared in a simple, clear, concise, and easily reproducible manner. Thus, the three elements of the IPs format, content, and design will be arranged to produce valuable IPs that can be used for water management training. The IPs will be delivered in both English and Arabic by the end of September 1997.

The selection of the format, content, and actual design of the IPs is performed below in a systematic way similar to the selection of titles process. The list of selection criteria for each consecutive decision (format, content, and design) is shown below along with a list of potential options (Table 1).

Table 1. Matrix of Decision Rules for Designing IPs

Consecutive Decisions	Criteria (relative weight)	Options
Decision 1 Format	Handling (10) Aesthetics (5) Quantity of Information (7)	1 A-4 Booklet 2 A-4 Sheet folded in 3 3 A-4 Sheet folded in 2 4 A-4 Sheet *
Decision 2 Content	Target Audience (10) Clarity (10)	5 Bulleted Instructions 6 Conventional Style * 7 Complete Graphical Layout
Decision 3 Design	Appeal (10) Simplicity (7)	8 1 Column with Graphics * 9 2 Columns 10 3 Columns 11 1 Column Text, 1 Column Graphics

* Selected Option in each case

Based on a subjective analysis of the elements, it was determined that an A-4 sheet, written in conventional style (introduction to the topic, procedures, tools, methods, and a brief summary with graphics), in 1 column on two sides is the optimal selection based upon the criteria above.

Using a scale of 0,1, 2 for zero, good, and excellent attainment, the following evaluation figures emerged, as shown in Table 2.

Table 2 Evaluation Matrix

Criteria	Weight	1	2	3	4	5	6	7	8	9	10	11
Handling	10	1	1	2	2							
Aesthetics	5	1	1	1	2							
Information	7	2	0	1	2							
Audience	10					1	1	2				
Clarity	10					1	2	0				
Appeal	10								2	2	1	2
Simplicity	7								2	1	1	1
TOTALS		24	15	32	44 *	20	30 *	20	34*	27	17	27

ANNEXES

Focus Group Proceedings and Findings

General

The meeting began at 9 15 a m on August 10, 1997 with all invitees present except a representative from the JVFA With Dr Maher Abu-Taleb acting as facilitator, the individuals in the group introduced themselves A general introduction was then presented by the facilitator incorporating the objectives of the focus group and the process of ranking IPs A simple chart selection example was presented to clarify the optimization procedure

Following the introduction, the criteria set developed by the ERMIC team was put forth for comments and relative weighting Subsequently, the actual evaluation and screening began in earnest producing the required results with everyone participating fully

Selection Criteria Set

The initial criteria set that was developed contained six criteria grouped under three headings as follows

Magnitude of the Problem

Area (90%)

Number of Farmers (80%)

Economics

Benefits (75%)

No of Beneficiaries (0%)

Potential Application

At the Farm Level (90%)

Information Availability (65%)

After several minutes of discussion, the group unanimously agreed that criterion number 4 should be deleted, since criterion no 2 covers the same or similar issues The criteria were then weighted separately by each individual and the average calculated Once a consensus was reached, the final relative weights were determined as shown above

Development of Potential IPs

A number of titles were developed based upon the team's previous experiences and work on the literature audit report The procedure for developing irrigation water extension IPs involved two steps First, extension requirements were categorized under either "Irrigation Water Management" or "Fertigation " Second, under each of those main headings, the key elements were discussed For example, under the first heading,

irrigation scheduling, leaching requirements, and irrigation requirements were analyzed in terms of region, crop pattern, water efficiency and other factors. Consequently, once an exhaustive set of elements was designed, the number of IPs fell out of the analysis, which was graphically presented to the focus group.

Screening Process

The screening process involved each individual in turn suggesting the deletion of any of the IPs based upon judgement and need. The screening continued with each individual discussing the reasons for deletion. The group discussed each suggestion and deletions were made by consensus. Based upon the screening, 25 IPs remained - the target for the focus group.

Final Results

The final list of IPs that will be developed is given in Section 3 of this report.

Focus Group Session Agenda Document

**THE HASHEMITE KINGDOM OF JORDAN
MINISTRY OF WATER AND IRRIGATION**

Water Quality Improvement and Conservation Project, WQIC

Water Management Extension Literature Project

**Focus Group Session Agenda
for
Ranking of Informational Piece Titles**

Environmental Resources Management Consultants

August 4, 1997

FOCUS GROUP SESSION AGENDA
SUNDAY, AUGUST 10, 1997

Time	Topic	Presenter
9 00 - 9 15	Introduction & Objectives	Dr Maher Abu-Taleb Dr Akram Baqa'in
9 15 - 9 45	Criteria Selection & Weighting	Dr Maher Abu-Taleb Eng. Moh'd Hamdan
9 45 - 10 00	Coffee Break	
10 00 - 10 30	Discussion of Titles	Dr Maher Abu-Taleb Eng. Moh'd Sha'ban
10 30 - 1 30	Ranking of Titles	ERMC Team
1 30 - 2 00	Light Lunch	

LIST OF INVITEES TO THE FOCUS GROUP MEETING

Group	Name	Position
JVFA	Mr Rakan Al-Faour	President, JVFA
Private Farmers	Mr Khalil Abu-Ghannam	JVA Farm
	Mr Yousef Baraket	JVA Farm
	Mr Mazen Odeh	JVA Farm
	Mr. Nabil Al-Tajj	JVA Farm
International Organizations	Dr Ross Hagan	Irrigation Specialist, DAI
MWI	Mr. Yasser Nazzal	Irrigation Engineer, MWI
MOA	Dr. Jamal Irshaidat	NCARTT
	Mr Rateb Abu-Zamha	MOA
ERMC	Dr Maher Abu-Taleb	Water Management Expert
	Dr. Akram Baqa'in	Extension Expert
	Mr Moh'd Sha'ban	Irrigation Specialist
	Mr Moh'd Hamdan	Extension Specialist