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The Hashemite Kingdom of Jordan
Ministry of Water and Irrigation

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

Audit of Water Management Research in Jordan

FINAL REPORT

Prepared for

Development Alternatives Inc (DAI)

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EXECUTIVE SUMMARY

This report is the first 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 literature audit of irrigation management publications of applicability to Jordan Valley Agriculture The work presents an exhaustive survey of the currently available literature (studies, project reports, texts, articles, bulletins, theses) on irrigation subtopics ranging from economics to water quality arranged chronologically under main themes or subtopics The audit begins with applicable literature reaching as far back as 1975 and continues through August 1997 The audit was designed to select those references and authors that have contributed to the advancement of knowledge, but at the same time have presented the information in a form that can be used immediately for prioritizing the issues and developing the final objective of this Project, namely, the design and preparation of irrigation extension informational pieces

The audit was designed to impart as much information on the selected references as possible Thus, for each reference, the following information was collected

> Title, researcher(s), researcher affiliation, publisher, document location, year, description and discussion of results

In addition, as each research work was reviewed, the following indicators were used to qualitatively assess the work in anticipation of prioritization and subsequent selection of the most important topics for extension

Research type (*theory, applied research*),
Completeness (*references, potential contribution of research, overall coverage*), and
Relative importance to extension material preparation (*benefit to farmers, potential application at farm level*)

Based on the work conducted, approximately 200 separate references were audited The work was arranged under irrigation subtopics as shown in the contents

The detailed design work for the informational pieces is scheduled to be completed at the end of September 1997 The deliverables during this period include this audit report and a report on selection of extension materials

LIST OF ACRONYMS

ACC	Agricultural Credit Corporation
AMPCO	Agricultural Marketing and Production Corporation
DAI	Development Alternatives Inc
DRC	Domestic Resource Cost Ratio
dunum	one tenth of a hectare
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
HCST	Higher Council for Science and Technology
IP	Information Piece
JVA	Jordan Valley Authority
JVFA	Jordan Valley Farmer's Association
KAC	King Abdullah Canal
KTR	King Talal Reservoir
km	Kilometer
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
SAR	Sodium Absorption Ratio
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

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 literature audit of irrigation management publications of applicability to Jordan Valley Agriculture The work presents an exhaustive survey of the currently available literature (studies, project reports, texts, articles, bulletins, theses) on irrigation subtopics ranging from economics to water quality The audit begins with applicable literature reaching as far back as 1975 through August 1997 arranged chronologically under nine main subtopics The audit was designed to select those references and authors which have contributed to the advancement of knowledge, but at the same time have presented the information in a form which can be used immediately for prioritizing the issues and developing the final objective of this Project, namely, the design and preparation of irrigation extension informational pieces

The Audit Process

The audit was designed to impart as much information on the selected references as possible Thus, for each reference, the following information was collected

> Title researcher(s), researcher affiliation, publisher, document location, year description and discussion of results

In addition as each research work was reviewed, the following indicators were used to qualitatively assess the work in anticipation of prioritization and subsequent selection of the most important topics for extension

(i) Research Type This indicator provides information on the type of research and whether the research is theoretical or applied The indicator is given by the following categories M = magazine article, D = Dissertation or thesis, P = Project Report, T = Textbook, TB or IB = Technical or Institutional Bulletin, S = Scientific Paper, followed by 1 = Theory, and 2 = Applied Research

(ii) Completeness This indicator reflects the level of completeness of the research work It is measured in terms of exhaustiveness of coverage (how extensive are the references?), potential contribution of research to future work or implementation (reliability and usefulness of research results), and overall coverage of topic (are there any gaps?)

1 *References* This indicator identifies the number of references and describes their importance and potential use The indicator is given as

follows No of References, followed by 1 = Extensive, 2 = Moderate, or 3 = Insufficient

2 *Potential Contribution of Research* Based on the knowledge of the auditor, this indicator is measured in terms of future use of such research in project oriented work or applications to other areas The measures are derived from the research results and are as follows 1 = reliable and useful results, 2 = acceptable level of results, or 3 = results do not indicate future contribution

3 *Overall Coverage of Topic* This is measured in terms of the fulfillment of the research of its intended objectives and the extent of fulfillment The measures are 1 = fulfilled objectives thoroughly, 2 = acceptable fulfillment, 3 = substandard fulfillment

(iii) Relative Importance to Extension Material Preparation This indicator is measured in terms of the potential change in the knowledge and attitudes of farmers, and its potential applications at the farm level

1 *Benefit to Farmers* The scale of measurement here varies from 1 = has affected knowledge and attitudes positively, or 2 = no affect on knowledge and attitudes

2 *Potential Application at the Farm Level* This indicator is measured in terms of the potential applicability of the work as follows 1= easily implementable, 2 = implementable with some difficulty, 3 = non-implementable

Organization of the Report

This report is organized in the following manner Following this introduction, Sections 2 to 11 contain the literature reviewed for the audit categorized under the titles of the subtopics Section 12 illustrates the methodology behind the audit procedure, while Section 13 concludes the report with a description of future work emanating from the audit The annexes contain the original scope of work and an extensive list of the persons contacted

PROGRAMS, POLICIES, ANNUAL REPORTS AND IRRIGATION DATA

Evaluation of Agricultural Policies in the Hashemite Kingdom of Jordan

Researchers	El-Habbab, M S and A S Jabarin
Affiliation	United Nations Economic and Social Commission for Western Asia
Publisher	U N
Document Location	MWI Library, Amman - Jordan
Year	1997

Description The study deals with the evaluation of agricultural policies in Jordan, with special focus on commodity, factor, and macro-economic and trade policy linkages The impact of the policies on agriculture were assessed A policy analysis matrix was used to analyze the data and measure competitiveness, efficiency, and effects of policy changes

Results The findings in this study represented base case scenarios where a computer spreadsheet model was developed to provide a viable analytical framework to asses the impact of the structural adjustment program at the farm level Detailed private and social budgets along with policy analysis matrices for each crop by agro-climatic zones are presented

Descriptive Indicators Research Type P2, References 18 (2), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Irrigated Agriculture

Author	The National Strategy of Water & Environment Program
Affiliation	Ministry of Agriculture - NCARTT
Publisher	GOJ
Document Location	NCARTT Library
Year	1997

Description This institutional bulletin identifies the strategies set out by NCARTT to meet its objectives in the coming years The overall irrigated agriculture sector is described followed by budget allocations based on an integrated approach to fulfill NCARTT's programs

Results The report sets out the importance of the sector and identifies the workings of NCARTT in the short term

Descriptive Indicators Research Type IB 2, References 0, Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Jordan National Policies and Strategies in Irrigation Research in Proceedings of The Regional Seminar on Irrigation Research in the Mediterranean Region

Author	Shatanawi, M
Affiliation	Water and Environment Research and Study Center
Publisher	University of Jordan and the Regional Agricultural Mission/French Embassy in Jordan
Document Location	ERMC Library
Year	1996

Description Water shortage and scarcity problems have been recognized by decision makers, planners and researchers In addition to water scarcity, water quality issues are becoming critical The options for increasing water supplies to be explored are desalination, utilization of brackish water and fossil fresh groundwater, reuse of treated waste water, and limited importation An alternative of using very expensive measures, is to focus efforts on better management of water resources and their uses An efficient and inexpensive management approach is through research and development Research and development can play a critical role in addressing the country's water shortage by determining the best management approach to minimize the gap between supply and demand and to prevent the water resources from getting polluted However, research in these sectors is presently performed without coordination and outside a framework of national priorities and objectives

Results Recommendations of the report included the following Research is needed in wide areas related to water Continued research is needed in irrigation management, including the determination of optimal and economic water requirements, improved irrigation technology, and suitable practices and crops for different water qualities There is a potential for enhancing water supplies through water harvesting of floods, artificial recharge, and by testing appropriate technology for cloud seeding Irrigation technology transfer and development is progressing, related in part to the success of the drip irrigation industry in the country

Descriptive Indicators Research Type S1, References 7 (3), Potential Contribution of Research 2, Overall Coverage of topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

Future Adjustment of the Agricultural Production Systems in the Jordan Valley

Author	Qasem, Subhi
Affiliation	Office for Integrated Development, GTZ
Publisher	GTZ/MOA
Document Location	MOA Library
Year	1995

Description This study was conducted in two stages (i) preparation of ten background papers and a series of tables which provided detailed information on Jordan Valley agricultural financial system, production and productivity, environmental stress, water management, soil and land resources, and (ii) preparation of a synthesis paper covering 22 chapters discussing future prospects and

development in the Jordan valley including marketing, financial, input supply, animal production, economic, and other systems

Results The report provides conclusions at each chapter, mainly dealing with possible scenarios over the short, medium and long terms

Descriptive Indicators Research Type P2, References 30 (2), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Jordan Water Sector Review - Volumes I & II

Researchers	Middle East Department III, Natural Resources, Water and Environment Division
Affiliation	World Bank
Publisher	World Bank
Document Location	ERMC Library, Amman - Jordan
Year	1995

Description This report reflects the findings of a Bank mission to Jordan in March 1995 The report comprises an executive summary of the main findings, actions that are being taken by the Government, and recommendations for further action Numerous annexes are included in Volume II to elaborate on the background, conclusions and recommendations put forward in the main body of the report The report states that present institutional arrangements in the water sector are demonstrably inadequate to meet the challenges described The report analyzes the various problems and puts forward 70 practical, specific recommendations, many of which could be implemented quickly

Results The findings are summarized, priorities defined, and an action plan recommended, not just for Government, but also suggesting the most appropriate roles that the Bank and donors might play in supporting the Government's efforts One of Key recommendations concerning irrigation was that the GOJ not increase the area of irrigated agriculture nor the allocation of water to existing irrigated areas

Descriptive Indicators Research Type P2, References 17 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Agricultural Extension and Information Department - Annual Report 1995

Author	Agricultural Extension & Information Department
Affiliation	Ministry of Agriculture
Publisher	GOJ
Document Location	MOA Library
Year	1995

Description This report surveys the accomplishments and highlights the problems in agricultural extension services in Jordan The report reviews the historical development of extension in Jordan The report states that despite 3 years of updating

and institutional development to the Agricultural Extension & Information Department, the services rendered do not meet farmers needs In some areas of Jordan, there are no extension services, e g , in the Arabia area and Southern Shouneh

Results The report makes several recommendations, including serving the farmers in their locales, applying planning in local extension programs (marketing, financial support), developing local training courses in cooperation with international organizations and regional and local supervisors

Descriptive Indicators Research Type IB 2, References 0, Potential contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Annual Agricultural Statistics Report

Author	Department of Statistics
Affiliation	MOA, MWI
Publisher	GOJ
Document Location	MOP Library
Year	1995

Description This annual report provides statistical data on all aspects of agriculture in Jordan from the Jordan Valley to the highlands to the southern regions

Results The report presents the data in tables for each region of Jordan

Descriptive Indicators Research Type IB2, References - extensive, Potential contribution of research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

National Farm Data Handbook for Jordan

Author	ESCWA/FAO/MOA
Affiliation	U N
Publisher	U N
Document Location	MOA Library
Year	1993

Description The objective of preparing this Farm Data Handbook is to facilitate the utilization of existing farm data for planning, policy analysis and project design The handbook contains basic crop and livestock standard input/output data for the major agro-ecological zones in Jordan for the crop year 1991/1992 The report states that the potential uses to which such data can be put are numerous, including agricultural policy analysis, agricultural sector planning, regional rural development planning, preparation of agricultural projects, planning agricultural support services, teaching and training These input/output data are too generalized to be used for planning and managing individual farms or devising specific extension recommendations, which should be based on more detailed data of the specific nature of a site or farming system

Results Data sets were collected from existing information generated through numerous farm surveys Gaps were then filled by interviewing farmers and fields agricultural officers in the agro-ecological zones Data are therefore not to be considered official statistics

Descriptive Indicators Research Type IB2, References - extensive, Potential contribution of research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Prospects for Regaining Sustainable Growth in Jordan Agriculture,

Author	Taimeh, Awni Y
Affiliation	Faculty of Agriculture, University of Jordan
Publisher	University of Jordan
Document Location	University of Jordan Library
Year	1993

Description This 130 page document outlines the major agricultural inputs in Jordan and identifies the key issues for all subsectors, including irrigated agriculture It covers land and water resources and focuses on their sustainable use

Results The study provides numerous recommendations to achieve sustainable growth in Jordanian agriculture over the short, medium, and long terms, including the need to pursue policies and programs that attempt to integrate resource use and comprehensively address the sectors combined

Descriptive Indicators Research Type P2, References 11(2), Potential contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

The Agricultural Policy Charter

Author	The Agricultural Policy Department
Affiliation	Ministry of Agriculture
Publisher	MOA
Document Location	MOA Library
Year	1993

Description This comprehensive document is the result of years of work by various organizations, consultants, and policy makers It outlines the policy guidelines and action plans for the entire agricultural sector with its subsectors
Results This document sets the stage for all agricultural development in Jordan by outlining the policies and programs to be followed by successive governments in achieving sustainable growth and development for all agricultural subsectors

Descriptive Indicators Research Type IB1, References - Extensive, Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Towards Science and Technology Strategies and Policies in the Agriculture and Water Sectors (HCST)

Author	Al-Fataftah, Abdel-Rahman A
Affiliation	Agriculture & Water Sector, HCST
Publisher	HCS&T, Jordan
Document Location	ERMC Library
Year	1991

Description This report describes the general water situation in Jordan in terms of supply and demand It also highlights water consumption rates for various uses, focusing on agriculture

Results The report recommends developing science and technology strategies based on national priorities and the cooperation of all involved

Descriptive Indicators Research Type IB2, References 9 (2), Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

Impact of Wheat Policy on Irrigated Wheat Production in Jordan

Researchers	Al-Habbab, M S , Jabarin, A S
Affiliation	University of Jordan/Department of Agricultural Economics and Extension
Publisher	Unpublished Report
Document Location	University of Jordan Library
Year	1990

Description Main objective of this research is to evaluate the government wheat policy in the irrigated regions of Jordan Valley and the southern desert, using a quantitative policy analysis

Results Wheat production under irrigation was found inefficient compared with tomato production in the Jordan Valley and with alfalfa in the southern desert of Jordan On the other hand the Domestic Resource Cost Ratio (DRC) was found to be 0 42 for wheat produced in the Jordan Valley, which meant that wheat production in this region makes an efficient use of the domestic resources, but when the revenues of tomato in the same area were used as the shadow price of land, the DRC become 4 53, which meant that production of tomato in Jordan Valley was more efficient in the use of resources than the wheat In the southern desert, also, the DRC's were one or less, when the cost of water (private price and social price) was estimated as 27 fils/m3 and 83 92 fils/m3, respectively However, when the price of water was set as its municipal use rates, the DRC reached 2 85 and 2 45 for summer and winter wheat respectively, and for alfalfa it was estimated to be 1 86 The domestic wheat consumption was 575 000 t (1988), 28% of which was locally produced Production of irrigated wheat in Jordan in the same year was 25 700 t, about 9% of the total consumption

Descriptive Indicators Research Type S2, References 8 (2), Potential Contribution of Research 2, Overall Coverage of topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

Towards an Agricultural Sector Strategy for Jordan

Researchers	Country Department III, Agricultural Operations Division
Affiliation	World Bank
Publisher	World Bank
Document Location	ERMC Library, Amman - Jordan
Year	1990

Description This report contains valuable and comprehensive information about the agricultural evolution in Jordan since 1970 The constraints facing agricultural production such as the export market and the limited water and arable land resources were analyzed

Results The report mentioned some strategies that must be followed to solve some problems in the agricultural sector, such as a Market and Trade Strategy, a Pricing Strategy, an Extension and Production Strategy, a Credit Strategy, as well as an Investment Strategy

Descriptive Indicators Research Type P2, References 17 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Law No 19 of 1988 Jordan Valley Development

Author	Jordan Valley Authority
Affiliation	Ministry of Water & Irrigation, GOJ
Publisher	GOJ
Document Location	ERMC Library
Year	1988

Description This document, known as Official Gazette No 3540, contains the articles of the 1988 Law establishing the JVA and assigning it duties of a government body authorized to plan, develop, and manage the Jordan Valley for the benefit of the country

Review of Jordan Valley Authority Irrigation Facilities

Author	Hill, R W and Keller, J
Affiliation	Utah State University, USA
Publisher	USAID Report for JVA
Document Location	MWI Library
Year	1987

Description The purpose of this report was to document the advice provided to JVA for the East Ghor Main Canal Irrigation Project The report outlined water management recommendations, presented routine preventive maintenance programs, and discussed the possibility of utilizing drainage water for irrigation

Results Nine major recommendations were made primarily dealing with system wide efficiency enhancement and overall management

Descriptive Indicators Research Type P2, References 13 (2), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Water Resources in Jordan and Their Impact on the Agricultural Sector Present Situation of Water Resources and Recommendations for Saving and Development in the Future

Researchers	Shatanawi, M and Herzallah, B
Affiliation	Jordan University, Amman, Dept of Soils and Irrigation
Publisher	Jordan University, Amman (Jordan)
Document Location	Jordan University, Library, Amman - Jordan
Year	1984

Description This 10 page paper identifies water supply and demand characteristics for Jordanian agriculture The paper presents the current situation and its shortcomings

Results The recommendations include generic strategies for the future in the areas of water savings and development of new sources

Descriptive Indicators Research Type S2, References 8 M, Potential Contribution of Research 2, Overall Coverage of topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

National Water Master Plan of Jordan Vol V - Irrigation

Authors	Agrar and Hydrotechnic
Affiliation	GTZ
Publisher	Natural Resources Authority
Document Location	MOP Library
Year	1977

Description Irrigation of agricultural land in Jordan is a significant factor of the present and future national economy Accordingly, this aspect was taken into account under the scope of works in the approach to the formulation of the National Water Master Plan of Jordan The investigations and conclusions outlined in this report and part of the documentation for the National Water Master Plan data base

Results In line with the objectives of the work they provide an overall-picture of the present and projected future utilization of the water resources for irrigated agriculture The results of these studies provided an assessment of the available water resources as well as into the comparative review of water resources and water demands It should be noted that the available data sources were not fully satisfactory A number of assumptions and estimates became necessary They served the purpose of this first approach, but it should be the subject of further specific surveys to improve the

background data and thus the information necessary to update the National Water Master Plan in due course

Descriptive Indicators Research Type P2, References - extensive, Potential Contribution of Research 2, Overall Coverage of topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

ECONOMICS OF IRRIGATION

Estimation of Economic Efficiency of Vegetable Production in the Jordan Valley

Researchers	Salman, Amer Z , M S Habbab
Affiliation	University of Jordan
Publisher	Dirasat, Vol 23, Agricultural Sciences No 1, pp 275-291
Document Location	The Deanship of Research
Year	1996

Description The purpose of this research was to estimate the economic efficiency of tomato and string bean production in the Jordan Valley and Ghor Al-Safi

Results The results showed that the production level of tomato which achieves economic efficiency in the Jordan Valley was 500 tons from 162 1 dunums, with a productivity of 3 08 tons/dunum while it was 5 3 ton/dunum in Ghor Al-Safi For string beans produced in the Jordan Valley, the level of production that achieves economic efficiency was 10 8 tons produced from 13 7 dunums, and 10 3 tons produced from 13 1 dunums in Ghor Al-Safi

Descriptive Indicators Research Type S2, References 2 (3), Potential Contribution of Research 1, Overall Coverage of Results 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

On the Economics of Irrigation Water Use in the Jordan Valley

Author	Salman, Amer Z
Affiliation	University of Hohenheim,
Publisher	Gedruckt mit Unterstulzung des Deutschen Akademischen Austauschdienstes (DAAD)
Location	ERMC Library
Year	1994

Description The dissertation describes how the Jordan Valley is suffering from shortages in irrigation water, where further improvements in available water management has not been associated with the expansion of agricultural production Thus, the objective of the study was to bridge the gap between the limited water resources and the increased production of the Jordan Valley farms and to show how the net farm income could be improved by increasing the efficiency of farm resources, particularly water In this study primary and secondary data were used and positive and normative analyses were used In the Positive analysis, the gross margins of single farm enterprises were calculated In addition, farming systems were classified

to calculate their incomes and their profitabilities to water, land and labor The normative analysis discussed the linear programming structure, data basis, cost determination of the representative farms and the possibilities to improve their incomes by increasing the efficiency of irrigation water In order to increase the availability and the efficiency of water, two strategies were examined in the short and long run (i) increasing the water supply, and (ii) introducing water storage facilities (reservoirs) on these farms, in order to store the irrigation water in the months which have water surplus to transfer it to the months which suffer from water shortages In addition to the above mentioned two strategies, the effects of an increased water price on the farm structure were examined in the long run analysis

Results The main findings of the positive analysis showed that the specialized fruit and citrus farms had the highest profitability to land However, the specialized plastic house farms had the higher profitability to water than other farm types such as specialized fruit, citrus and open field production The main findings of the normative analysis in the short-sun included (i) mixed farms which represented combinations between the specialized farms had the highest total net incomes, lower water losses, higher profitabilities and cropping intensities according to the available water supply - these farms suffered from water shortages in the months where plant production increased, (ii) doubling the irrigation water quantity increased the total supply increased - water scarcity problems were not completely solved and in some months water shortages were observed, (iii) introducing a water storage facility (reservoir) on the farms under the present water supply optimized the distribution of water and fulfilled water requirements in the months where water shortages were observed - in addition, cropping intensities and profitabilities to available water supply increased, while water losses decreased, and (iv) the long run analysis indicated that introducing a reservoir on the optimal vegetable farm under the present water supply, would decrease the area under the surface irrigation system in favor of the area under plastic houses and drip irrigation systems Also with the existence of the reservoir, the water price could be increased to 0 05 JD/m3 without leading to changes in the farm structure

Descriptive Indicators Research Type D2, References 68 (1), Potential Contribution of Research 1, Overall Coverage of Results 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Economic Analysis of Irrigation Water in the Jordan Valley

Researcher	Majdalawi, Mohammad E
Affiliation	Ministry of Agriculture
Publisher	Faculty of Agriculture/University os Jordan
Document Location	Faculty of Agriculture/University of Jordan
Year	1993

Description Secondary data for 1990 and 1991 related to production, area planted, export, nutrient contents of the produced products and human nutritional requirements were used in the process of price determination The researcher used 24 vegetable crops, 10 fruit crops in addition to wheat, barley, and garlic Linear programming techniques were used to analyze the data where the objective function was

minimization of water quantity consumed, and the constraints included nutritional requirement and cash value of these crops From the optimal combination of inputs, the quantity of irrigation water and the proposed price was determined for each crops The pricing considered the actual use of water (water requirement of crops) and the relative importance of crops in terms of nutrient content

Results The results of this study can be summarized as follows The proposed prices of irrigation water without considering the export factor, for vegetables, fruit trees, vegetables and fruit trees combined, vegetables, fruit trees, and field crops combined were 10 5, 7 75, 11 75, and 11 4, fils/m3 respectively When considering the export factor (8 1, 6, 10 3, fils/m3, respectively) The study recommended that the proposed price of irrigation water be set at 11 4 fils/m3, where additional revenue could be used to support the farmers in terms of encouraging the use of modern techniques of irrigation water

Descriptive Indicators Research Type D, References 27 (1), Potential Contribution of Research 2, Overall Coverage of Results 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Economical Efficiency of Input Use for Open Field Vegetable Crops in the Ghors of Jordan

Researcher	Mahadeen, Malek
Affiliation	Ministry of Agriculture
Publisher	Faculty of Agriculture/University on Jordan
Document Location	Faculty of Agriculture/University of Jordan
Year	1993

Description The main objective of this study was to examine the efficiency of input use for open field vegetable crops in the Jordan Valley The specific objectives were (i) to estimate production functions for the most important vegetable crops and elasticity of production for each input, and (ii) to estimate the efficiency of input use and determine the optimal and efficient levels to produce vegetables crops To accomplish theses objectives, the researcher selected a sample of 200 farmers A regression model (quadratic equation) was used in this study

Results Parameters used in the study included land ownership in the Jordan Valley (private land, or land utilized by rent or share cropping, or land where the farmer is the operator) and a drip irrigation system for vegetables crops The findings of the study indicated an inefficiency of input use

Descriptive Indicators Research Type D (2), References 22 (2), Potential Contribution of Research 1, Overall Coverage of Results 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

The Relation Between Economic Size at Irrigated Land Property and Economic Aspects in Deir Alla District

Researcher	Haddad, Anwar
Affiliation	Agricultural Credit Corporation

Publisher	Faculty of Agriculture/University of Jordan
Document Location	Faculty of Agriculture/University of Jordan
Year	1993

Description The researcher selected a simple random sample of 81 owners, out of 2,205 owners who represent the total population, allocated to 6 strata Data collection was conducted by using questionnaires, and different statistical and mathematical tools were utilized to achieve the study objectives The researcher faced many problems (e g , different products and prices in the sample)

Results The main results and findings of the research include (i) a low average of land property (26 dunums/owner), and a high degree of land property fragmentation, (ii) optimum economic size of irrigated land property was 53 dunums, whereas the maximizing profit to the property was found to be 78 dunums, (iii) the use of drip irrigation compared with open channel irrigation for the same group of crops and some areas, reduces the economic and maximizing profit size of the land property by 20%, and (iv) the crops that recorded the highest net profit included snapbeans, cucumber and tomato under plastic houses and irrigated by drip irrigation, and citrus, whereas cauliflowers, garlic, and some others, recorded negative net profits

Descriptive Indicators Research Type D (2), References 21 (2), Potential Contribution of research 2, Overall Coverage of Results 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Economics of the Irrigation Methods Used by Farmers

Researcher	Al-Habbab, Mohammad, S
Affiliation	Arab Organization for Agricultural Development
Publisher	Regional project for Supplementary Irrigation
Document Location	University of Jordan Library
Year	1992

Description This study aimed to calculate the benefit-cost ratio, partial budget per dunum and per ton for vegetables and fruit trees in the Highlands and Jordan Valley by using three irrigation methods It contains two chapters Chapter one includes a description of land resources, water resources, cropping patterns, developed agricultural area and an overview of irrigation methods used in the Jordan Valley The second chapter includes the results and recommendations on actual water consumption by crops

Results The main result in this study was that drip irrigation is better than the surface irrigation method in the Ghors and Highlands for vegetables and fruit trees The study presented advice to farmers in using drip irrigation methods and discussed financial savings to farmers

Descriptive Indicators Research Type 2P, References 7 (1), Potential Contribution of Research 1, Overall Coverage of Results 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Cost of Irrigation Water in the Jordan Valley & in the Southern Ghors

Author	Ohlmeyer, Peter, GTZ
Affiliation	Jordan Valley Authority, Amman
Publisher	Unpublished
Document Location	ERMC Library
Year	1991

Description During the past 15 years, Jordan has made considerable investments for the development of irrigation and general infrastructure in the Jordan Valley This effort has been strongly supported by a number of international and bilateral donors who have asked the Government of Jordan to adjust the water tariff to a more realistic level in order to recover the operation and maintenance cost and at least a portion of the capital cost involved In order to evaluate the order of magnitude of cost recovery through water charges, the cost of irrigation operation and maintenance and the capital invested so far is discussed

Results The first tariff for irrigation water in Jordan was issued in 1961 fixing the price at 1 fils/m3 Between 1961 and 1966 the tariff was amended to an extent that any monthly consumption exceeding 1,800 m3 was charged at 2 fils/m3 In 1974, the water price was fixed at 3 fils/m3 regardless of the monthly consumption In May 1989, the water tariff was raised to the present 6 fils/m3

Descriptive Indicators Research Type P2, References 0 (3), Potential Contribution of Research 1, Overall Coverage of Results 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Agribusiness Investment Opportunities in the Hashemite Kingdom of Jordan - A Survey Report

Authors	American Society of Agricultural Consultants International
Affiliation	Under contract to USAID
Publisher	Unknown
Document Location	ERMC Library
Year	1990

Description Jordan has many positive factors for developing agribusiness The study team felt that Jordan can double its agricultural exports to 280 million Jordanian dinars per year in jobs and add one billion JD to the economy During its visit to Jordan, the team interviewed trade group officials, foreign government agency personnel, businessmen, farmers, exporters, the Minister of Agriculture, the Secretary General of the Higher Council and the Royal Scientific Society, and others

Results The study noted that some entrepreneurial agri-businessman had already started new ventures or plan to expend existing businesses It was encouraging to see a few enthusiastic and capable managers who are initiating improvements or expansion to their agricultural operation They need capital and technology in production, processing and/or packing methods, post-harvest handling and transportation, and marketing functions in order to compete successfully in today's modern and competitive food system The report outlined areas where farmers could benefit from government policy Farmer-to-farmer technology transfer is needed as

well as fresh fruit and vegetable packing house technology and when and how to harvest, equipment needed to harvest, pre-cooling and product handling Finally, the report recommends (i) to attract private investment capital from knowledgeable foreign produce companies to expand exports and transfer technology, and (ii) to develop a program of farmer-to-farmer technology transfer

Descriptive Indicators Research Type P2, References - extensive, Potential Contribution of research 1, Overall Coverage of Results 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Discussion of the Possibilities to Introduce a New Water Tariff For Irrigation Water in the Jordan Valley

Author	Ohlmeyer, Peter, GTZ
Affiliation	Jordan Valley Authority, Amman
Publisher	Unpublished
Document Location	ERMC Library
Year	1989

Description An investigation was carried out by the Jordan Valley Authority in 1986 into the cost for the conveyance and distribution of irrigation water to the farm units and the cost recovery through water charges revealed that the water supply in the Jordan Valley is heavily subsidized from the government budget From the point of view of the national economy and in view of the recent developments of the economic situation of the country, a more balanced water charges system with respect to substantial subsidy reduction and to corresponding increase in cost recovery percentages seems to be more necessary and advisable than ever in the past On the other hand, any changes in the Jordan Valley water charges will not only positively influence the government budget but also will have an impact on the income of the farmers At the former water tariff of 3 fils/m3, the annual total water cost charged could be considered as a nominal fee and almost represented a negligible quantity in the cost of production

Results Even after the increase of the water charges from 3 fils/m3 to 6 fils/m3 that became effective in May 1989, the percentage of subsidy for the irrigation water in the Valley is still considerably high Conclusions included the following (i) the average operation and maintenance cost for the irrigation facilities in the Jordan Valley amounted to about 23 4 fils per cubic meter of water delivered to a farm unit during 1986 - including the capital cost for the construction of the irrigation water, this increased to about 34 fils/m3, (ii) at the water tariff of 3 fils/m3 charged until April 1989, each cubic meter of water delivered was subsidized from the government budget at 31 fils and thus recovered only 22 percent of the operation and maintenance cost and not more that 8 8 percent of the total actual cost of a cubic meter of water, and (iii) even after the increase of the water charges to 6 fils, the total subsidy was 27 fils per cubic meter and recovered 44 percent of the operation and maintenance cost and 17 6 percent of the actual cost only

Descriptive Indicators Research Type P2, References 0 (3), Potential Contribution of research 1, Overall Coverage of Results 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Report on Short-term Secondment to Jordan Valley Authority for Collection and Use of Economic Farm Data

Author	Dietz, Martin
Affiliation	GTZ
Publisher	Unpublished Report
Document Location	ERMC Library
Year	1987

Description For this report, the employed method to evaluate the costs of production in relation to returns was made through the calculation of gross margins (farm gate price x yield minus direct cost of each crop) The gross margin is the added value of production generated on an established farm Gross margins of crops can be compared to judge the relative profitability of single crops, they are aggregated as functions of cultivated areas to assess the productivity of farms or areas Distinction was made between 21 crops in three areas, North, Middle and South Jordan Valley Farm budgets were determined for average and non-representative typical farms Data were collected in interviews with farmers Keeping of distributed crop sheets by farmers was not successful Available and cultivated area figures received from JVA Irrigation Department are approximate and need reviewing

Results The most productive crops per dunum - on low or high technical level as well as in all three areas - are the crops in greenhouse (cucumber 477 JD/dunum), fruit trees (orange 312 JD/dunum), broad beans, and eggplant In terms of productivity per m3 of water fruit trees and some winter crops ranked better than other crops Aggregated area gross margins were almost JD 40 million (193 JD/dunum in the North, 230 JD/dunum in the South, and 187 JD/dunum in the Middle of the Valley

Descriptive Indicators Research Type D2, References 68 (1), Potential Contribution of Research 1, Overall Coverage of Results 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

IRRIGATION WATER MANAGEMENT

Irrigation Water Management for Onion Trickle Irrigation with Saline Drainage Water

Researchers	Abu-Awwad, A M
Affiliation	Faculty of Agriculture/University of Jordan
Publisher	Dirasat - Agricultural Science, Volume 23, No 1
Document Location	ERMC Library
Year	1996

Description This study was conducted during 1991/1992 and 1992/1993 at the Experimental Research Station of the University of Jordan in the Jordan Valley on

onion The experiment consisted of three irrigation water qualities, and four water levels The study contains two tables and three figures

Results Results indicated that increasing water applied compensated partially for the adverse effects of increasing irrigation water salinity Salt accumulation in the crop root zone was at the max in W3 (1 0 Evaporation) With supplemental irrigation, winter onion production per unit area can be increased by two to three times The tolerance threshold soil salinity of relative onion yield varied from 2 43 to 3 6 ds/m, and the rate of relative yield varied from 8 4 to 21 5% These result place winter onion grown in the Jordan Valley in the moderately sensitive to salinity category

Descriptive Indicators Research Type D2, References 16 M (1), Potential Contribution of Research 1, Overall Coverage of topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Optimal Irrigation Management Under Conditions of Limited Water Supply in the Jordan Valley

Researcher	Al-Qudah, Hussein
Affiliation	A Thesis submitted for the Degree of Doctor of Philosophy at the University of London/WYE College
Publisher	University of London
Document Location	University of Jordan Library
Year	1996

Description Water shortage has been a central problem in the Jordan Valley area since the mid 1980s Given the prospect of declining water availability to the agricultural sector, modernization management practices are important means to deal with water shortages Thus, the overall objective of the thesis is to create knowledge of more desirable patterns of water use The main hypotheses are as follows First, that the socio-economic characteristics of the farmers affect the level of adoption of water saving technology Second, that reduction in water use can be achieved with relatively small losses in farmers' incomes in the Jordan Valley Third, that the marginal value product of water among farmers is different, and fourth, that the marginal value of irrigation is higher than the marginal cost of supplying it Univariate and multivariate statistical analysis of survey data are used to investigate the relationship between socio-economic characteristics of farmers and their adoption decisions The linear programming models are used to test hypothesis 2 The marginal value product derived from the models is used to investigate the last two hypotheses

Results The main conclusion are that education appears to have an important role and should accompany other programs to accelerate adoption decisions Under conditions of optimal irrigation management, relatively large reductions in water use can be achieved with relatively small losses in farmers' incomes The establishment of an appropriate institution to deal with tradable water rights could promote economic efficiency in allocating water resources in irrigated agriculture Finally, given the estimated marginal values of water in agriculture, the impact on farmers' incomes of charging water according to its long run marginal cost might be

substantial Almost all the modelled farmers' incomes would be severely affected However, economic charges for water according to its marginal costs appear likely to influence the uptake of new water technology and cropping patterns

Descriptive Indicators Research Type S2, References 150 (1), Potential Contribution of Research 2, Overall Coverage of Results 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

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

Researchers	Sha'ban, M
Affiliation	Regional Seminar on Irrigation Research in the Mediterranean Basin
Publisher	Unpublished paper
Document Location	ERMC Library
Year	1996

Description This study was carried out on a private farm in the Middle Jordan Valley, through a cooperative project between the University of Jordan and the Agricultural Mission at the French Embassy in Amman, to achieve the following objectives (i) to examine the possibility of irrigation scheduling using electronic tensiometers, (ii) to examine the possibility of saving water by using water-mark tensiometers in comparison with the usual way of irrigation, and (iii) to achieve more participation from the farmers in working with tensiometers and making irrigation scheduling decisions

Results The primary results of this study indicate there is a possibility of saving water without any reduction in the yield by scheduling irrigation with water-mark tensiometers The results also show that, on the average about 50% of the irrigation water can be saved by proper water management

Descriptive Indicators Research Type D2, References (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Effect of Water (pH) on the Stability of Pirimicarb

Researchers	Al-Mughrabi, Khalil I , Nazer, Ibramim K, Al-Shuraiqi, Yousef T
Affiliation	University of Jordan/Department of Plant Protection/Faculty of Agriculture
Publisher	Mu'tah Journal For Research and Studies Vol 10, No 2
Document Location	University of Jordan/Library
Year	1995

Description The chemical stability pf pirmicarb was studied at different values of water pH Four different treatments were used to study the stability of Pirimicarb King Abdullah Canal Water (KAC) (pH = 8 26), distilled water, phosphoric acid-

treated canal water (pH = 6 00), and propionic acid-treated canal water (pH = 6 00) Samples were allowed to stand for three different periods (1,4, and 24 hours) after spraying solution preparation Gas Liquid Chromatography was used in the determination of pirimcarb in water samples

Results Results indicated that KAC water treatment caused the highest percentage of hydrolysis of Pirimicarb after 1,4, and 24 hours from treatment, while losses were slightly lower in distilled water Phosphoric acid treated canal water showed a negligible percentage of hydrolysis at 24 hour period, while propionic acid-treated water was less efficient compared to phosphoric acid treatment

Descriptive Indicators Research Type P1, References 10 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Rationality of Water Use in Jordan

Researchers	Arab Organization for Agricultural Development
Affiliation	Ministry of Agriculture
Publisher	Arab Organization for Agricultural Development
Document Location	NCARTT-Library
Year	1995

Description This study contains seven descriptive chapters on water resources, water uses, water balance, irrigation methods and efficiency, distribution of water for different agricultural units, water quality in the Jordan Valley and the Highlands, crop water requirements and cropping patterns, and the rationality of water use The main objective of this study was to determine the rationality of water use by increasing water resources or increasing the charge for water use

Results The quality of water resources and run-off is suitable for all crops, but King Talal Dam Water is only suitable with some restrictions Water efficiency must be increased by increasing pumping efficiency and selecting suitable crops with suitable methods for irrigation

Descriptive Indicators Research Type D2, References 10 (2), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Irrigation Management and Water Quality in the Central Jordan Valley - A Base Line Survey

Researchers	Shatanawi, M , Ibrahim Ghawi, Mannar Fayad
Affiliation	University of Jordan
Publisher	USAID Report
Document Location	University of Jordan Library
Year	1994

Description Research was conducted during the growing season of 93/94 to measure on-farm irrigation management efficiency (IME) and to evaluate the economics of

agricultural production for typical crops and irrigation methods in Central Jordan Valley and Zarqa triangle In addition, investigations on irrigation water quality were carried out

Results In terms of on-farm irrigation management efficiency, two main conclusions can be drawn (i) the efficiency of on-farm drip irrigation in plastic houses is very low, high technology systems operate at 70 percent efficiency or less, (ii) the conventional wisdom that surface irrigation methods are inefficient when compared with drip irrigation methods is incorrect - drip irrigation has the potential to be very efficient, however, realization of the potential can occur only if systems are well designed and maintained and if irrigation scheduling is in accordance with crop-water requirements In terms of the economic return to water use (JD/M3), production in plastic houses was higher than from production using open field drip irrigation, which were in turn superior to the returns from conventional surface irrigation Average returns to water use for the three types of irrigation were far greater than the current price of water In terms of water quality, high concentrations of nitrogen were detected in the drainage water due to excess fertilizer use In addition, excess fertilizer use can result in increased vegetative growth at the expense of fruit The concentrations of all trace elements were found to be low and within guidelines for irrigation water However, long-term use of irrigation water suggests than the accumulation of these elements in soil should be monitored regularly

Descriptive Indicators Research Type P2, References 1, Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Irrigation Water Management of Trickle-Irrigated Onion

Researcher	Abu-Awwad, Ahmad M
Affiliation	UOJ Faculty of Agriculture
Publisher	The Deanship of Research, University of Jordan/Dirastat (Pure and Applied Sciences), Vol 21 B No 6, pp 186-199
Document Location	University of Jordan Library
Year	1994

Description Four different water amounts were used on a given soil via trickle irrigation Soil water content was measured just before each irrigation at 150 mm Irrigation water was applied twice weekly The amount of water to be irrigated was estimated with reference measurement from class A pan evaporation The objective of this study was to investigate the impact of effective rainfall, water use, yield of onion bulb and water use efficiency as affected by rainfall and four different amounts of water

Results Effective rainfall increased with light frequent rainfall The effective rainfall was at the maximum in the lowest water treatment, and decreased as water amount increased with the minimum in the highest water treatment Increasing water use from 25% level to 100% increased onion yield significantly However, no increase in yield occurred as water use increased from 100% to 150% Water use varied from

294 mm and 262 mm to 448 mm with corresponding yield ranging from 19 5 and 16 4 tons/ha to 36 8 and 36 5 tons/ha in 1991/1992 and 1992/1993, respectively

Descriptive Indicators Research Type S, References 19 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Proper Use of Irrigation Water in the Near East in "Regional Workshop on the Role of Extension Services in Promoting the Proper use of Irrigation Water and Agro-Chemicals at the Farm Level"

Researchers	Sarraf, S , Azad, A M
Affiliation	FAO and The Regional Center for Agrarian Reform & Rural Development for the Near East
Publisher	FAO, CARDNE
Document Location	ERMC Library
Year	1994

Description Irrigated land makes a very significant contribution to global crop production Currently, that contribution is about 37 percent and FAO assessments towards 2010 indicate that this contribution is likely to increase to 42 percent by 2010 Despite its impressive performance in the past, the future role of irrigated agriculture will have to be examined in the light of emerging economic, environmental and socio-political factors World wide, the average rate of expansion of irrigated areas was 1 percent per year in the early 1960s, reaching a maximum annual rate of 2 3 percent from 1972 to 1975 Since then, the rate of expansion has decreased and is currently less than 1 percent per year As much as 60% of the water diverted or pumped for irrigation is wasted Extremely low irrigation efficiencies (20%-30%) in some key countries and very low irrigation efficiencies (30%-50%) in virtually all developing countries are cited

Results Various results and recommendations were presented in this document Based on different experiments, water flow in the furrows was quicker by about 30%, soil moisture was totally homogenous throughout the length of the furrows, while it varied greatly in the traditional methods, the grading process was much quicker, the field trail showed that the grading by laser instrument costs 15% more than the traditional method Recommendation regarding the management and extension aspects were (i) establishing demonstration fields at the farmers' farms, in order to show them the advantages and convince them to grade their fields before planting it, and (ii) the extension service should put more efforts and conduct extension campaigns to transfer technology of land grading and surveying to the farmers

Descriptive Indicators Research Type S2, References 3(2) , Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Irrigation in Jordan in "Proceedings of the Regional Seminar on the Optimization of Irrigation in Agriculture"

Researcher	Avedis Serpekian

Affiliation	Jordan Valley Authority
Publisher	French Embassy in Jordan & GTZ
Document Location	ERMC Library
Year	1994

Description This paper contains general information about Jordan's topography, climate, agriculture, irrigation projects, and water resources Also, some of the investment proposals and projects concerned with the irrigation projects proposed to Middle East/North Africa Economic Summit were present

Results The report contains a recounting of facts already published elsewhere

Descriptive Indicators Research Type S2 References 0 (3), Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 3

Basic Principles for Water Requirements and Irrigation Intervals

Researcher	Al-Sharief, Wael A
Affiliation	NCARTT
Publisher	Unpublished Report
Document Location	NCARTT Library
Year	1994

Description This report contains brief lecture sheets on basic principles of irrigation

Results The report does not reach any conclusions

Descriptive Indicators Research Type S2, References (1), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Minimizing Water Demand for Different Uses in the ESCWA Region (In Arabic)

Researchers	ESCWA
Affiliation	ESCWA
Publisher	Regional Seminar on Water Uses, Conservation Means, ESCWA, World Health Organization
Document Location	ESCWA Library
Year	1993

Description This report has general information about ESCWA countries concerning (1) local water resources in comparison with the global water resources, (2) water demand for the different uses municipal, agricultural, and industrial, (3) water supply and water demand management, and (4) demand management objectives water quality control, water resources conservation, and sustainable development Technical and economic aspects of water demand management aimed at reducing water losses are presented

Results There are huge losses in all water use aspects in ESCWA countries Therefore, water resources planning and water demand management are vital in this region

Descriptive Indicators Research Type P1, References 11(2), Potential Contribution of Research 3, Overall Coverage of Results 1, Benefit to Farmers 2, Potential Application at
the Farm Level 3

Irrigation Water and Agriculture in Jordan Valley and Southern Ghor· The Possibility of Cultivating Substitute Crops

Researcher	Ghezawi, Ali Z , Mohammed M Khasawneh
Affiliation	Center for International Studies, Royal Scientific Society
Publisher	RSS
Document Location	RSS Library
Year	1993

Description This document reviews agricultural production and practices in the vast region of the Jordan Valley and the Southern Ghors The study contains water use and supply data and examines the nature of crop selection in these areas A representative sample of 500 farmers in the Jordan Valley and Southern Ghors were interviewed The sample accounted for about 7% of the 7000 farmers in these regions

Results More than 22% of the Jordan Valley and Southern Ghor irrigated lands are cultivated with perennial trees, and consume 41% of the total irrigation water in the Valley In 1991, Jordan Valley and Southern Ghor agricultural production contribution amounted to 70% and 65 7% of the country's vegetables and fruits production, respectively In these regions the cost of irrigation water does not exceed 5% of the vegetables and fruits production cost In addition, the research presents a number of scenarios where production of some crops could be enhanced and new crops developed for the area

Descriptive Indicators Research Type T2, References 20 (1), Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the farm level 3

Water Management at the Farm Level (In Arabic)

Researcher	Shatanawi, M
Affiliation	University of Jordan/WERSC
Publisher	Ministry of Agriculture/National Center of Agriculture, NCARTT
Document Location	NCARTT/Library
Year	1992

Description The study contain a brief description of irrigation in the highlands and desert areas, water scheduling methods, consumptive use, and efficiency of water use

Results The researcher proposed six studies to analyze the farm level irrigation situation Water requirements for the major crops in the Jordan Valley were presented

Descriptive Indicators Research Type P2, References 10 (2), Potential Contribution of research 3, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 3

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

Researcher	Al-Zuraiqi Said, Al-Rajabi, Mazin, Al-Dabbas, Mohamad
Affiliation	National Center of Agriculture, NCARTT
Publisher	Deir-Alla Agricultural Department/MOA
Document Location	Deir-Alla Regional Center Library/NCARTT
Year	1991

Description An experiment was conducted in Deir-Alla agricultural station to schedule the irrigation for beans according to tensiometers readings Three irrigation treatments were used these are to irrigate at 0 3, 0 5, and 0 7 bar, with 4 replicates

Results Results indicated that there is no significant difference in crop production between the treatments, although there is an increasing trend in the yield with increasing the amount of water The yield was 5 97, 5 87, and 5 6 tons/dunum, and the amount of water used was 742 7, 653 4, and 576 7 mm/dunum, for the tensions of 0 3, 0 5, and 0 7 bar respectively

Descriptive Indicators Research Type P2, References 0 (2), Potential Contribution of Research 2, Overall Coverage of Results 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

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

Researchers	Al-Zuraiqi, Said, Al-Rajabi, Mazin
Affiliation	National Center of Agricultural, NCARTT
Publisher	Dier-Alla Agricultural Department/MOA
Document Location	Deir-Alla Regional Center Library /NCARTT
Year	1991

Description Three plastic-houses were used in this experiment as replicates Two irrigations were used as main treatments (I1 irrigation once a week and I2 irrigation twice a week) Five nitrogen levels were used as sub-treatments (zero, 30, 50, 70, and 90 kg/d) The water quantity was determined at a 100% of the evaporation pan reading 20 fertilizer applications were used, the first application before planting, the second after one month, and the remaining applied in a one week interval throughout the season

Results Results indicated that, the amount of water applied throughout the season was about 265 mm, which is relatively low due to weather conditions in that year There is no significant difference in the yield between the two main treatments I1, and

I2 which produce 5 88, and 5 65 tons/dunum respectively All N- application treatments gave significantly higher yield compared to the control (zero kg N/d) The N- fertilization with 30 kg/d once a week gave significantly the highest yield compared to the other treatments

Descriptive Indicators Research Type P2, References 0, Potential Contribution of research 2, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Irrigation Water in Jordan and the Size of the Problem (In Arabic)

Researchers	Irrigation Department, JVA
Affiliation	MWI
Publisher	Irrigation Department, JVA
Document Location	Irrigation Department, JVA
Year	1991

Description This paper contains information about water resources in Jordan, and the amounts of water consumed by the different development sectors in Jordan This paper also discusses irrigated agriculture in Jordan, and its water requirements and the importance of increasing the water conveyance efficiency to reduce water losses

Results The available water in Jordan in 1989 reached about 1,291 MCM Although the agricultural sector provided 14% of the population needs, it consumed about 75% of the available water Therefore, a long term strategy to increase irrigation water efficiency is needed

Descriptive Indicators Research Type IB1, References 0, Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2 Potential Application at the Farm Level 3

Chemistry of King Abdallah Canal Water in the Jordan Valley II Effect of Water pH on the Stability of Dimethoate

Researchers	Al-Mughrabi, Khalil I , Nazer, Ibramim K
Affiliation	University of Jordan/Department of Plant Protection/Faculty of Agriculture
Publisher	Arab Gulf Journal for Scientific Resources, 9 (2), pp 13-22
Document Location	University of Jordan Library
Year	1991

Description Chemical analysis of King Abdallah Canal (KAC) water in the Jordan Valley (JV) was conducted for collected samples from ten different sites along the KAC Water analysis included parameters such as pH, electrical conductivity (EC), and major anions and cations The chemical stability of Dimethoate was studied at different water pH values Four different treatments were used to study the stability of Dimethoate These treatments were canal water (pH = 8 44), distilled water, phosphoric acid-treatments were canal water (pH = 6 00), distilled water, phosphoric acid-treated canal water (pH = 6 00) Spray solutions samples were allowed to stand

for 1,4 and 24 hrs before extraction Gas Liquid chromatography was performed in the determination of Dimethoate in water samples

Results Canal water samples caused the highest % of hydrolysis for Dimethoate after 24 hrs of treatment, while losses were much lower in distilled water Phosphoric acid-treated canal water showed almost negligible % of hydrolysis during 24 hrs, while propionic acid-treated canal water was much less efficient compared to distilled water and phosphoric acid-treated canal water Results of chemical analysis of water showed that water pH values of the selected sites along the KAC in the JV were slightly high and ranged between pH 7 90-8 27 This was during July 1988

Descriptive Indicators Research Type P1, References - extensive, Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Irrigation Management of Plastic House Cucumbers

Author	Oweis, Th Y
Affiliation	Jordan Univ , Amman (Jordan)
Publisher	Dirasat (Jordan) (Oct 1990) v 17B(4) p 59-71
Document Location	University of Jordan Library
Year	1990

Description The cucumber yield response to different levels of irrigation under plastic house conditions was studied in Central Jordan Valley A drip irrigation system was used to apply four water treatments of 40%, 60%, 80% and 100% of the crop potential water requirements Weekly transpiration was determined and Crop-pan coefficients (Kcp) were developed

Results The irrigation production function was found to be quadratic A maximum yield of 946 tons/hectare (t/ha) was produced with 223 mm of water consumed as transpiration The water use efficiency ranged from 0 38 to 0 50 t/ha-mm Kcp increased from about 0 14 at planting to over 0 5 in midseason, and dropped to 0 30 at the end of the season The derived irrigation production function and crop coefficients are the basis for determining irrigation amount and schedules for optimal production of cucumber in plastic houses Such relationship can also help in the development of sound national water policies

Descriptive Indicators Research Type S2, References 6 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Agriculture in Jordan Potentials, Constraints, Objectives Agricultural Resources, and Their Utilization in "Regional Workshop on The Role of Extension Services in Promoting the Proper Use of Irrigation and Agrochemicals on the Farm Level"

Researchers	Zindaqa, Tal'at
Affiliation	University of Jordan/Faculty of Agriculture
Publisher	Unknown

Document Location University of Jordan/Library
Year Undated

Description This report discusses the various agricultural regions of Jordan, and briefly discusses water scarcity and the fluctuations of availability of water from one year to the other The report also briefly presents various land, socio-economic, and other issues of concern to agriculture in Jordan

Results The report suggests the following (i) expanding food production by utilizing all the available agricultural production resources such as water, soil and vegetation cover, (ii) preserving the essential natural resources and utilizing them in the optimum way, (iii) increasing the returns on investment in the agricultural sector and improving the incomes of farmers and agricultural workers, (iv) contributing to an improved external trade balance by increasing the exports of agricultural goods, and (v) attaining the largest possible levels of agricultural integration between Jordan, Iraq, Syria, Lebanon and Palestine at a first stage, and with the countries of the Gulf operation council at a later stage

Descriptive Indicators Research Type S 2, References 0, Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

Rainfall Forecasts and Irrigation Demand A Case Study From the Jordan Valley

Researchers Radwan A Al-Weshah, Muhammad Shatanawi
Affiliation University of Jordan
Publisher University of Jordan
Document Location ERMC Library
Year Undated

Description Rainfall plays a significant role in irrigation scheduling and management It is evident that the amount of net rainfall forms a substantial portion of the irrigation water requirements during the rainy season If this role of rainfall on irrigation demand is not well considered, it may negatively affect the irrigated area by flooding, excessive erosion and overloading of the irrigation conveyance system itself If rainfall can be accurately forecast, it shall be incorporated in the irrigation scheduling and demand by controlling the water release from the diversion source This paper presents a preliminary conceptual illustration on the effect of rainfall on irrigation demand for the whole Jordan Valley (JV) and irrigation demand for fruit trees in the northern part of the Jordan Valley (NJV) The observation and preliminary results from this case study shows that about 81 and 66 percent of the variability in the monthly irrigation demand can be attributed to the variations in monthly rainfalls for the JV and NJV, respectively However, a more comprehensive research in this regard has started recently by the Water and Environment Research and Study Center (WERSC) taking into account rainfall forecasts on daily, weekly, and monthly time horizons

Results This case study presents a simple illustration of the use of rainfall to predict the irrigation demand and thus the water release from the diversions in the irrigation system It recommends a more comprehensive study to develop a daily water demand model for the NJV using rainfall forecasts

Descriptive Indicators Research Type S 2, References (2), Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 3

Optimal Irrigation Management for Protected Tomato in the Jordan Valley

Researchers	Oweis, Th Y , Shatanawi, M R , Ghawi, I
Affiliation	University of Jordan
Publisher	Dirasat (Jordan), Vol 15(11), p 104-118
Document Location	University of Jordan Library
Year	1988

Description The irrigation production function of tomatoes grown in plastic houses was studied and used to optimize its irrigation management under Jordan Valley conditions Drip irrigation systems with variable dripping lines were designed and used to apply predetermined amounts of water to four treatments along the plastic house Tensiometer and soil water plants relationship were considered to schedule irrigation Transpiration was determined by considering the amounts applied where evaporation, deep percolation and other losses were eliminated

Results The results showed that the relationship between total tomato yield and transpiration was quadratic The relative yield responded linearly to relative transpiration Maximum yield of about 158 tons/hectare could be produced with 600 mm of net irrigation Weekly crop-pan coefficients (Kcp) were derived using transpiration data observed and class A pan data from the site Kcp increased from 0 15 when harvest was completed The derived production function relationship can be used with confidence to optimize tomato production and water use in the Jordan Valley Obtained crop-pan coefficients can be used as simple and accurate measurements for scheduling tomato irrigation in the Jordan Valley and similar areas

Descriptive Indicators Research Type S2, References 14 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Irrigation Scheduling of Sweet Paper Inside The Plastic Houses

Researchers	Al-Rajabi, Mazin
Affiliation	National Center of Agricultural, NCARTT
Publisher	Al-Aghoara Agricultural Department/MOA
Document Location	Deir-Alla Regional Center Library/NCARTT
Year	1988

Description An experiment was conducted in Deir-Alla agricultural station to schedule the irrigation for sweet paper by tensiometer readings Three irrigation treatments were used, these are to irrigate at 30, 50, and 80 cb, with 4 replicates to

determine when to irrigate The neutron probe readings before irrigation and after 24 hours were used to determine how much to irrigate

Results Results indicated that the amounts of water consumed were 342 9, 348 1 and 306 4 m3/d, for the treatments 30, 50, and 80 cb respectively Treatment 30 cb gave significantly higher yield than the treatment 50 cb There is no significant difference in the yield between the treatment 30 cb and the treatment 80 cb To schedule irrigation according to tensiometer reading at 80 cb for sweet peper inside plastic-houses in Deir-Alla is recommended by this study

Descriptive Indicators Research Type IB2, References 0 (1), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

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

Researcher	Safadi, A S
Affiliation	University of Jordan
Publisher	Thesis (M Sc in soils and irrigation)
Document Location	University of Jordan/Library
Year	1987

Description The study describes experiments performed on squash in the Central Jordan Valley Results showed no significant differences between the three treatments of irrigation schedules at 30, 50, and 80 KPa for winter and spring seasons with respect to yield, total water supplied, irrigation amounts, application water efficiency, water use efficiency, vertical root length, horizontal root length and oven-dry root weight The plants under the three treatments consumed average water amounts of 12 79, 12 75 and 12 44 cm, respectively, during the winter season and produced average yields of 19 4, 21 6, and 22 0 /ha, respectively During the spring season the plants consumed average water amounts of 15 28, 13 98, and 14 97 cm and produced average yields of 8 6, 7 4 and 7 6 t/ha for all of the three treatments Average water use efficiencies for the 30, 50 and 80 KPa treatments were 1 58, 1 79 and 1 88 t/ha/cm for the winter season, and 0 56, 0 58 and 0 51 t/ha/cm for the spring Number of irrigation treatments was significantly lower in the 80 KPa when compared to the 30 KPa treatment during the winter

Results During the spring significant differences in the number of irrigations were revealed between 30 and 50 KPa, and the 30 and 80 KPa treatments Recalibration of the yield portion of the soil water management simulation model (CRPSM) for squash for both seasons resulted in new sets of growth stage weighing factors (lambdas) and maximum field attainable yields Better calibration was obtained during the winter due to disease and temperature effects during the spring The different water management options provided by the model were tested to select the best irrigation schedules that will maximize yields and optimize water use efficiency, and cut down field trials to be tested in future studies for achieving lower cost and less time span

Descriptive Indicators Research Type D2, References 51 (1), Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

Irrigation Scheduling of Tomato Grown Under Drip-Irrigation Inside Plastic Green House in the JordanValley

Researchers	Al-Battikhi A , Judah O , Suwwan M
Affiliation	UOJ
Publisher	Dirasat, Vol XII, No 6
Document Location	Scientific Research Deanship, UOJ
Year	1985

Description A study was carried out in 1979/80 with the objective of scheduling irrigation of tomato grown inside plastic-houses under drip irrigation in the Jordan Valley Three levels of soil moisture tension 30, 50, and 70 cb, were used These levels were selected from a soil absorption curve specially prepared for soils representing the area under study The tensiometers were used to determine time of irrigation

Results Results obtained indicated that as the soil moisture tensions were increased, intervals between irrigations and eventually total amounts of irrigation water applied were significantly changed The total amount of applied water were, 859, 803, and 639 mm for the 30, 50, and 70 cb treatments respectively Total yields obtained were 197 4, 201 5 and 172 9 ton/ha for the 30, 50, and 70 cb respectively The water use efficiencies for the different treatments had no significant differences between them, although there were significant difference in some cases between total yields No significant differences were found between south and north sides of the plastic-house for all parameters tested

Descriptive Indicators Research Type S2, References 8 (2), Potential Contribution of Research 1, Overall Coverage of Results 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Drip Irrigation (In Arabic)

Researcher	Al-Fahmawi, Subhi
Affiliation	Agricultural Engineering Private Sector
Publisher	Agricultural Research and Extension Department, MOA
Document Location	MOA Library
Year	Undated

Description This extension bulletin was written in a new style, which is to transfer the information in the form of answers to frequent and specific questions The writter of this article translated the information from World Agriculture magazine, to introduce the drip irrigation as a new technology to Jordanian farmers

Results The informations introduced in this article is considered very basic

Descriptive Indicators Research Type M 1, References 0, Potenti
Research 2, Overall Coverage of Topic 1, Benefit to Farmers 2, Pote
at the Farm Level 1

The Irrigation of the Jordan Valley

Reseacher	Maser, Ibrahim
Affiliation	Ministry of Planing
Publisher	Ministry of Planing/The Economic Planing Di
Document Location	NCARTT/Library
Year	1956

Description This study contains general descriptive data about the
such as climate, land, water resources, population, development probl
crop and water exploitation, cropping patterns, possibility of market
crops, and animal production The purpose of this paper was to gi
concise idea on the conditions and possibilities the Jordan Valley ar
within the agricultural economics of Jordan

Results The report concluded that it will be necessary to establis
permanent Governmental Authority which will be responsible for the
the valley, and determine cropping patterns, types of field cro
vegetables

Descriptive Indicators Research Type S 2, References 0, Potential
Research 3, Overall Coverage of Topic 1, Benefit to Farmers 2, Poter
at the Farm Level 3

CROP WATER REQUIREMENTS AND PRODUCT

**The Effect of Irrigation Scheduling on Citrus Yield Under Drip Ir
Jordan Valley**

Researchers	Mohamed Al-Azhare M Saleh
Affiliation	Faculty of Graduate Study/University of Jordan
Publisher	Faculty of Graduate Study/University of Jordan
Document Location	University of Jordan/ Library
Year	1996

Description This study was conducted at an irrigated citrus farm loc
Central Jordan Valley during the 1995 growing season to examine the
saving water using estimated evapotranspiration for irrigation sched
researcher used 4 irrigation treatments based upon the Penmen-Montei
class "A" pan, the Hargreaves equation, and irrigation twice a week for
half hours The literature review contained good information on wate
irrigation systems evaluation, and salinity effects

Results The results indicated that Penman-Monteith, Pan evaporation, and Hargreaves appear to be satisfactory for the use by irrigators in the Jordan Valley for scheduling irrigation and save considerable amounts of water

Descriptive Indicators Research Type B2, References 48 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Water Requirements and Irrigation Scheduling for Tomatoes by Using the Methods of Spotting Irrigation for Exposed Planting in South Ghors Region

Researcher	Al Sharif, Wa'el, Atef Mahadeen, A E Ahmad Madadha, Uhoud Al-Horani
Affiliation	MOA
Publisher	Unpublished
Document Location	NCARTT Library
Year	1996

Description The water requirements and irrigation scheduling for tomato crops in the exposed fields in Ghour Al-Safi region (Agricultural Researches Station) have been studied for the harvest season 94/95 Spotting irrigation has been used as a developed irrigation method, where three levels of irrigation quantities were used These were (50, 75, 100%) of the loss reading from class "A" pan and three extra periods which were two days, four days and six days where these treatments have been executed by using split plot design repeated for three times

Results Results showed that the loss quantity by evaporation from the class "A" evaporation pan during the period from 5/1 until 15/4/1995 has reached about 440 4 mm It was also found that there were no substantial differences in total, marketed and non- marketed production for the tomato crop as a result of using irrigation treatments where production reached 1 8, 1 6, 1 6 Tons/dunum (100 sq m) for the treatments which have been irrigated at a level of 50%, 75%, 100% of loss readings from the evaporation pan

Descriptive Indicators Research Type S 2, References (3), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Salt Distribution and Soil water Management for Line Source Trickle Irrigated Sweet Corn

Researchers	Abu-Awwad, Ahmad M
Affiliation	University of Jordan/Faculty of Agriculture
Publisher	Dirasat, Vol 22 B (Pure and Applied Science) No 1, pp 7-25
Document Location	University of Jordan/Faculty of Agriculture Library
Year	1995

Description The work involved an experiment with the following parameters three water qualities, salinity of 1,1 6 and 1 4, ID, 3 5 and 2 2, D, 5 2 and 3 7 ds/m, four

water amounts, W1 = 0 25, W2 = 0 5 and W3 = 1 0 and W4 = 1 5 times the evaporation from class A pan during 1991 and 1992 Sweet corn was planted at 5 cm between rows The work was conducted at the University of Jordan Agricultural Research Station in the Jordan Valley

Results Increasing water salinity resulted in a significant increase in the average crop root zone salinity The highest salt concentration occurred in the root zone when the amount of water applied was near the crop evapotranspiration, indicating the importance of avoiding under irrigation with saline irrigation water Adoption of the so-called "varied leaching" concept for irrigation management might be of appreciable benefits for reducing salinity hazards Salt accumulation varied according to irrigation water salinity and amount of applied water with a maximum salt accumulation at the soil surface and toward the edge of the wetting front

Descriptive Indicators Research Type S, References 23 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Water Requirements and Irrigation Scheduling for Sugar beet For Exposed Planting in Jordan Valley Region (Deir Alla) and the Eastern Heights and (Al Khaldiyeh) - In Arabic

Researchers	Wa'el Al-Sharif, Hussain Meqdadi, Said Zuraiqi, Abdullah Al-Shobaki, Saleh Shdeifat, Ismat Karadsheh
Affiliation	NCARTT
Document Location	NCARTT Library
Year	1995

Description The objectives of this work were to estimate the total water requirements for sugar beet and fix suitable irrigation dates

Results Results showed that there is no significant difference between the irrigation treatment quantities to production of heads, whereas the interaction between treatments showed significant differences among three groups

Descriptive Indicators Research Type S, References (2), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Production Function Determination of Row Inter-cropping Between Broad-Bean and Potato Under Different Water Amounts Under Central Jordan Valley Conditions

Researcher	Al-Qahwaji, Anwar
Affiliation	Faculty of Graduate Study/University of Jordan
Publisher	Faculty of Graduate Study/University of Jordan
Document Location	University of Jordan Library
Year	1995

Description This study was conducted at the University of Jordan Research Station in the Central Jordan Valley during the 1994/1995 growing season, to determine the production function of broad beans and potato as affected by water applied and ET under two cropping systems (inter-cropping and sole cropping) The thesis has 11 tables, 15 figure, and 8 appendices (6 tables, and 2 figures)

Results Results indicate the superiority of inter-cropping with respect to yield for most water levels The production functions were found to be non-linear They were parabolic for potato, and hyperbolic for broad bean Seasonal evapotranspiration values were found to be lower when compared to those for sole crops Land equivalent ration (LER) was greater than one for all water levels

Descriptive Indicators Research Type P2, References 28 (1), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Effect of Irrigation and N-Fertilization (Fertigation) Scheduling on Tomato Crop in the Jordan Valley

Researcher	Al-Deek, Ibrahim M
Affiliation	Faculty of Graduate Study/University of Jordan
Publisher	Faculty of Graduate Study/University of Jordan
Document Location	University of Jordan Library
Year	1994

Description A field study was carried out during the 1992/1993 season on tomato crop under field conditions at the University of Jordan Research Station in the Jordan Valley to achieve the following objectives (i) to improve the use of water by determining the proper irrigation interval, (ii) to study the effect of combined irrigation-fertigation practices on tomato yield under drip irrigation, and (iii) to study the effect of irrigation and nitrogen fertigation on mineral-N, organic-N, and organic matter content of the soil Three irrigation schedules and three fertigation treatments were used

Results The results indicated that irrigating three times a week gave more yield, ETc, added irrigation water, WUE, and deep percolation than irrigation once or twice a week Fertigation ten times distributed equally or according to plant needs resulted in significantly higher values when compared to fertigation three times only

Descriptive Indicators Research Type P2, References 65 (1), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Crop Water Requirements Guide (In Arabic)

Researchers	Al-Nakshabandi, Gh and M Shatanawi
Affiliation	WERSC/University of Jordan
Publisher	Unpublished
Document Location	ERMC Library
Year	1994

Description This book aims to introduce the facts related to water requirement studies The first chapter is about the definition of evapotranspiration The second chapter introduces a summary of the factors that affect the water consumption process such as solar radiation, wind speed, and soil and plants properties The third chapter introduces the direct and indirect methods for estimating water consumption

Results Kc values calculated by many empirical methods for some crops in the Jordan Valley were tabulated evapotranspiration and net water requirements for some crops in the North, Middle, South Jordan Valley and Ghor Al-Safi were presented

Descriptive Indicators Research Type S 2, References 0, Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

Irrigation Method and Water Quantity Effects on Sweet Corn

Researchers	Abu-Awwad, Ahmad M
Affiliation	The Deanship of Research, University of Jordan
Publisher	Journal of Agronomy and Crop Sciences, 173, pp 271 - 278
Document Location	ERMC Library
Year	1994

Description Soil evaporation, water use, yield of sweet corn (Zea Mays 4) and water use efficiency as affected by two irrigation methods, trickle and sprinkler and four values of irrigation water on clay soil were used for this experiment Four amounts of water, twice weekly were applied and evaporation was measured by class A pan, and soil water content was measured by using neutron meter at a depth of 75 mm The experiment was conducted during 1991 and 1992 at the Experimental Research Station of the University of Jordan in the Jordan Valley

Results Trickle irrigation method resulted in substantial water savings when compared with sprinkler method Soil evaporation under sprinkler was significantly higher than under trickle method, and water use also was higher than with trickle method at the same water level Trickle irrigated sweet corn yielded more than sprinkler irrigated sweet corn Water use efficiency with trickle irrigation was higher compared with sprinkler irrigation

Descriptive Indicators Research Type S, References 18 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Irrigated Sweet Corn Production Functions and Efficient Water Use

Researchers	Abu-Awwad, Ahmad M
Affiliation	The Deanship of Research, University of Jordan
Publisher	Journal of Agronomy and Crop Sciences, 172, pp 161 - 170
Document Location	ERMC Library
Year	1994

Description Yield of sweet corn (zea Mays 2), Four different amounts of water with trickle irrigation on a clay soil and seasonal evaporation were tested at the Experimental Research Station of the University of Jordan in the Jordan Valley during 1991 and 1992

Results Seasonal evapotranspiration increased as total water applied increased Crop productivity and water use increase were highest when optimal water levels were used

Descriptive Indicators Research Type S2, References 17 (1), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Effect of Supplementary Irrigation and Nitrogen Fertilization on Wheat Production in the Northern Jordan Valley by Using Sprinkler Irrigation System

Researchers	Al-Zuraiqi Said, Al-Shoubaki Adel, Al-Suttari Yehia
Affiliation	National Center of Agricultural, NCARTT
Publisher	Deir-Alla Agricultural Center/NCARTT
Document Location	Deir-Alla Regional Center Library/NCARTT
Year	1994

Description In this study sprinkler irrigation systems with 5 irrigation quantities according to the distance from the irrigation line (3, 3-6, 6-9, 9-12, and 12-15 m) were used Sprinkling diameter was 12 m which meant that the treatment 12-15 m distance was without irrigation treatment The water quantities from rainfall and irrigation were 551 5, 222 2, 203 9, 187, 169 7 mm The N-fertilization treatments used were zero, 50, 100, 150, and 200 kg N/ha The objectives of this study were to determine the proper water quantity and N-fertilizers, and the interaction between them for economical wheat production

Results Results indicated that there is an increase in the yield with increasing the amount of water applied (from rainfall and irrigation) up to 222 2 mm Results also indicated that, there is no effect of the amount of N-fertilization applied on the plant height The grain yield obtained under N-fertilizer applications were 1 07, 0 93, 0 83, 0 78, and 0 79 Ton/ha, for the treatments zero, 50, 100, and 200 respectively The straw production was 3 96, 4 24, 4 01, 4 08, and 4 45 tons/ha for the same treatments respectively Water utilization efficiency for grain production reached 0 51, 0 59, 0 39, 0 29, and 0 29 Kg/m3, and for straw production reached 0 2, 1 8, 2 1, 2, 2 2, and 2 Kg/m3 for the irrigation treatments respectively

Descriptive Indicators Research Type IB2, References 0 (1), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Determination the Cropping Pattern of Plastic Farms in the Different Agricultural Areas in Jordan

Researchers	Al-Hunaiti, Doukhi

Affiliation	Queen Alia Foundation
Publisher	Faculty of Agriculture/University of Jordan
Document Location	Faculty of Agriculture/University of Jordan
Year	1994

Description This study aims to find the optimum size and cropping pattern for plastic house farms by shifting agricultural resources to achieve maximum productive efficiency Three mathematical models were designed for the three study areas that represent the different climates (Deir Alla, Al-Baqa'a and Amman) The study uses three substitution models that depend on secondary data and quantitative field data The models contained information like quantity of monthly irrigation water under plastic houses, monthly workers, capital needed, and other costs of production By using sensitivity analysis and comparison between models and areas, the models were able to reach the limits and the optimal cropping pattern in every region, and for agriculture season, the maximum and minimum limits that maximize the objective function for each agricultural resource

Results The study found that the best way for solving the problem of plant diseases is through regional plant protection process The problem of increasing the price of production resources could be solved by opening foreign markets, and the problem of the changing weather patterns could be faced by establishing agricultural insurance, in the production side the study found many factors effect the plant productivity (e g , price of water)

Descriptive Indicators Research Type D2, References 22 (2), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

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 (In Arabic)

Researchers	Irrigation Departement, JVA
Affiliation	JVA, MWI
Publisher	Irrigation Department, JVA
Document Location	Irrigation Department, JVA
Year	1993

Description This report discussed the development of trees planted in the areas under the authority of JVA in the Jordan Valley This report also showed the yearly actual requirements that must be available to overcome trees water needs Also it showed the maximum water requirement during summer The report made a comparison between the available water resources monthly and yearly for three years, and compared those with trees water requirements

Results The water requirements for trees reached 103, 109, and 117 MCM for the years 1989, 1991, and 1992, respectively, while the water available for irrigation reached about 211, 171, and 301 MCM for the same years, respectively

Descriptive Indicators Research Type IB1, References 0, Potential Contribution of Research 3, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 3

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

Researcher	Mazahreh, Naem T
Affiliation	Faculty of Graduate Study/University of Jordan
Publisher	Faculty of Graduate Study/University of Jordan
Document Location	University of Jordan/Library
Year	1993

Description The research was carried out during the 1991 growing season at the University of Jordan Research Station in the Jordan Valley The objectives of the study were (i) to determine the actual water consumption of mature banana, and (ii) to determine its crop coefficient values (KC) using lysimeter, class "A" pan, and six selected indirect methods

Results Results indicated that the irrigation at 100% of E-pan gave the best yield and WUE compared with 50% and 150% Class "A" pan evaporation was highly correlated with actual water consumption of mature banana and potential evapotranspiration for grass with R2 values of 0 93 and 0 86, respectively followed by ETP B-C The mean maximum temperature was found to be the most significant climatic factor in predicting ETa, ETP-lys, and E-pan

Descriptive Indicators Research Type P2, References 52 (2), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Yield response of Plastic-House Tomatoes to Soil Moisture Tension in the Jordan Valley

Researchers	Zuraiqi, S and Battikhi, A M
Affiliation	University of Jordan
Publisher	Dirasat (Jordan) Vol 17B(3) pp 196-211
Document Location	Jordan University Library
Year	1990

Description A study was carried out during 1983/1984 with the objective of determining the irrigation schedules for tomatoes inside plastic houses, under drip irrigation in the Jordan Valley Soil moisture tensions at 0 3 and 0 7 bar were used

Results Results indicated no significant differences between soil moisture tension treatments with respect to total and marketable yields, fruit numbers and irrigation intervals, as well as nitrogen and phosphorus concentrations in plant tissues The yield at 0 3 bar was greater by 8 2% than at 0 7 bar treatment It is recommended that tomatoes grown under conditions similar to those of this study can be irrigated at 0 7 bar rather than at 0 3 bar soil moisture tension

Descriptive Indicators Research Type S2, References 9 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Irrigation Scheduling of Snap Beans Grown in Plastic Houses in Jordan

Researchers	Oweis, Y , Ghawi I , Shatanawi M R
Affiliation	University of Jordan
Publisher	Dirasat (Jordan), Vol 17B(3) pp 97-110
Document Location	Jordan University Library
Year	1990

Description Yield response of snap beans grown in plastic houses in the Central Jordan Valley to different levels of irrigation was studied Transpiration rates over the growing season were determined and used with evaporation from class-A pan to develop weekly crop-pan coefficients for irrigation scheduling The snap beans yield ranged from 8 12 tons/hectare (tons/ha) using 120 mm of water to 19 1 tons/ha using 316 mm of irrigated water

Results The results showed that the irrigation production function is quadratic with a maximum possible production of 19 6 tons/ha attainable with a net amount of 378 mm of water Water Use Efficiency (WUE) was 0 06 tons/ha-mm at high production levels and 0 08 tons/ha-mm at low production levels Crop pan coefficients (Kcp) ranged from 0 15 during the planting week to over 0 8 at maximum plant activity, after which it dropped to about 0 6 at the end of the season Irrigation production function, together with the crop-pan coefficient curve, could be used to determine optimal irrigation levels and timing for snap beans grown in plastic houses, these can also be used for planning national water resources allocation for irrigation

Descriptive Indicators Research Type S2, References 7 (2), Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

Evaluation of Several Wheat Genotypes for Grain Yield and other Agronomic Characteristics under Field and Greenhouse Conditions

Researcher	Magdadi, H M
Affiliation	University of Jordan Amman (Jordan)
Publisher	Thesis (M Sc in plant production)
Document Location	University of Jordan Library
Year	1990

Description Performance of several wheat genotypes for grain yield and other agronomic traits under field and greenhouse conditions at three agricultural stations differing in rainfall Ramtha 220 mm, Mushaquar 350 mm, Jubeiha 470 mm, were studied Genotypes used were Houran, Stork, Jubeihd, Houran X Stork, Maru, Petra Om-Rabi-14, and Golan

Results Results indicated that a few genotypes of Houran X Stork cross were found to be superior to Houran Agronomic traits studies showed also that awn length was

strongly associated with grain and biological yields and fertile tillers at Ramtha station which was the driest, whereas flag leaf area was associated with kernel weight at wet sites, Mushaquar and Jubeiha The genotype HNXST 13 gave high fertile tillers at Ramtha and Mushaquar indicating that it could be a promising drought tolerance genotype The negative correlation between heading date and most of the agronomic traits confirmed the need to develop early heading cultivars as a way to escape from drought and high temperature during seed filling period In the greenhouse experiment two irrigation treatments, "field capacity" and "one third available water" were applied The differences between the means of the two treatments were significant for biological and straw yields, peduncle length, number of fertile spikes per pot, heading and maturity dates and water use efficiency The interaction between irrigation treatments and genotypes was not significant except for plant height, heading date, flag leaf area and biological yield characters, indicating each factor was acting independently Late heading genotypes suffered from high temperature in the greenhouse thus resulting in failure of spikes to produce fertile spikelets, genotypes receiving one third available water treatment headed and matured earlier as compared with the field capacity Hourani produced the highest values for weight of roots which could be an important factor for Hourani adaptation to rainfed conditions and should be utilized as a source of root weight and length in breeding programs for drought tolerance

Descriptive Indicators Research Type D, References 114 (1), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 1

Growth and Seed Production of Different Cultivars of Pea (Pisum sativum L) as Affected by Water Availability

Researcher	Tamimi, S M
Affilation	Jordan Univ , Amman (Jordan)
Publisher	Dirasat (Jordan) (Oct 1990) v 17B(4) p 189-199
Document Location	University of Jordan Library
Year	1990

Description Growth, seed yield and water use efficiency (WUE) in leafless, semi-leafed and normal leafed cultivars of pea were compared in green house conditions of high, medium and low irrigation

Results The level of irrigation had a marked effect on the growth of normal leafed plants The degree of this effect was less marked on plants of the semi-leafed cultivar, whereas the growth of leafless plants was not affected by the level of irrigation Seed yields and WUE at high and medium irrigation were the highest in normal-leafed plants, but under the conditions of low irrigation, semi-leafed plants showed the highest seed yields and the highest WUE

Descriptive Indicators Research Type S2, References 9 (2), Potential Contribution of Research 1, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

Water Consumption of Cauliflower and Watermelon in the Jordan Valley

Researchers	Ghawi I , Shatanawi, M R , Sharaiha, R K
Affiliation	University of Jordan,
Publisher	Dirasat (Jordan), Vol 16 (7), pp 7-22
Document Location	University of Jordan Library
Year	1989

Description Two experiments were conducted in the Jordan Valley to determine the actual evapotranspiration (ETc) of cauliflower and watermelon during 1984 and 1985 using drainage lysimeters Actual ET values were compared with reference ET and potential ET as calculated by three empirical methods

Results Cauliflower ETc was 192 mm during 123 days while ETc for watermelon reached 481 for 102 days because of different climatic conditions Crop coefficients (Kc) for cauliflower ranged from 0 31 during the initial stage, 1 1 during mid-season, to 0 96 during the harvest period For watermelon, Kc ranged from 0 27 in the initial stage and reached 1 01 during harvest Modified Jensen-Haise and Hargreaves methods were used to calculate reference crop evapotranspiration (ETr)

Descriptive Indicators Research Type S2, References 11 (2), Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

Water Consumption of Okra in the Jordan Valley

Researchers	Ghawi, I , Shatanawi, M S , Sharaiha, R K
Affiliation	Jordan University, Amman
Publisher	Unknown
Document Location	Jordan University, Library, Amman - Jordan
Year	1989

Description Values of water consumption of okra in the Jordan Valley measured by lysimeter were compared with the calculated values of potential evapotranspiration using modified Blaney-Criddle, modified Jensen-Haise, Hargreaves, and class-A pan evaporation methods Crop coefficient values (Kc) for these methods were determined The time variation of Kc values had similar characteristics for all methods

Results Obtained Kc values and season ET(mm) for the methods were as follows Blaney-Criddle Season ET, mm (Kc = 1 0) 994 2, average Kc 0 36 for June, 0 52 for July, 0 69 for August and 0 50 for September Class-A pan Season ET, mm (Kc = 1 0) 942 3, average Kc was 0 36 for June, 0 65 for July, 0 70 for August and 0 56 for September Jensen-Haise Season ET, mm (Kc = 1 0) 805 9, average Kc for June was 0 43, 0 65 for July, 0 84 for August and 0 64 for September Hargreaves Season ET, mm (Kc = 1 0) 682 1, average Kc for June was 0 51, 0 78 for July, 0 99 for August and 0 77 for September

Descriptive Indicators Research Type S2, References 9 (1), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 1

Production Function of Sugar beet in Jordan as Affected by Irrigation and Nitrogen Fertilization

Researchers	Oweis, Th Y , Ghawi, I , Umari, M A , Al-Tall, A , Shatanawi, M R
Affiliation	University of Jordan
Publisher	Dirasat (Jordan), Vol 16(9), p 7-24
Document Location	University of Jordan Library
Year	1989

Description Sugar beet (Beta vulgarise L) is the main source for the world supply of sugar The importance of sugar beet production cannot be over emphasized especially in developing countries like Jordan where 100% of its sugar needs is imported Government policies in Jordan emphasize food self-sufficiency including the introduction of sugar beet farming to reduce dependency on imports Previous studies indicated the suitability of several areas in Jordan for sugar beet production However, the knowledge of the optimal inputs combination for economical production is yet to be determined Among these inputs, water and fertilizers are the most important The study aimed at determining the production functions of sugar beet in Jordan as effected by irrigation and nitrogen fertilization The effect of the yield level on the sugar content of the roots was also studied Line source sprinkler system was used to apply variable amounts of water to different water treatments where tensiometers and soil moisture measurements were used to schedule irrigation

Results The results showed a linear relationship between fresh root yield and irrigation water Yield improved from less than 0 3 tons/hectare at 82 mm of irrigation to about 5 5 tons/hectare at 1,148 mm of irrigation water Yield increased with higher levels of nitrogen application Water use efficiency increased from 2 31 kg/mm at zero nitrogen to about 5 kg/mm at 200 kg nitrogen/hectare Sugar percent in the root juice was found to decrease as yield increased per hectare The sugar percent dropped from over 30% to about 20% when yield increased from 3 0 tons/hectare to 5 5 tons/hectare Production function relationships were developed and reported in mathematical forms for general use

Descriptive Indicators Research Type S2, References 14 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Irrigation Scheduling and Cantaloupe Yield Model for the Jordan Valley

Researchers	Battikhi, A M , Hill, R W
Affiliation	University of Jordan
Publisher	Agricultural Water Management (Netherlands) (1988) v 15(2) pp 177-187
Document Location	University of Jordan Library
Year	1988

Description This paper puts forward a yield model for cantaloupe growth in the Jordan Valley taking into account various inputs along with scenarios for irrigation scheduling

Results Once initialized, the model predicted the highest yield given an optimal irrigation schedule as determined through field studies on the crop Using 1 5 cm per irrigations for a total of 44 to 47 irrigations and starting the first instead of the last April, Simulated yield were about double what was actually obtained in the field The model van be used successfully to study different irrigation scheduling possibilities, and would be useful in reducing costs by suggesting these most promising for field experiments, i e high values of model yield percentage, transpiration water ratio, and water yield increase

Descriptive Indicators Research Type D2, References 11 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Effect of Organic Residues on Some Moisture Characteristics of Sandy Soils and Tomato Growth Response

Researchers	Abdelrasul, E A , Nadui, D R
Affiliation	Basra University, Basra (Iraq)/Faculty of Agriculture
Publisher	Dirasat (Jordan), Vol 15(10), p 108-126
Location	University of Jordan Library
Year	1988

Description The study was conducted on two sandy soils of Zubir region Each soil was mixed with poultry, sheep manure and artificial organic manure at rates of 2 75%, 5 50% and 8 25% based on dry weight soil Two untreated soils were used for comparison Tomato crops were grown in pots containing 25 kg of soil It appeared from the results that soil bulk density was reduced, and the hydraulic conductivity, water holding capacity, and the plant dry matter were significantly increased with increasing the level of organic residues for both soils Accumulative water infiltration as a function of time was described by Kostiakov, Philip two-term, and Philip three-term equations by fitting the non-linear regression program The fitness of the equations had decreased with increasing the rate of organic matter as compared with the experimental data, particularly at high application level

Results Residual mean square (RMS1) was high for the treated soils when compared with the untreated soils Philip three term equation had a better fitness than the other two equations Linear regression program was used to describe the accumulative water infiltration as a function of wetting front, and to calculate the additional volumetric soil moisture (fillable porosity) during the water movement through soils, which increased as the level of organic matter had increased, for both soils

Descriptive Indicators Research Type S1, References 44 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Water Consumption by Forage Corn in the Central Jordan Valley

Researcher	Ghawi, I
Affiliation	University of Jordan
Publisher	Dirasat (Jordan), Vol 15(10), p 96-107
Location	University of Jordan Library
Year	1988

Description Water consumption by forage corn, Zea mays, and alfalfa, during 1983-1984 season in the Central Jordan Valley, measured by the drainage type lysimeters was determined Corn ET was compared with potential evapotranspiration, calculated by using Hargreaves, modified Jensen-Haise, modified Blaney-Criddle and class-A pan evaporation methods

Results Actual ET for corn measured by lysimeter was 348 mm, whereas reference crop ET (ETR) was 517 mm Modified Jensen-Haise and Hargreaves methods estimated ETR fairly well, while modified Blaney-Criddle method gave high values Actual crop coefficient values were as follows 0 25 at emergence, 0 78 after two months from emergence, 0 98 after three months from emergence and decline to 0 9 at harvest

Descriptive Indicators Research Type S2, References 19 (1), Potential Contribution of Research 1, Overall Coverage of Topic 2, Benefit to Farmers 1, Potential Application at the Farm Level 2

Effect of Some Cultural Practices on the Performance of Two Forage Legume Species and their Residual Effect on the Succeeding Wheat

Researcher	Al-Musri, I O
Affiliation	University of Jordan
Publisher	Thesis (M Sc in plant production)
Document Location	University Of Jordan/Library
Year	1988

Description Effect of seeding rate, inoculation with rhizobium bacteria, phosphorus fertilization and harvesting stage on performance of vetch and lathyrus and their residual effect on the succeeding wheat crop under rainfed conditions at Maru and Rubba RS, 1984-85/6, were evaluated Randomized complete block design was used

Results Application of phosphorus resulted in more residual available phosphorus of 3 0 ppm at Maru and 3 9 ppm, Rabba, in the first layer 0-15 cm, after harvesting When the effect of the previous treatments on succeeding wheat crops was considered, the lowest wheat production at Maru was recorded under continuous wheat treatment

Descriptive Indicators Research Type D2, References 77 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

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

Researchers	Oweis, Th Y , Ghawi, I , Shatanawi, M R
Affilation	University of Jordan
Publisher	Dirasat, v 15(10) p 43-55
Document Location	University of Jordan/Library
Year	1988

Description The irrigation production function of potatoes was studied using line source sprinkler irrigation system The study was conducted for two winter seasons in the central Jordan Valley Tensiometers were used to schedule irrigation and evapotranspiration (ET) was measured by monitoring soil moisture changes using a neutron scattering technique

Results The results indicated that total tuber yield changed linearly as ET increased from about 100 mm to about 300 mm Yield reached 14 tons/hectare in the first season and 16 tons/hectare in the second season Crop-pan coefficients (Kcp) were derived by relating weekly ET to pan evaporation Kcp changed in response to crop growth stage from less than 0 5 during plant emergence to about 0 8 at maximum crop leaf area and declined to less than 0 5 just before harvesting The production function and crop-pan coefficients can be used with confidence to manage and schedule irrigation of winter potatoes in the Jordan Valley

Descriptive Indicators Research Type D2, References 9 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Preliminary Study on the Effects of Soil Moisture Depletion under Black Plastic Mulch and Drip Irrigation on Root Growth and Distribution of Squash in the Central Jordan Valley

Researchers	Safadi, A S , Battikhi, A M
Affiliation	University of Jordan
Publisher	Dirasat (Jordan) (Oct 1988) v 15(10) p 30-42
Year	1988

Description A study was carried out in the central region of the Jordan Valley during the winter and spring seasons 1985/86 (December-April, April-June) The objective of the experiment was to study the effect of three different irrigation schedules based on soil-moisture tensions of 30, 50 and 80kPa, which are equivalent to 39, 50 and 64 % soil moisture depletion's under black plastic mulch and drip irrigation on root growth and distribution of squash

Results Results showed no significant differences between treatments with respect to vertical (tap and secondary) and horizontal roots as well as oven - dry root weights during the winter and spring seasons Vertical roots reached max averages of 27 0 and 31 4 cm during the winter and spring seasons respectively Horizontal roots reached max averages of 63 5 and 94 4 (from one side) during the winter and spring seasons respectively Results indicated that for the purpose of irrigation water

application a 30 cm maximum depth is recommended under the experiment's conditions

Descriptive Indicators Research Type D2, References 30 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Muskmelon Production under Mulch and Trickle Irrigation in the Jordan Valley

Researchers	Battikhi, Anwar M and Ibrahim Ghawi
Affiliation	American Society for Horticultural Science
Publisher	Horticultural Science 22(4) 578 - 581
Document Location	University of Jordan Library
Year	1987

Description Effects of different plastic mulch in using drip irrigation on yields, soil temperature, crop water requirements, and root density and distribution for muskmelon in the Jordan Valley were studied

Results Significant differences were found in yield Transparent mulch treatments yields averaged 14 2T/ha and were significantly lower (5% level) than average yields 28 7 T/ha of black mulch Non-mulched treatments yields averaged 6 0 T/ha and were significantly different from the average transparent mulch (5% ,eve,) and from black mulch (1% level)

Descriptive Indicators Research Type S2, References extensive (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Production Function Determination of Onion as Affected by Water Amounts, Evapotranspiration and Nitrogen Fertilization Rates in the Central Jordan Valley

Researcher	Al-Rajabi, M F
Affiliation	Jordan Univ , Amman (Jordan) Dept of Soils and Irrigation
Publisher	Thesis (M Sc in Soils and Irrigation) 84 p
Document Location	University of Jordan
Year	1987

Description There were linear relationships between onion bulb and total water applied and seasonal ET Yield was highly correlated with nitrogen (N) and water (W), and with N and ET Consumptive use of water increased with increasing water application rates Daily consumptive use reached its max value after 12-15 weeks from transplanting Diameter, length, dry-weight percentage of onion bulb, and total soluble solids (TSS %) were not significantly affected by N rates Significant differences in nitrogen contents of onion bulb were detected between N4, N3, and N1 rates Significant differences in nitrogen contents of leaves were also detected between N4 and both N2 and N1 and between N3 and N2 The data were used to develop function for onion bulb yield, as affected by nitrogen fertilization rates, and

irrigation water amounts and also as affected by nitrogen fertilization rates and evapotranspiration

Results Results showed that at all water levels, application of nitrogen at 0, 100 and 200 kg N/ha rates produced significantly higher yield than the 400 kg N/ha rate Yield for all nitrogen rates has increased gradually with increasing water amounts except at 0 and 200 kg N/ha rates at 73 4 cm water amount The max onion bulb yield (39 92 t/ha) was obtained from treatment W3N1 which represented 40% available soil moisture depletion (ASMD) or 63 5 cm applied water or 55 8 cm total evapotranspiration (ET) and zero nitrogen rate

Descriptive Indicators Research Type S2, References 33 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Water Consumption of Wheat and Barley in the Jordan Valley

Researchers	Shatanawi, M , Ghawi, I , Sharaiha, R K , Duwayri, M
Affiliation	University of Jordan
Publisher	Dirasat (Jordan) (Feb 1987) v 14(2) p 49-67
Document Location	University of Jordan/Library
Year	1987

Description Water consumption's of wheat (Triticum aestivum L) and barley (Hordeum Vulgare) during the growing season of 1985-1986 in the Jordan Valley measured by drainage type lysimeters were determined and compared with the different values of potential evapotranspiration obtained from a reference crop (grass) grown in a lysimeter, modified Blaney-Criddle, modified Jensen-Haise, Hargreaves, and class-A pan evaporation methods The productions were 4 2 tons/ha and 3 6 tons/ha for wheat and barley, respectively Seasonal ET for wheat was found to be 326 mm and for barley was 304 mm Crop coefficient values (Kc) for these methods were determined

Results The monthly average values of Kc for the wheat and barley for the different methods were determined

Descriptive Indicators Research Type D2, References 26 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Effect of Moisture and Temperature on Organic and Inorganic Nitrogen Transformation in North Shuneh Soil

Researcher	Wazwaz, A H I
Affiliation	University of Jordan
Publisher	University of Jordan Thesis (M Sc in soils and irrigation)
Document Location	University of Jordan Library
Year	1987

Description The study aims to evaluate the transformation of nitrogen in poultry manure as affected by moisture, temperature and addition of nitrogen fertilizer, and the applicability of nitrification inhibitors in irrigated soils

Results Results showed that net mineralized nitrogen at low temperature (20 °C) was greater at less water condition (-0 1 to -0 5 bar) than more water, or relatively dry condition (-1 0 to 5 0 bar) In contrast, maximum mineralized N at high temperature (30, 40 °C) was obtained in the dry conditions The values obtained reflected the balance between immobilization losses, and mineralization Addition of N in form of (NH4)2SO4 decreased the net mineralized nitrogen particularly at high moisture content and temperature Nitrification proceeded immediately at 30 °C, but when the soil was amended with 5% or 200 ppm NH4-N, the influence of moisture was pronounced Nitrification was correlated with moisture content at the other temperatures, low temperature and ammonium sulfate addition favoured nitrite accumulation, and the latter persisted for longer time in the presence of ammonium-form Nitrification inhibitors (N-serve DCD) retarded the oxidation of NH4 at low temperature (20 °C) for 28 days Increasing the temperature to 30 °C decreased the dicyandiamide inhibit efficiency markedly High temperature and organic matter content resulted in great decline in the effectiveness of both inhibitors due to volatilization of N - severe and hydrolysis of both inhibitors The effectiveness extended not more than a week Although the effect of concentration of N - severe was not obviously shown, DCD effectiveness on the other hand was correlated with its concentration

Descriptive Indicators Research Type D2, References 64 (1), Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

Water Requirements for Cucumber Inside Plastic Houses in Deir-Alla

Researchers	Al-Zuraiqi Said, Al-Dabbas Mohamad
Affiliation	NCARTT
Publisher	Al-Agoar Agricultural Department/MOA
Document Location	Deir-Alla Regional Center Library/NCARTT
Year	1987

Description This experiment was conducted in Deir-Alla agricultural station inside plastic house by using a black mulch Three treatments were used, these are 60%, 90%, and 120%, of evaporation pan (Ep) readings with 4 replicates

Results Results indicated that there is no significant difference for yield production among the treatments The water consumption shows a significant difference between the treatments (462, 317, and 228 mm for the treatments 120%, 90%, and 60% respectively) which mean that the treatment 60% of Ep was the best under the experiment conditions

Descriptive Indicators Research Type IB2, References 0, Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Squash Production Under Mulch & Trickle Irrigation in the Jordan Valley

Researchers	Al-Battikhi A , Ghawi I
Affiliation	UOJ
Publisher	Dirasat, Vol XIV, No 11
Document Location	Scientific Research Deanship, UOJ
Year	1987

Description This study was carried out in the Jordan Valley during the winter season of 1984 The objectives were to determine squash yield and water requirements under trickle irrigation as affected by plastic mulches, as well as the effect on soil temperature, root growth and distribution Irrigation timing was determine by tensiometer reading (30 cb) The neutron probe reading were used to determine irrigation amount

Results Results indicated that non-mulched treatments received an average of 20 6 cm water to produce 11 8 ton/ha squash, whereas treatments with transparent and black plastic mulching consumed an average of 19 1 and 17 9 cm water, respectively, and yielded average of 25 9 and 18 0 ton/ha, respectively Alfalfa potential evapotranspiration for transparent, black, and non-mulched treatments were calculated from weather data available, and values obtained by modified Penman method were 42 3, 43 7, and 45 1 cm, respectively Calculated evapotranspiration requirements of squash for the three respective treatments were 24 4, 25 9, and 33 7 cm These results indicated that the plots were not sufficiently irrigated to receive the plant consumptive use requirements, probably due to improper water scheduling

Descriptive Indicators Research Type S2, References 20 (1), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Vegetable Yield and Irrigation Scheduling Model for the Jordan Valley

Researchers	Battikhi, A M , Hill, R W
Affiliation	University of Jordan
Publisher	Dirasat (Jordan), Vol 14(11), pp 73-98
Document Location	Jordan University Library
Year	1987

Description A crop yield and soil water management simulation model (CRPSM) developed at Utah State University was modified and calibrated using data from trickle irrigation experiments with different mulch treatments on squash, cucumber, cantaloupe, and watermelon in the Jordan Valley Simulated irrigation schedules were tested using different scheduling options provided by the model

Results A water yield index, Wi, which relates crop yield and water use, ranged from 29 to 66 for squash, 21 to 82 for cucumber, 29 to 72 for cantaloupe, and 12 to 52 for watermelon A higher value of Wi indicates a relatively higher crop yield per unit of irrigation water A mulch simulated treatment had the highest Wi of 66, 82, 72 and 52 for squash, cucumber, cantaloupe and watermelon respectively It required 23 4, 33 0,

80 0 and 73 2 cm of irrigation water, respectively The average water per treatment and the number of irrigations were 1 3 cm/irrigation for a total of 18 irrigations and starting as early as 1 April for squash, 1 3 cm/irrigation for a total of 26 irrigations and starting as early as 20 March for cucumber, 2 0 cm/irrigation for a total of 40 irrigations, as early as 15 March for cantaloupe, 2 0 cm/irrigation for a total of 36 irrigations as early as 15 March, for watermelon Simulated yields were about double of what was actually obtained on the field This indicates that the date of the first irrigation as well as total water applied are important for maximizing yield Plants in the field were apparently subjected to water stress from 1 to 7 April for squash, from 20 March to 7 or 14 April for cucumber, and from 15 March to 22 or 30 April for cantaloupe, and from 15 March to 28 April or 2 May for watermelon, before irrigation was initiated The use of CRPSM could reduce the number of plots needed in further field experimentation since the least successful possibilities could be identified by simulation and field efforts can be concentrated on treatments most likely to provide higher yields with improved irrigation management

Descriptive Indicators Research Type S2, References 23 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Effect of Plant Spacing, Clipping and Tomatotone on Yield, Fruit Quality and Growth of Tomato Grown Under Plastic House Conditions in the Jordan Valley

Researchers	Al-Maslamani, H K , Suwwan, M A
Affiliation	University of Jordan
Publisher	Dirasat (Jordan), Vol 14(11), p 7-27
Document Location	University of Jordan Library
Year	1987

Description Effects of plant spacings (10x80, 20x80, 30x80), three levels of clipping (control at 3 and 2 flower clusters) and two levels of tomato tone (without and 10 ml/l water) in yield quality and growth of "Claudia RAF" tomato cultivars were studied for two consecutive seasons Reducing plant spacing produced significant increases in the marketable tomato yield and fruit numbers throughout both harvest seasons Clipping at three flower clusters reduced late yields only, while two clusters treatment reduced both (mid and late seasons) yields and fruit numbers, thus reducing the seasonable marketable yields and fruit numbers

Results Clipping had no effect on early tomato yields or fruit numbers While tomato tone application increased early tomato yields significantly later yields were reduced and seasonal yields were not affected, fruit numbers, other than the early, were reduced Wider plant spacing, clipping and tomato tone application gave larger tomato fruits Dry weight of vegetative growth per hectare was also significantly reduced by wider plant spacing, clipping and tomato one application All treatments exerted no significant effect on pH, % TSS and % TA of tomato fruits Specific gravity was reduced significantly by tomato tone

Descriptive Indicators Research Type S2, References 107 (1), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

A Preliminary Study on Cucumber Production Under Plastic Mulching Using Trickle Irrigation in the Jordan Valley

Researchers	Al-Battikhi A , Ghawi I
Affiliation	UOJ
Publisher	Dirasat, Vol XIV, No 11
Document Location	Scientific Research Deanship, UOJ
Year	1987

Description An experiment with cucumber was conducted at University of Jordan Research Station, located in the Jordan Valley Its objectives were to determine the effects of different plastic mulching (transparent, black, and non-mulched) using drip irrigation on yields, soil temperature, crop water requirements, and root density and distribution Neutron probe reading were used to determine the amount of irrigation water

Results Results obtained indicated that there were no significant differences between transparent, black, and non-mulched treatments with respect to irrigation amount, soil moisture depletion, total water supplied, deep percolation losses, and evapotranspiration Transparent mulch yield average 7 9 ton/ha and were significantly lower than average yield (11 9 ton/ha) of the black mulch treatments Non-mulched treatment yields average 1 7 ton/ha and were significantly different from the average transparent mulch and from black mulch Calculations of expected potential evapotranspiration for cucumber during the season showed that the plants did not receive their water requirements

Descriptive Indicators Research Type S2, References (2), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Irrigation Effect on Water Consumption & Productivity of Wheat in the Jordan Valley (In Arabic)

Researchers	Shatanawi M , Oweis Th , Ghawi I
Affiliation	UOJ
Publisher	Dirasat, Vol XIV, No 11
Document Location	Scientific Research Deanship, UOJ
Year	1987

Description A field experiment was conducted in the Research Station of the university of Jordan at the Jordan Valley during 84/85 and 85/86 seasons using line source sprinkler system

Results Results showed that the relationship between yield and water applied could be described by a non-linear equation On the other hand, a linear relationship was obtained between yield and ET The seasonal ET for wheat was 328 mm and 341 mm,

and grain yield were 3 0 tons/ha and 4 05 tons/ha for the first and the second seasons, respectively

Descriptive Indicators Research Type S1, References 5 (2), Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

Water Requirements For Potato by Two Irrigation Methods in Abu-Habil Agricultural Station

Researcher	Al-Zuraiqi Said, Al-Rajabi Mazin, Al-Dabbas Mohamad
Affiliation	National Center of Agricultural, NCARTT
Publisher	Al-Agoar Agricultural Department/MOA
Document Location	Deir-Alla Regional Center Library/NCARTT
Year	1987

Description This experiment was conducted in two successive years 1985/1986 and 1986/1987 Two irrigation methods (Furrow and Drip irrigation) with three water amounts (40%, 80%, and 120% from Ep) and four replicates were used To determine when to irrigate, tensiometers were installed at 15 cm depth, and the tension kept at 0 3 bar throughout the growing season

Results Results indicated that there is no significant difference in total and marketable yield between all treatments (irrigation method and amount) The treatments 40%, 80%, and 120% from Ep under drip irrigation consumed 108, 170, and 196 mm respectively The same treatments under furrow irrigation consume 116, 179, and 235 mm respectively The results indicated that treatment 40% from Ep under drip irrigation consume the lowest amount of water, which made it the most efficient treatment for potato

Descriptive Indicators Research Type IB2, References 0, Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Water Requirements for Squash Crop in Abu-Habil Agricultural Station

Researchers	Al-Zuraiqi Said, Al-Dabbas Mohamad
Affiliation	National Center of Agricultural, NCARTT
Publisher	Al-Agoar Agricultural Department/MOA
Document Location	Deir-Alla Regional Center Library /NCARTT
Year	1987

Description An experiment was conducted in Abu-Habil agricultural station to schedule the irrigation for squash according to evaporation pan readings Four irrigation treatments were used 40%, 60%, 80%, and 100% from Ep reading, with 4 replicates A fixed Irrigation interval (once a week) was used

Results Results indicated that the treatment 40% of Ep gave significantly the lowest yield There is no significant difference in yield between the other treatments The amount of water consumed during the growing season were 197, 247, 300, and 350

mm under the treatments 40%, 60%, 80%, and 100% respectively The irrigation scheduling once a week with 60% of the Ep reading was recommended by this study

Descriptive Indicators Research Type S2, References 0, Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Irrigation Scheduling Of Squash Under Drip Irrigation And Black Plastic Mulch In Central Jordan Valley

Researcher	Safadi, Assad Salah
Affiliation	University of Jordan-Faculty of Agriculture
Publisher	University of Jordan-Faculty of Agriculture
Document Location	University of Jordan -Faculty of Agriculture-Library
Year	1987

Description The study was carried out in the Research Station of the University of Jordan located in the Jordan Valley during the 1986/1987 growing season The objective of the work was to study the effect of three different irrigation schedules of squash under black plastic mulch and drip irrigation on yield, root growth and distribution, and water requirements

Results The main results can be summarized as follows (i) yield, fruit production, and fruit weight did not vary under the three treatments for both winter and spring seasons (yields of the winter season were almost double that obtained during the spring season where average yield was 21 tons/ha during the winter and 7 9 tons/ha during the spring season for the three treatments), (ii) no significant differences were found between treatments with respect to irrigation amounts, total supply, crop water consumption, water application efficiency (lower water consumption occurred during the winter season when compared to the spring season), and (iii) the average water consumption for the three treatment was 12 66cm during winter and 14 71 cm in spring (higher water use efficiency was obtained during the winter season)

Descriptive Indicators Research Type D2, References 51 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Drip irrigation of Tomatoes and Measurement of Soil Moisture by Neutron Method

Researcher	Judah, O M
Affiliation	University of Jordan
Publisher	Dirasat (Jordan) (Feb 1986) v 13(2) p 39-48
Document Location	University of Jordan/Library
Year	1986

Description The response of tomato plants to various applications of water under drip irrigation was studied The irrigation treatments consisted of three frequencies 2, 4 and 7 days between the growing period from 26 March to 28 May 1982 The

amount of water applied each irrigation was equal to the amount of water which had been absorbed by plants, as determined using the neutron probe procedures

Results Total water applied during the season was 980, 1000 and 976 mm for 2, 4 and 7 days frequency respectively which included 430 mm applied to all treatments using the same irrigation interval prior to 26 March Tomato yield was increased as the interval between irrigation decreased It was 104 8, 104 1 and 99 9 tons/ha for 2, 4 and 7 days interval, respectively Thus it is recommended to irrigate tomatoes frequently under drip irrigation

Descriptive Indicators Research Type S2, References 17 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Effect of Drip Irrigation, Furrow, and Sprinkler on Tomato Yield and Soil Salinity in the Jordan Valley

Researcher	Mudabber, Mohammed Ali
Affiliation	NCARTT
Publisher	Faculty of Agriculture/University os Jordan
Document Location	University of Jordan/Library
Year	1986

Description The purpose of the study was to compare the effect at drip, furrow, and salt distribution This research contained an introduction, literature review, material and methods, results and discussion

Results The results showed that salts increased with depth under the sprinkler method, and towards mid way between rows under both drip and furrow methods Lower amount of water applied, and higher water use efficiency, were achieved using the drip irrigation method

Descriptive Indicators Research Type D2, References 41 (2), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

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

Researchers	Abu-Awad, A , Al-Battikhi A ,Ghawi I
Affiliation	UOJ
Publisher	Dirasat, Vol XIII, No 8
Document Location	Scientific Research Deanship, UOJ
Year	1986

Description A field experiment was conducted in the Research Station of the University of Jordan at the Jordan Valley during the spring of 1981 with one of the main objectives to study the effect of N-fertilizer rate and water application rates on the nitrate-nitrogen movement, under sprinkler irrigation in a field planted with sweet corn Four nitrogen treatments were used N1 = 0 kg urea/dunum, N2 = 30 kg

urea/dunum, N3 = 60 kg urea/dunum, and N4 = 90 kg urea/dunum The irrigation treatments were W1 = 9 4 mm/irrigation, W2 = 15 mm/irrig , W3 = 20 7 mm/irrig , and W4 = 26 7 mm/irrig , using a line source sprinkler irrigation system

Results Results obtained indicated that an increase in Nitrate-N concentration and movement has taken place upon increasing cumulative total amount of irrigation water applied and total amount of urea fertilizers used Results also indicated that under the conditions of this experiment and by considering grain yield of corn obtained, the treatment N2W3 and N2W4, would be most suitable in terms of yields of fertilizer and irrigation water use

Descriptive Indicators Research Type S1, References 16 M, Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Tomato Yield and Consumptive Use Under Different Water Stress Using Plastic Mulch

Researchers	Qasem J M , Judah O M
Affiliation	UOJ
Publisher	Dirasat, Vol XII, No 6
Document Location	Scientific Research Deanship, UOJ
Year	1985

Description This study was carried out in 1978 at private farm to develop a procedure to schedule drip irrigation for tomato crop in the Jordan Valley using class A evaporation pan, by determining appropriate constants that relate pan evaporation to evapotranspiration, and to study the effect of different soil moisture tensions (20, 30, 40, and 50 cb) on tomato yield

Results Results showed that tomato can be irrigated by drip irrigation when the soil moisture tension reaches 50 cb with no significant differences in yields compared to the lower tensions (20, 30, 40 cb) The water applied and consumptive use were found to decrease with increasing soil moisture tension Crop coefficients increased rapidly to a maximum during the flowering stage and then declined at the end of the season

Descriptive Indicators Research Type S2, References 11 (1), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Determination of Crop Coefficient for Potatoes in the Jordan Valley

Researchers	Ferdous, A , Ghawi, I , Shatanawi, M
Affiliation	University of Jordan
Publisher	Unknown
Document Location	University of Jordan Library
Year	1985

Description A lysimeter study was conducted at the University of Jordan Experimental Station to determine the crop coefficients (Kc) values for fall potatoes using different methods

Results Results indicated that Kc values obtained from ratios between potential ET of potato and potential ET of alfalfa for the different growth stages were 0 3 at emergence, 1 23 during full coverage, and 0 48 at maturity The Kc values of Blaney-Criddle method for potato were close to Kc values of lysimeter The Kc values of Hargreaves method were higher than those of the lysimeter and Blaney-Criddle Relationship between measured Kc from lysimeter and calculated Kc for Blaney-Criddle, Hargreaves, Jensen-Haise, and class-A pan evaporation were obtained Relationship between Kc for the different methods and crop growth stages were found to be significant of 1% level

Descriptive Indicators Research Type D2, References 8 (1), Potential Contribution of research 1, Overall Coverage of topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Water Utilization by Tomato Under Drip Irrigation in the Jordan Valley

Researchers	Qasem, J , Judah, O M , Battikhi, A
Affiliation	University of Jordan
Publisher	Dirasat (Jordan) (Jun 1985) v 12(6) p 13-22
Document Location	University of Jordan Library
Year	1985

Description Soil moisture extraction by tomatoes under drip irrigation has been studied in the Jordan Valley

Results The major results may be summarized as follows Most of the water is depleted from the upper 30 cm layer for the 20, 30, 40 and 50 cb treatments during the growing season The effective root depth of tomato plants under these conditions of water treatments was 30 cm during the first 60 days and extended to the 2nd layer (30-60 cm) before harvest The soil moisture extraction patterns fluctuated during the season according to weather conditions and the stage of plant growth

Descriptive Indicators Research Type D2, References 11 (1), Potential Contribution of research 1, Overall Coverage of topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Yield Response of Cucumber to Various Levels of Applied Water Under Plastic Houses in Jordan Valley

Researchers	Judah, O M , Rushdi, Y
Affiliation	Jordan Univ , Amman (Jordan)
Publisher	Dirasat (Jordan) (Apr 1985) v 12(4) p 77-85
Document Location	University of Jordan Library
Year	1985

Description This study reports on a field experiment to investigate the effect of two levels of irrigation water supply (20 mm and 30 mm) on yield of cucumber inside plastic houses in the Jordan Valley Water applied, water use efficiency and evaporation were evaluated Two plastic houses were used for the experiment, one was drip irrigated, the other furrow irrigated

Results It was found that yield increased where the soil moisture tension decreased in both plastic houses Drip irrigated house yielded more that the furrow irrigated house Water use efficiency decreased while the water applied at each irrigation increased in drip irrigated house, where it was almost the same in the furrow irrigated house

Descriptive Indicators Research Type S2, References 8 (2), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Determination of Crop Coefficient (Kc) for Fall Potato for Some Direct and Indirect Methods of Estimating Evapotranspiration the Jordan Valley

Researcher	Abdel-Nabi Fardous
Affiliation	NCARTT
Publisher	Faculty of Agriculture/University of Jordan
Document Location	University of Jordan/Library
Year	1984

Description The research was conducted during the 1982/1983 growing season at the University of Jordan Experiment Station in the Jordan Valley to determine the crop coefficients for fall potatoes by lysimetric method with Alfa as a reference crop, class -A pan evaporation and selected indirect methods

Results Results indicated that (Kc) values obtained from the ratios between potential evapotranspiration estimated by the Hargreaves Method gave highest correlation coefficient, during the growth stages, the incident solar radiation was the best single climatic factor in estimating (EIP)

Descriptive Indicators Research Type D2, References 45 (2), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

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

Researcher	Karajeh, F F R
Affiliation	Amman (Jordan) Apr 1983 82 p
Publisher	Thesis (M Sc in soils and irrigation)
Document Location	University of Jordan Library
Year	1983

Description This study provides a detailed investigation of sorghum production under various water levels The study covers the relations among evapotranspiration, yield, and growth variables and covers numerous references of importance

Results The results are presented in terms of statistical analyses of variables and identify the trends in growth of sorghum under different conditions of irrigation cutback

Descriptive Indicators Research Type D2, References 51 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Wetting Fronts Under a Trickle Source in Two Soils of the Jordan Valley

Researchers	Hawatmeh N , Al-Battikhi A
Affiliation	UOJ
Publisher	Dirasat, Vol X, No 1
Document Location	Scientific Research Deanship, UOJ
Year	1983

Description A field study was carried out in two regions of the Jordan Valley representing the Ghor-1 soil series Three water application rates (5 26, 8 4, and 12 6 liters/hour/meter) and three initial soil moisture contents (1 5-3 5%, 5 5-8%, and 11 5-14%) were used

Results Results obtained show that advance of wet fronts increase with initial soil moisture, and with the increase in water application rates Equations for vertical and horizontal wet front advance in both soils under the conditions of the experiment were determined for their use during the design of irrigation systems and the studies of salt movement in soil

Descriptive Indicators Research Type S1, References 19 (2), Potential Contribution of Research 3, Overall Coverage of Results 2, Benefit to Farmers 2, Potential Application at the Farm Level 3

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

Researchers	Abu-Awad, A , Al-Battikhi A ,Ghawi I
Affiliation	UOJ
Publisher	Dirasat, Vol X, No 1
Document Location	Scientific Research Deanship, UOJ
Year	1983

Description A field experiment was conducted at the Research Station of the University of Jordan at the Jordan Valley with the main objectives to study the effect of water and nitrogen (urea) levels on sweet corn Four nitrogen treatments were used N1 = 0 kg urea/dunum, N2 = 30 kg urea/dunum, N3 = 60 kg urea/dunum, and N4 = 90 kg urea/dunum The irrigation treatments were W1 = 9 4 mm/irrigation, W2

= 15 mm/irrig , W3 = 20 7 mm/irrig , and W4 = 26 7 mm/irrig , using a line source sprinkler irrigation system

Results The sweet corn grain and dry matter yields were found to depend upon the different nitrogen fertilizer rates and water application amounts The data were used to develop functions for the grain yield and dry matter as affected by irrigation and nitrogen fertilizer The highest grain yield was 368 kg/dunum, with 60 kg urea/dunum and 61 4 cm water, and the highest dry matter yield was 686 kg/dunum when 30 kg urea/dunum, and 47 5 cm water were applied

Descriptive Indicators Research Type S1, References 7 (1), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the farm level 2

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

Researcher	Abu-Awad, Ahmad
Affiliation	Faculty of Agricultural/University of Jordan
Publisher	Faculty of Agriculture/University of Jordan
Document Location	University of Jordan Library
Year	1982

Description The main objective of this study was to investigate the effect of different water and nitrogen (urea) levels on sweet corn grain and dry matter yield and the effect of water application rates on the Nitrogen -Nitrate movement by using the sprinkler irrigation methods

Results The sweet corn grain and dry matter yields were found to depend upon the different nitrogen fertilizers rates and water application amount, the movement of fertilizers below the rate zone for corn grown on these sandy loom soil can be kept very small with proper water and fertilizer management

Descriptive Indicators Research Type D2, References 22 (2), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Wetting Fronts Under A Trickle Source in Some Soils of the Jordan Valley

Researcher	Hawatmeh, Nader G
Affiliation	Faculty of Agriculture
Publisher	University of Jordan
Document Location	University of Jordan Library
Year	1980

Description This study was carried out in order to collect some data on the wetting fronts and moisture distribution patterns for two soils under three different initial moisture contents and three rate of water application These soils were located in the southern region of the Jordan Valley

Results The results obtained may be summarized as follows (i) the horizontal and vertical advances of wetting fronts were found to increase with increasing initial moisture content, (ii) wetting fronts were found to be affected by soil properties - an increase in horizontal advance and a decrease in vertical advance had taken place in the heavy soil when compared to the light one, (iii) water application rates affect the horizontal and vertical advances of wetting fronts It was found that the horizontal advance of wetting fronts increase with increasing the water application rare On the other side ,the vertical advance of wetting fronts was found to decrease with increasing the water application rate

Descriptive Indicators Research Type D2, References 35 (2), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Evaluating the Effect of Wind Velocity, Spacing, and Operating Pressure On Water Distribution From Sprinklers in The Jordan Valley

Researcher	Yousef, Abdullah S
Affiliation	University of Jordan-Faculty of Agriculture
Publisher	M Sc Thesis at the Faculty of Agriculture
Document Location	University of Jordan Library
Year	1980

Description This research contains chapters on previous studies, material and methods The study was carried out in the Jordan Valley to evaluate the effect of wind, spacing, and operating pressure on the uniformity coefficient of water distribution using sprinklers

Results The results of this work indicated that wind has a pronounced effect on the uniformity coefficient It was also shown that the adverse effects of wind could be largely reduced by correct lateral spacing between sprinklers Selecting the proper operating pressure also increase the ability of sprinklers in overcoming the wind effect on uniformity of water distribution

Descriptive Indicators Research Type D2, References 35(2), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Water Requirement and Scheduling Irrigation For Sweet Corn Under Sprinkler Irrigation In The Jordan Valley

Researcher	Al-Sharif, W A
Affiliation	University of Jordan-Faculty of Agriculture
Publisher	University of Jordan-Faculty of Agriculture
Document Location	University of Jordan -Faculty of Agriculture-Library
Year	1980

Description The objective of this research was to determine the water requirements and the frequency of irrigation for sweet corn using sprinklers in the Central region of the Jordan Valley

Results The results obtained may be summarized as follows (i) vegetative growth, plant height and yield of sweet corn were found to increase with soil moisture tension at times when irrigation was lower - sweet corn irrigated by sprinklers at soil moisture tension equivalent to 0 30 bar resulted in significant differences in yield and plant height when compared to the higher soil moisture tension, (ii) the requirement of water for the sweet corn ranged from 165 to 211 mm, (iii) the daily average rate consumption ranged 6 33 to 7 53 mm and it was to increase to a maximum as sweet corn plants grew older , then decreased as plants approached maturity, and (iv) evapotranspiration rates during the growing period were found to be higher for low soil moisture tension

Descriptive Indicators Research Type D2, References 28 (2), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Water Requirement and Scheduling Irrigation for Sweet Corn Under Sprinkler Irrigation in the Jordan Valley

Researcher	El-Sharif, W A
Affiliation	University of Jordan
Publisher	Thesis (M Sc in soils and irrigation)
Document Location	University of Jordan Library
Year	1980

Description The thesis puts forward a case study of sprinkler irrigation of sweet corn in the Jordan valley and attempts to quantify the actual requirements and impacts on production levels

Results The major recommendations are for future research to develop the data and enhance the initial results gathered for the thesis

Descriptive Indicators Research Type D2, References 42 (1), Potential Contribution of research 1, Overall Coverage of topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Mujib And Southern Ghors Irrigation Project

Researchers	Kanaan, Wael
Affiliation	MOA
Publisher	MOA (National Planning Council)/USAID, Amman
Document Location	NCARTT Library
Year	1973

Description The document includes a brief description of the area, its water resources, soil classification, land tenure, agricultural services, and farming practices In addition the document indicated the economic situation in the project area

Results The document describes the project for irrigating the Mujib area and the Southern Ghors

Descriptive Indicators Research Type P 2, References 0, Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

NEEDS ASSESSMENT AND TRAINING

Identification of Jordanian Male an Female Farmers' Needs

Researchers	Hamdan, Mohammed, Harb, Mohammed, El-Karki, Mohammed, and Salman, Amer
Affiliation	University of Jordan
Publisher	INSTRUPA, GTZ, MOA
Document Location	University of Jordan/Faculty of Agriculture
Year	1996

Description The main objective of this study was to develop an extension strategy that can meet the Jordanian farmers needs The study covered all research available from 1985 to present, and focused on the main farmers needs both from the institutional and experts points of view as well as the farmers point of views

Results By using four criteria (adverse effects, irreversibility potential, rate of degradation, geographic extent of problem) for the purpose of identifying the environmental needs in Jordan, the following priority system was identified (a) High priorities (soil salinization, soil degradation, Ground degradation, Desertification, soil erosion), (b) Medium priorities (Ground water salinization, Ground water depletion, plant cover destruction, surface water degradation, Habitat destruction), (c) Low priorities (Surface water salinization, Loss of agricultural land, Quality of products, deforestation, Wetland destruction, Cultural degradation)

Descriptive Indicators Research Type S3, References 45 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Agricultural Extension Guide Water Harvesting Techniques (In Arabic)

Researcher	Abu-Mishref, Jihad
Affiliation	Ministry of Agriculture
Publisher	Extension Department/MOA
Document Location	ERMC Library
Year	1995

Description This extension bulletin consists of two parts The first part discusses the water harvesting concept, and the factors affecting water harvesting The second part discusses water harvesting means appropriate to our local conditions General information about the different types of terraces is presented bench terraces, contour stones terraces, contour cement stone terraces, earth dams, runoff in macro catchment, and stone earth tree basins

Results The results emanating from this work include the various opportunities for water harvesting

Descriptive Indicators Research Type 3, References 12 (2), Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 1, Potential Application at the Farm Level 2

Opportunities and Options for Participatory Irrigation Management in Central Jordan Valley

Researchers	Reiss, P , J Al-Rashdan, Al-Hanbali
Affiliation	DAI, JVA
Publisher	USAID Report by DAI
Document Location	ERMC Library
Year	1995

Description This report was conducted for the Water Quality Improvement and Conservation Project The main objective of this report was to examine whether one or more water user organization are needed and can be made viable in the central Jordan Valley To that end, the report identifies generic types of farmer organizations operating in the valley, characterizes their basic features, explains the legal framework within which they operate, and details particular cases However, their investigation in the valley indicated that a focus of the report should be broader than the need for WUOs alone This report is considered an initial effort to assess what might be appropriate roles for farmers in the Jordan Valley

Descriptive Indicators Research Type P2, References 13 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Needs Assessment for an Irrigation Management Service

Researchers	Busch, Charles D
Affiliation	Volunteers in Overseas Cooperative Assistance
Publisher	USAID Project Report by DAI
Document Location	ERMC Library
Year	1994

Description This report conducted under the Water Quality Improvement and Conservation Project The work has two objectives (i) To assess the need for an irrigation management service (IMS) to help farmers improve their use of irrigation water and thereby conserve water resources, and (ii) if irrigation management is deemed to be needed suggest alternatives for IMS establishment and sustainability

Results The researcher concluded that an irrigation management service is assessed as a need without doubt However, the path leading to its establishment crosses many different interests and will require time and discussion to reach consensus among the various parties A number of general recommendations were made, including (i) only orifices be used to help minimize turnout flow variation and the current defective system of flow meters and pressure regulators be abandoned - the base for water billing should be the field crop and water time, and (ii) Jordan Valley Authority and Jordan Valley farmers should visit neighboring countries where laws allow farmer participation in the operation of the irrigation system - Turkey is suggested

Descriptive Indicators Research Type P 2, References 0, Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 1, Potential Application at the Farm Level 2

Irrigation Training in the Public Sector Guidelines for Preparing Strategies and Programs

Researchers	Economic Development Institute
Affiliation	World Bank, USAID
Publisher	World Bank, USAID
Document Location	ERMC Library
Year	1989

Description This book provides guidelines to help decision makers and others concerned with the management of irrigated agriculture to formulate long-term training policies, strategies, and programs This book is a companion to the ICID/World Bank "Guide for the Preparation of Strategies and Manuals on Planning the Management, Operations and Maintenance of Irrigation and Drainage Systems" (June 1988)

Results It is argued that the resulting systematic training should contribute to the improved performance of irrigation and drainage schemes and enhance the management of irrigated agriculture, particularly in the developing countries The guidelines do not provide specific recommendations on how management and staff training should be organized and financed Rather, they provide a fairly comprehensive overview of the main issues to be considered in forming a national or departmental training strategy The main focus is on public-sector irrigation organizations Most of the issues would also have to be considered in developing a systematic training program for a private-sector organization, such as a water users group

Descriptive Indicators Research Type P1, References 22 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Agricultural Extension

Researcher	Van den Ban, A W , H S Hawkins
Affiliation	Department of Extension Education, The University of Melbourne
Publisher	Longman Scientific and Technical , England
Document Location	ERMC Library
Year	1985

Description The effects of extension work depend to a large extent on the professional competence of the extension agents This book can be used to help increase this competence by extension agents or by students who wish to become extension agents It discuses the major decisions which have to be made regarding extension philosophies, strategies, methods and organization Also, it shows how the

social sciences and the experience of extension agents can help us to make these decisions

Results Extension involves the reception and interpretation of messages transmitted through different channels - extension agents will be more effective in helping farmers if they understand some of the theoretical background to their work Extension agents have many different methods available for exchanging information with farmers, research workers and other members of the agricultural system Hence extension agents must be familiar with the characteristics of the media and how to use them effectively More systematic planning can increase the effectiveness of many extension organizations This planning requires clear decisions about what kind of changes the extension organization is trying to achieve among what categories of farmers and how these changes will be achieved This planning must be based on careful analysis of past extension experiences and the reasons why these changes have not been already Careful evaluation of objectives, methods and results is an integral part of effective planning Information produced in evaluation is an important tool for extension organization management The management style should stimulate the learning processes of extension agents mentioned above

Descriptive Indicators Research Type T1, References vast with additional readings (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

LOW QUALITY WATER USE

Sewage Effluent Reuse in Jordan

Researchers	Taha, S S , Stoner, R F
Affiliation	ICID
Publisher	ICID Journal Vol 45, No 1
Document Location	ERMC Library
Year	1996

Description Jordan is typical of a number of arid countries where is competition for water between domestic, industrial and agricultural users As the population grows and the economy strengthens, water use grows to meet the population increase and also to meet an increased per-capita demand Further, as the population's demand for consumer goods grows, so industry develops with ever increasing demands for water Since these demands are seen to be of higher value than those for agriculture they must be the first to be met However, waters used for these purposes are not all lost, they re-appear as wastewater in sewers and drains or seep directly into the groundwater, the only amount lost is that which is evaporated and a very small amount consumed in the manufacturing processes Thus a great deal of the resource is still available for agriculture in the form of effluent

Results As the economy develops further then a greater quantity of water will be diverted to domestic supply and industry and agriculture will be forced more and more toward the re-use of effluent The questions which remain are whether there are any limitations on this process and what treatment in necessary in order to render these effluents fit for re-use The paper examines the situation in Jordan and attempts to address the questions raised above

Descriptive Indicators Research Type S, References vast (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Effect of Khirbet As-Samra Treated Effluent on the Quality of Irrigation Water in the Central Jordan Valley

Researchers	Shatanawi, M , Fayyad, Manar
Affiliation	University of Jordan / Faculty of Agriculture
Publisher	Water Resources, Vol 30 (12), Great Britain, pp 2915 - 2920
Document Location	University of Jordan Library
Year	1996

Description The Central Jordan Valley is irrigated with two main sources The first one is the King Abdullah Canal (KAC) water of the Yarmouk river, and the second is King Talal Reservoir (KTR) water The KTR water is a mixture of surface runoff from Amman-Zarqa area and treated sewage water effluent from Khirbet As-Samra Treatment Plant Based on water samples and irrigation system performance, the treated wastewater has adversely affected the efficiency of irrigation

Results Results showed that irrigation water emanating from the KTR can be used with restrictions The high calcium and magnesium content of the water causes clogging of drip irrigators In addition, the high bacterial and nutrient count in the treated waters promotes algae growth and consequently clogging of drip irrigators

Descriptive Indicators Research Type S2, References 10 (2), Potential Contribution of Research 2, Overall Coverage of Results 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

Quality of Irrigation Water in the Middle Jordan Valley

Researchers	Shatanawi, M , Fai'th, M , Abu-Sharar, T
Affiliation	University of Jordan/Faculty of Agriculture
Publisher	Water and Environment Research and Study Center/University of Jordan
Document Location	University of Jordan Library
Year	1996

Description The Middle Ghor of Jordan Valley is irrigated with two main sources The first one is the King Abdullah Canal (KAC) water of the Yarmouk river, and the second is King Talal Reservoir (KTR) water The KTR water is a mixture of surface runoff from Amman-Zarqa area and treated sewage water effluent from Khirbit As-Samra Treatment Plant (KTP) Water samples were collected periodically throughout the period of April-May 1993, to Ovtober/1994 from 10 different sites along the pathway of KTP effluent water down to Jordan Valley at a merging point with KAC (site 5)

Results Results showed that the lowest average EC value (0 89 dS/m) was observed in water samples of site 6 (KAC water before merging with KTR water) and the highest average EC value (2 36 dS/m) was observed at site 1 (KTR water) The relations between EC and the major soluble ions in the water samples (Ca, Mg, Na, C1, and SO4) were studied The results indicated absence of any linear relation between EC and the above ions in site 1 However, for KTR surface water showed a linear relation between EC and SO4 was observed in site 4 A linear relation between EC and each of the soluble ions was observed at site 5 Association between EC and any of the soluble ions increased with increasing salinity in all sites Except for the good water quality of KAC, water sodicity in all other sites was considered as marginal (SAR ranges between 4 and 5) All water sources were classified as very hard, except for KAC water which was classified as hard All waters have the ability to precipitate calcium and magnesium as carbonates The results also indicated that the concentration of trace and toxic elements in all sites was low

Descriptive Indicators Research Type , References 12 (2), Potential Contribution of Research 2, Overall Coverage of Results 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

Water Use and Production Function of Sweet Corn Irrigated with Saline Drainage Water

Researchers	Abu-Awwad, Ahmad M

Affiliation	University of Jordan/Faculty of Agriculture
Publisher	Dirastat (Pure and Applied Sciences), No 4, pp 99-114
Document Location	University of Jordan Library
Year	1994

Description The yield of sweet corn (Zea Mays 2, NK 199) and soil-water contribution to seasonal evapotranspiration as affected by different quantities and qualities of irrigation water were studied

Results Soil-water contribution to seasonal evapotranspiration increased with increasing total water applied, regardless of the irrigation water salinity Crop-Salinity production functions indicated that for adequate irrigation with less than 3 5 ds/m irrigation water salinity, these was no significant reduction in sweet can yield

Descriptive Indicators Research Type S2, References (2), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Water Quality of Irrigation Water in the Jordan Valley

Researcher	Hanbali, Mohammed
Affiliation	Jordan Valley Authority
Publisher	French Embassy in Jordan and GTZ / Proceedings of the Regional Seminar on the Optimization of Irrigation in Agriculture
Document Location	ERMC Library
Year	1994

Description General information about the quality of irrigation water used in the Jordan Valley with its three agro-climatic zones, the north, the middle, and the southern part, were presented The author mentions 5 tables, but they are not present in this paper

Results Yarmouk river water - is the main source of water carried in King Abdullah Canal Project (KAC) - Wadi Hasa and all side wadis except Zarqa River-waters are relatively constant in their chemical composition which does not vary from year According to FAO Guideline these waters can be used for irrigation purposes with or without slight restrictions (TDS = 400-700 ppm) However, the water quality of King Talal Reservoir (KTR) which is the largest surface water body in Jordan is the principle source of irrigation water to the middle and southern parts of the Jordan Valley upstream of the Dead Sea- its quality is variable depending on yearly rain-fall and the percentage of treated sewage effluent to storm water (TDS ranges from 600 to 1500 ppm) According to FAO Guidelines KTR water can be used for irrigation purposes with slight to moderate restrictions

Descriptive Indicators Research Type S 2, References 0, Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 3

Response of Chrysanthemum Morifolium Ramatto Drip Irrigation with Treated Wastewater and Fresh Water at Different Planting Densities

Researchers	Sawwan, J S
Affiliation	University of Jordan
Publisher	Dirasat (Jordan) (Jan 1992) v 19B(1) p 279-295
Document Location	University of Jordan Library
Year	1992

Description A field experiment was conducted during the 1988 growing season at Amman Industrial City, where industrial wastewater is subjected to secondary treatment A split plot design with water source as the main plot and plant spacing as the subplot was used The response of cut chrysanthemum to treated industrial wastewater (TIW) was similar, if not superior to that of fresh water (FW) in all aspects studied Both the mean plant height and number of inflorescence per cyme were significantly higher for plants irrigated with TIW than plants irrigated with FW Number of branches after pinching as well as number of opened inflorescence per cyme were not affected by the source of irrigation water

Results Irrigation with TIW resulted in higher leaf chlorophyll content when compared to irrigation with FW Iron and zinc were the only nutrient elements showing a significant increase after the use of TIW Though other nutrients showed no significant differences by the use of TIW, an increase trend in the level of potassium, manganese and copper was noticed Planting densities resulted in variable plant height, number of inflorescence/cyme and number of opened flowers/cyme, but neither show any significant differences in the number of branches nor the plant nutrient content The use of TIW in chrysanthemum production could be possible, but further studies on the effect of soil characteristics is recommended

Descriptive Indicators Research Type S2, References 15(2), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Examining the Effect of Irrigation Water Type on Tomato Crop Productivity (In Arabic)

Researchers	Ferdous, Abdul N, Karadsheh, Ismat , Shdeifat, Salih, Dabbas, Mohammed
Affiliation	NCARTT
Publisher	NCARTT
Document Location	NCARTT Library
Year	1992

Description This research aims at studying the effect of adding fixed quantities of salty & non salty water on tomatoes productivity This experiment was made in Al Khaldiyeh Station for Agricultural Research for the seasons 94/95 Split Plot Design was used in designing the experiment by taking up four levels of added irrigation water levels which are (50%, 75%, 100%, 125% of the evaporation pan readings) ad the main treatments and the irrigation water types (salty 4,600 parts of million, Fresh 500 parts of million) as minor treatments repeated four times The used experiment was planted on 15/4/95

Results The results of the experiment showed an increase in the production rate by raising the added quantity of water for the treatments irrigated by water whether salty or fresh, and that the highest production was when adding fresh water at the irrigation level 125% of the evaporation pan readings (8,131 m3/hectare) where the production reached about 20 2 tons/hectare It is clear that the treatment 50% of the evaporation pan readings for fresh water has given a production equal to the treatment 75% of the evaporation pan readings (About 20 tons/hectare) for salty water By comparing the production of salty and non salty water, it was shown that all the fresh water treatments gave the highest production The experiment results showed that the percentage of the hard materials and the average abstractly by the added irrigation water quality or quantity, but it was relatively higher in the fruit resulted of the salty irrigation water, and also the increase in the fruit with a total average that equal 35% of production for the treatments irrigated by non salty water and 20% of production for the salty treatment irrigated by salty water It was also noticed that the fruit weight in the first picking was higher, and started to decrease in the following pickings However, the fruit weight was noticed to be increased by the increasing of the added irrigation water quantities at the end of the season (the fourth and fifth picking) and by the quality of the fresh and salty water The results of experiment also showed that the treatment 125% of the evaporation pan readings for fresh water was the best treatment regarding the accumulation of salt in the soil section where the saltiness of water didn't change during the season

Descriptive Indicators Research Type P2, References 15(2), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1 , Potential Application at the Farm Level 1

The Effect of Using the Semi-Saline Water on the Production of Sugar Beet in Al Khladiyeh Regional Centre (In Arabic)

Researchers	Ferdous, Abdul N, Karadsheh, Ismat , Shdeifat, Salih, Dabbas, Mohammed
Affiliation	NCARTT
Publisher	NCARTT
Document Location	NCARTT Library
Year	1992

Description This study looked at managing and utilizing the available water resources especially saline water by studying the effect of the irrigation water and leaching treatment on the production of sugar beet and its sugar percentage This study was conducted at Al Khaldiyeh Center during the season 94/95 Three levels of leaching treatment were used (0, 15, and 30% of the evaporation pan readings) and three irrigation water types - fresh (500 parts of million), saline (4,600 parts of million), mixed (2,560 parts of million)

Results Significant differences in the production rates did not appear in comparison with the irrigation water type and the washing treatments, but the 30 % treatment which was watered by the non-saline water has given the highest production rates

where it reached 33 54, 15 46, and 7 02 tons/hectare for roots, leaves and sugar, respectively The statistical analysis rates for sugar production rates from sugar beet for the season 1994/1995 showed that according to the added water type, no significant differences at the level of 5% appeared between the irrigation water types, where the production rates reached 5 97, 5 74, 5 85 tons/hectare for fresh, saline and mixed water, respectively

Descriptive Indicators Research Type P2, References 12 (1), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 1 , Potential Application at the Farm Level 1

Irrigation Water Quality in Jordan (In Arabic)

Researchers	Irrigation Department, JVA
Affiliation	JVA, MWI
Publisher	Irrigation Department, JVA
Document Location	Irrigation Department, JVA
Year	Undated

Description This report discussed the factors affecting water quality in general, and contains information about the quality of some water resources in the Jordan Valley, the Highlands, and the desert areas This report contains general information about the restrictions of using low quality water in irrigation, and their effect on soil properties Analysis results for EC, B, Cl, Na, and bicarbonates for some water resources in Jordan are tabulated

Results Water quality determination is very important in deciding the proper use of water for different purposes Careful consideration must be taken when dealing with low quality water in irrigation

Descriptive Indicators Research Type IB1, References 0, Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 3

Effect of Sewage Sludge Treatments on Corn Crop, Water Consumption, and Some Natural Soil Properties

Researchers	Muhsen, N I , El-Kattani, S , Battikhi, A
Affiliation	University of Jordan
Publisher	Dirasat (Jordan), Vol 16(9), p 71-87
Document Location	University of Jordan/Library
Year	1989

Description An experiment using four sewage sludge treatments at rates of 0, 2, 4, and 6 tons/dunum incorporated with the surface soil (0-30 cm) was carried out at Jiza Region Each treatment was replicated three times in a randomized complete block design The vegetative and grain yields of corn increased significantly due to the addition of sewage sludge The increase in vegetative yield was 461, 1084, 977 kg/d over the control (1265 kg/d of dry matter yield), while the increase in ear production was 247, 499 and 477 kg/d over the control (676 kg/d) at rates of 2, 4 and 6 tons/d,

respectively The consumptive use of water decreased with increasing sewage sludge Water consumption was 8 2, 71 4, and 137 9 mm less than the control (747 7 mm) at the different sludge rates

Results The available water in treated soil increased by 1 16, 19 25, and 23 42%, whereas the infiltration rate of surface soil also increased by 12 8, 17 3, and 27 8% over the control at 2, 4, and 6 tons/d sludge, respectively The bulk density was slightly decreased in the surface layer

Descriptive Indicators Research Type S, References 18(2), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Effect of Treated Wastewater on Concentration of Nutrients and Some Heavy Metals in Soil and Irrigated Corn Plants

Researchers	El-Khattari, S , Jamjoum, Kh
Affiliation	University of Jordan
Publisher	Dirasat (Jordan), Vol 15(11), p 29-44
Document Location	University of Jordan Library
Year	1988

Description Concentration of heavy metals Ni, Cd, Pb, in corn leaves and seeds was not affected by irrigation with treated wastewater as compared to that irrigated with regular water, whereas the concentration of N, P, K was increased The concentrations in plant leaves were 2 35% N, 0 2% P, 2 2% K, wastewater irrigation, respectively, while irrigated with regular water they showed 1 93% N, 0 25% P, 1 69% K In corn seeds of wastewater irrigated plants concentrations were 0 8, 0 28, 0 25%, respectively, and 0 71, 0 26, 0 22% in plants irrigated with regular water Wastewater also affected the soil EC and organic matter content but had no significant effect on pH At mid-season soil EC increased by 0 35mmhos/cm, and organic matter by 0 16% at the surface soil, while at the end of the growing season increase in EC reached 0 41mmhos/cm due to use of wastewater, but organic matter content did not increase significantly Soil extractable P and K were highly increased while the extractable trace nutrients were increased to lesser extent No increase in extractable heavy metals concentration was detected The high quality treated wastewater, produced from the airport treatment plant, could be used in irrigation of economic crops with continuous monitoring for water quality to avoid the addition of undesired substances

Results Results indicated that irrigation with treated wastewater increased the total dry matter yield of corn and its components, especially ear yield, where the increase was 18% over the control

Descriptive Indicators Research Type S, References 15(2), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

ENVIRONMENTAL CONSIDERATIONS

Sodicity of Drainage Water as Affected by Bicarbonate Enrichment of Irrigation Water Under Green House Conditions

Researcher	Ayesh, Mohammed Ibrahim
Affiliation	Faculty of Graduate Study/University of Jordan
Publisher	Faculty of Graduate Study/University of Jordan
Document Location	University of Jordan/Library
Year	1994

Description A greenhouse experiment was carried out at the University of Jordan/Amman to study the influence of irrigation water characteristics (salinity, sodium adsorption ratio (SAR), and bicarbonate content) on salinity, SAR, and major chemical constituents of drainage water Also alfalfa water use efficiency was studied He used a synthetic and King Talal Reservation waters The introduction and literature review contains a valuable information about the use of saline water The thesis contain 21 tables and 27 figures

Results At SAR 5, results of salt balance analysis of irrigation and drainage waters indicated an increasing tendency of CA and MG precipitation with HCO3 - enrichment of irrigation waters of 20 and 30 molem 3 For a given irrigation water, salinity of dw increased with decreasing LF The WUF of alfalfa irrigated with prepared waters decreased with increasing SAR and HCO3/C1 ratio

Descriptive Indicators Research Type B1, References 111 (1), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Genesis of Some Salt Affected Soils in Southern Jordan Valley

Researcher	Taimeh, A Y
Affiliation	University of Jordan
Publisher	Dirasat (Jordan), Vol 15(11), p 70-103
Document Location	University of Jordan Library
Year	1988

Description The objectives of this research were to (i) study the pedological changes that had taken place in saline soils occurring in the southern region of Jordan Valley since the deposition of their parent material, and (ii) assess any possible climatic changes during the same period

Results Interpretation of physical, chemical, mineralogical and field information indicated the presence of three major parent materials that contributed to the occurrence of various soils in that region The oldest formation is the Lisan Marl whose deposition was terminated during arid climate 16,000 years ago After that period, two formations were concurrently deposited over the Lisan Marl One is a lacustrine sediment, called recently the Damya formation, deposited in a shallow lake of sweat water during which the climate was humid The other one is colluvium deposited by colluvial activity The deposition of the Damya and the colluvium

extended to the time when the Dead Sea evolved 11,000 years ago However, colluvial activity had not ceased Since the completion of the deposition of Damya formation and the involvement of the Dead Sea arid climate prevailed and continued to the present time

Descriptive Indicators Research Type S2, References 40(2), Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 3

A Plastic Green House for Semi-Arid Agriculture (JAP Green House)

Researchers	Snobar, B A , Denis, P , Suwwan, M A
Affiliation	University of Jordan
Publisher	Dirasat (Jordan), Vol 15(11), p 35-45
Document Location	University of Jordan/Library
Year	1988

Description The roof of a plastic greenhouse was utilized to catch rain water into a specially designed groin reservoir along the greenhouse This water was later used to irrigate the greenhouse tomato crop using a solar system to operate an irrigation pump irrigation is essential in this technique

Results Results indicated that in a zone where the annual rainfall is more than 350 mm, a sufficient amount of rain water could be collected to supply the water requirement for a vegetable crop grown under such plastic greenhouse Tomato yield obtained from this experiment was 8 times more than that obtained under the open field rained conditions The use of this technique is feasible and may be applicable in marginal and arid zones if sufficient size of catchment area was allocated to each greenhouse

Descriptive Indicators Research Type S, References 13(2), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

Trickle Irrigation and its Effect on Squash Yield, Root Development and Soil Salinity

Researcher	Shatanawi, M R
Affiliation	University of Jordan
Publisher	Dirasat (Jordan) (Feb 1987) v 14(2) p 107-117
Document Location	University of Jordan/Library
Year	1987

Description Squash yield, root development and salt movement as affected by emitter discharges and locations relative to the plant were investigated
Results The results showed that yield was similar when one emitter per plant (S1) or one emitter per two plants (S2) was used, and was higher than the yield obtained when one emitter per four plants (S4) was used Roots were concentrated mainly in the upper 100-mm soil layer Root mass under S4 was higher than root mass under S1 or

S2 The roots penetrated to a depth of 320 mm Emitter discharges had no effect on yield or on root mass

Descriptive Indicators Research Type S2, References 14(2), Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

Salt Distribution & Accumulation as Affected by Drip Irrigation Treatments for Tomatoes Grown Inside Plastic Houses

Researchers	Judah, O M , Taimeh, A Y , Suwwan, M A
Affiliation	University of Jordan
Publisher	Dirasat (Jordan)Vol 14(11), p 113-125
Document Location	University of Jordan/Library
Year	1987

Description For two consecutive seasons, effect of irrigation frequency (4 and 7 days) and water application rate (2, 4 and 6 1 ph) on salt accumulation and yield of plastic house tomato were studied using a split-plot design Salt accumulation increased in the soil surface (10 cm depth) for all treatments as distance from the dripper increased The electrical conductivity increased from less than 1 ds/m to about 3 ds/m during the first season Also salt accumulated but to less extent at the depth of 15 cm, below this depth no indication of salt accumulation was traced Second season data exhibited a similar pattern of salt accumulation but the salt accumulated at a deeper level

Results Results suggested that the salt content, regardless of water treatment, was reduced around the tomato plants The frequency of water application showed significant effects on the salt contents within 10 cm from the drippers, effect of application rate, however, was clear to distance of 25 cm away Tomato yield decreased from 191 (1st season) to 155 (2nd season) ton/ha This reduction in yield may be due to the salt accumulation in the 2nd season Regardless of the reduction, data for the separate seasons indicated that yields were not affected by both frequency and rate of irrigation

Descriptive Indicators Research Type S2, References 11 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

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

Researchers	Hatter, B , Shadafan, H , Baqa'in, A
Affiliation	University of Jordan
Publisher	Dirasat, Vol XIII, No 2
Document Location	University of Jordan Library
Year	1986

Description This study aims to determine the quantities of fertilizers that are usually used by Jordan Valley farmers inside plastic-houses, and to determine the significant

difference in the fertility level and salinity accumulation inside and outside the plastic houses To achieve the first objective, 35 farmers were interviewed as a sample, and for the second objective, soil samples from 17 farms were taken and analyzed

Results Results obtained indicated that most of the farmers usually use amounts which generally exceed the crops needs About 50% of the farmers used more than 6 m3 of organic fertilizers per dunum, 45% used more than 60 Kg N/d, and about 37% used more than 12 Kg P/d The salt accumulation in the surface soil inside the plastic-houses was significant Also a significant decrease in soil pH was observed on the other hand, available P content was high in the soil and it increased significantly inside the plastic-house The increases in organic matter, K and Micronutrients (Fe, Zn, Mn, Cu) were not significant

Descriptive Indicators Research Type S1, References 15 (1), Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 1, Potential Application at the Farm Level 1

Salt Accumulation Under Various Drip Irrigation Treatments

Researcher	Judah, O M
Affiliation	University of Jordan
Publisher	Dirasat (Jordan) (Apr 1985) v 12(4) p 61-75
Document Location	University of Jordan/Library
Year	1985

Description Soil salinity for different irrigation treatments was investigated The rates - average and highest salinity - were determined The relationship between water applied and yield was also investigated

Results Based upon the results of the experiments conducted, recommendations were made for more frequent and longer time irrigation to assure keeping salt accumulation far away from the plants in the Jordan Valley

Descriptive Indicators Research Type S2, References extensive, Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Safety Limits in the Use of Irrigation Water

Researcher	Al-Shuraideh, R
Affiliation	NCARTT
Publisher	Al-Muhandes-al-Ziraai (Jordan) (Mar 1985) v 14(22) p 43-45
Document Location	NCARTT Library
Year	1985

Description This document presents different Water Classifications - American and Russian Systems - regarding irrigation water standards The document provides for an explanation of osmotic, toxic and nutrition effects on plants

Results The results are presented in tables of safety limits for irrigation water

Descriptive Indicators Research Type S 2, References (2), Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

PLANNING, DESIGN, AND PERFORMANCE OF IRRIGATION SYSTEMS

Surface Irrigation Performance in Jordan in "Proceedings of The Regional Seminar on Irrigation Research in the Mediterranean Region"

Researchers	Shatanawi, Muhammad, Jitan Muhammad
Affiliation	University of Jordan
Publisher	Water and Environment Research and Study Center, University of Jordan, and the Regional Agricultural Mission/French Embassy
Document Location	ERMC library
Year	1996

Description A study was carried out at Al-Muwaqqar area in order to evaluate the performance of subsurface irrigation studying the wetting patterns in a soil profile These tubes were installed at three burial depths (0 20, 0,35, and 0 50) Three initial masteries contents were used before starting the irrigation Two methods for water detection were used (soil moisture samples and by using the calibrated Neutron Probe device) In general, the results indicated the capability of this system to overcome the problems related to soil and weather conditions which reduce the efficiencies of other irrigation systems Relation-ships were develop to predict water movement in the soil profile in all directions as a function of time, these were used to produce charts that are helpful for the design of this system under similar soil conditions

Results The results confirms a direct relation between the moisture content around the tube with the discharge rate Where high initial moisture contents reduced the difference in the hydraulic gradient between the water pressure inside the tube and outside of it, causing a reduction in the discharge rate In a general comparison between the results obtained by the Neutron Probe device and the results of the gravimetric method, the results of the N P where less accurate to predict the wetting pattern shapes in the soil profile, especially when close irrigation periods are practiced The results of the study showed that the subsurface irrigation method can overcome many of water application problems in arid soils especially problem associated with very low infiltration and high evaporation rates

Descriptive Indicators Research Type S, References 15(2), Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

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

Researchers	Shatanawi, Muhammad, Sha'ban, Mohammad, Martin, Gilles, Ospital, Philip
Affiliation	University of Jordan
Publisher	Unpublished Report
Document Location	University of Jordan/Library
Year	1996

Description Good quality water is generally scarce in arid and semi arid regions such as Jordan Such scarcity arises from many factors such as, low rainfall with low distribution, high losses due to evaporation, and increasing demand on water due to high population growth rate In addition, about 90% of the country receive less than 200mm of annual rainfall

Results To manage the irrigation for tomato, cucumber and strawberry in the Middle Jordan Valley, some watermarks tensiometers were installed at certain depths and distances from the drippers The irrigation was scheduled according to the tensiometers values throughout the growing season The amount of water used for the experimental houses of tomato throughout the season was about 265 6 mm, compared to the usual addition by the farmer which was about 547 5 mm Therefore, the amount of water saved by irrigation according to the tensiometers readings was about 51% For cucumber the amount of water used for the experimental houses was about 436 2 mm, compared to 765 6 mm which is usually used by the farmer Therefore, the amount of water saved was about 43% For strawberry, the amount of water used for the experimental house was about 266 3 mm, compared to the usual addition by the farmer which was about 805 mm Therefore, the amount of water saved was about 76% The purpose of this experiment was to determine the possibility of using the tensiometer technology to schedule irrigation The theoretical principle of this technique is based on simple indications The simplicity of equipment used such as Watermark enables the farmer to take benefits of this technique In Jordanian farms, localized irrigation networks are under difficult conditions (variation of pressure, clogging) and few farmers can measure the irrigated amount of water (flow meters are not used) Under these conditions, it is very difficult to use the ET calculation to schedule irrigation For most of the farmers, the millimetre unit can not tell them anything The great advantage of tensiometers is that their maintenance is easy and that they focus on the soil moisture whatever the irrigation network

Descriptive Indicators Research Type P2, References 0, Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Sprinkler Irrigation

Researcher	Toufaha, Sami
Affiliation	Ministry of Agriculture
Publisher	National Library of Agriculture, NCARTT 631 7
Document Location	Proceeding of the Regional Seminar on the Optimization of Irrigation in Agriculture
Year	1994

Description This document describes the process of planning, designing, selection of materials, and installation of sprinkler irrigators The stages of the process are illustrated using pictures, charts, and instructions In addition, the document describes some sprinkler projects in Jordan such as Feisal Nursery Sprinkler Irrigation Plant

Descriptive Indicators Research Type TB, References 0, Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 1, Potential Application at the Farm Level 2

Water Management and Conservation Measures Under Semi-Arid and Arid Conditions

Researcher	Arar, Abdullah
Affiliation	Arab Consult/Private Sector
Publisher	French Embassy in Jordan, and GTZ / Proceedings of the Regional Seminar on the Optimization of Irrigation in Agriculture
Document Location	ERMC Library
Year	1994

Description This informational paper describes the measures which can be taken under arid and semi-arid conditions to increase available water resources and to conserve the available resources No tables or figures are presented in this paper

Results Measures that increase available water resources include rainfall harvesting, runoff agriculture, recycling of the water, use of brackish sea water, recharge of underground water from runoff water following intensive rain storms, and desalting of brackish and sea water Measures that would increase the efficient use of available resources include reducing evaporation from water surfaces in reservoirs, reducing seepage losses by lining open canal, or conveying water in pipes, reducing evaporation from soil surface by covers of mulches, reduce percolation losses in sandy soils by the use of underground moisture barriers, minimizing the consumptive use of water by crops grown in controlled environments, and finally, the use of hydrophilic soil amendments to minimize soil moisture losses by either evaporation or deep seepage

Descriptive Indicators Research Type P2, References 9 (1), Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 1, Potential Application at the Farm Level 2

Information System for Irrigation Management in the Jordan Valley

Researchers	Shatanawi, Muhammad R , AL-Shrouf, Ali
Affiliation	WERSC/University of Jordan
Publisher	French Embassy in Jordan, and GTZ / Proceedings of the Regional Seminar on the Optimization of Irrigation in Agriculture
Document Location	ERMC Library
Year	1994

Description This paper contains theoretical information about irrigation management using irrigation scheduling methods such as water sensing devices and water balance procedures Methods for estimating potential evapotranspiration were discussed In addition the writers present an information system for irrigation scheduling in the Jordan Valley, and an example for estimating the crop water requirement

Results The results indicated that water needs of the crop are paramount important in determining the time of irrigation during the growing season that obtain their water supplies from storage reservoirs or from other dependable sources of water Some irrigated areas have a limited water supply during the irrigation season Also some farmers cannot always apply water when the crop is most in need Sometimes, to save water, they must apply it even though the crop does not need it, provided the soil has the capacity to store additional water

Descriptive Indicators Research Type S1, References 9 (2), Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 1, Potential Application at the Farm Level 2

The Changing Concept of Management in Irrigation

Researcher	Svendsen, Mark
Affiliation	Entwicklung + Landlicher raum
Publisher	Entwicklung + Landlicher raum 2/89, pp 3-5
Document Location	ERMC Library
Year	1989

Description In recent years, the use of the term "water management" has been largely overtaken by "irrigation management' employing a broader scope of interest and the inclusion of things other than water in the management equation - things such as people, finances, and equipment

Results The central idea of this short note is that while irrigation system managers or researchers or advisors have embraced the term, but have not yet completely accepted or understood its implications Moreover, to take advantage of the opportunities for improving irrigation performance that it offers, the categories in which we think must be changed, not marginally, but radically

Descriptive Indicators Research Type S2, References 0, Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

Irrigation Water Management A New Type of Engineering

Researcher	Horst, Lucas
Affiliation	Entwicklung + Landlicher raum
Publisher	Entwicklung + Landlicher raum 2/89, pp 12-13
Document Location	ERMC Library
Year	1989

Description The planners and designers of small holder irrigation projects make decisions mostly on the basis of physical parameters

Results These decisions have a direct, and often negative, bearing on the social, cultural and political consequences of irrigation projects can be blamed on the result of the inability of irrigation engineers to assess these consequences and to integrate

them into their planning and design To remedy this, the training of irrigation engineers needs to be adapted, to include the socio-economic and political implication of irrigation theory and practice

Descriptive Indicators Research Type S, References 15(1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

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

Researchers	Huppert,Walter, Walker, Hans H , Wolter, Hans Werner
Affiliation	Entwicklung + Landlicher raum
Publisher	Entwicklung + Landlicher raum 2/89, pp 7-11
Document Location	ERMC Library
Year	1989

Description The "Management of Irrigation Systems" is one of the significant topics which has engaged the attention of the GTZ in recent years Following completion of the most important phases of development, a three-part working guide for irrigation management is now available, consisting of a concept paper aimed at deepening general understanding of the subject, of a set of strategic guidelines ("Guidelines to Irrigation System Management") for project planning, and of a package of working aids for specific problems in the management field

Results In a nutshell irrigation management needs radical re-thinking, with much more effective integration of new management theory approaches than has so far been evident

Descriptive Indicators Research Type P2, References 0, Potential Contribution of Research 2, Overall Coverage of Results 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

Operation and Maintenance of Small Irrigation Schemes

Researcher	Stern, Peter H
Affiliation	Unknown
Publisher	Intermediate Technology Publications Ltd, UK
Document Location	British Council Library
Year	1988

Description The quality and organization of maintenance can be the single most important factor in the success of irrigation schemes This short, practical manual deals with the problems of operation and maintenance at the source of supply and in the conveying of water in pipes or open channels Water distribution is described both on- and off-farm and the maintenance of irrigation systems and devices - and advice is given on drainage, health and general management problems

Results This book has been written to supplement the author's Small Scale Irrigation which was first published in 1979, and is intended for those who are concerned with the development of irrigation cultivation on a small scale, with limited technical and

financial resources Currently world-wide attention is being given to the poor performance of so many irrigation developments, including both well-established schemes and new projects The Overseas Development Institute of London, appointed by the World Bank to carry out research in the organization and management of irrigation projects, found that while the original design of schemes was sometimes at fault, usually the significant causes of poor performance lay in the problems of management and operation In a paper on the Bank's own experience in post-project evaluation, presented at the Special Session of the Eleventh Congress of the International Commission of Irrigation and Drainage in 1981, John M Malone and others pointed out that projects which featured small-scale irrigation were generally less costly in relation to results achieved than larger-scale, single-purpose, classical irrigation projects I hope that this little book will make some contribution to the continuing success of small-scale irrigation

Descriptive Indicators Research Type T1, References 15(1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Delivery Performance and Efficiencies of The Jordan Valley Irrigation Project

Researcher	Tahboub, Alaeddein Borhan
Affiliation	University of Jordan/Faculty of Agriculture
Publisher	University of Jordan/Faculty of Agriculture
Document Location	University of Jordan/Faculty of Agriculture Library
Year	1987

Description A Diagnostic Survey was conducted aiming at evaluation of the Jordan Valley irrigation system (open canal and pipeline) performance with regard to delivery policies as related to irrigation efficiency of different component The field application efficiency was calculated for 219 farmers by calculating the net irrigation requirement for these farms

Results The results showed that the pipeline network distribution system was more efficient in reducing the water losses than the open canal distribution system This was demonstrated by the values obtained for (Ea, Ed Ec, and Ep) - the highest value of Ea was obtained in the North- East Ghors which is served by the pipeline net work system That means this system gave the farmer chance to improve his field application and efficiency In addition, application efficiency for citrus farms was the highest As for the irrigation systems, sprinkler irrigation was more efficient than the other two irrigation methods in term of water application Sprinkler irrigation gave the lowest distribution uniformity due to the interception by trees because most of sprinkler irrigation farms were orchard farms

Descriptive Indicators Research Type D2, References 0, Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

The Efficient Use of Water in Irrigation Principles and Practices for Improving Irrigation in Arid and Semi-arid Regions

Researcher	Hillel, Daniel
Affiliation	World Bank Technical Paper No 64
Publisher	World Bank
Document Location	ERMC Library
Year	1987

Description This book is in the nature of a primer, providing a basic review and analysis of the principles governing soil-crop-water-climate relationships, irrigation, and the efficient utilization of water in arid and semiarid regions It presents a critique of traditional and of current irrigation concepts and practices, pointing out the needs and potentialities for improving the efficiency of land and water use in developing countries Starting from a basic analysis of the environmental, physiological, and agronomic factors affecting irrigation, the book contrasts historical and modern approaches to management It then describes methods of scheduling irrigation and of measuring irrigation water, and compares alternative irrigation systems It also describes in detail the requirements and methods of drainage and salinity control Finally, this book discusses some of the human considerations involved in the vital task of developing sound, appropriate, and sustainable irrigation systems

Descriptive Indicators Research Type S1, References 102 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Efficiency of Jordan Valley Irrigation System (Examination of the East Ghor Canal System Performance)

Researcher	Shatanawi, M R
Affiliation	University of Jordan
Publisher	Dirasat (Jordan) v 13(5) p 121-142
Document Location	University of Jordan/Library
Year	1986

Description The water balance for the Jordan Valley Irrigation Project was evaluated for the years 1979, 1980, 1981, 1982 and 1983 in order to determine the efficiency of the conveyance and distribution system (CDE) The on-farm irrigation efficiency (FIE) for 240 farms selected at random, was evaluated for the year 1982/1983 as related to irrigation districts, irrigation methods and type of crops

Results The results showed that CDE averaged 80% ranging from 70% to 94% for the five years For wet months, CDE values were higher than those for dry months The volume of spilled water was large and exceeded the volume of water released from the side dams in some months Analysis showed that physical conveyance losses were approximated at 5% whereas administrative losses were 15% The size of water losses ranged from 24 MCM to 33 5 MCM The average FIE of 1982/83 was 63% FIE for the northern part of the Jordan Valley was higher than that for the southern part FIE under drip irrigation was very low, 64% For citrus and wheat, FIE values were 84 6% and 82 2%, respectively, while for banana, they averaged 45% only For vegetables under drip irrigation, FIE values were 57 2%, 54% and 52 5% for tomatoes, cucumber, and squash, respectively It is recommended that the overall

canal operation system and the water management on the farm level should be upgraded Improvement in water delivery policies, water use system and irrigation scheduling is needed Periodical evaluations of the water balance and on-farm irrigation efficiency are recommended

Descriptive Indicators Research Type S2, References 19 (2), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 2

Soil and Water Management Guide for the Jordan Valley (Soil Fertility, Salinity, Irrigation)

Researcher	Dow, A I
Affiliation	Soil and Water Specialist, Washington State University
Publisher	Washington State University, USAID
Document Location	University of Jordan Library
Year	1984

Description This document presents a management guide for soil fertility management, management of salt-affected soil, and water management in the Jordan Valley, based on experiments and personal observations

Results The guidelines presented are recommended to be updated regularly for effectiveness

Descriptive Indicators Research Type P2, References 0, Potential Contribution of Research 2, Overall Coverage of Topic 1, Benefit to Farmers 2, Potential Application at the Farm Level 2

MISCELLANEOUS PUBLICATIONS

Evaluating Market-Oriented Water Policies in Jordan A Comparative Study

Researchers	Shatanawi, M , Jayyousi, Odeh
Affiliation	University of Jordan/Applied Science University
Publisher	Water International, No 20, pp 88-97
Document Location	ERMC Library
Year	1995

Description The paper argues for the establishment of tradable water rights to increase productivity and sustainability of water use The paper presents the potential for Jordan in comparison with Chile, Mexico, and California

Results In Jordan, it was determined that policy makers believe that dealing with future water scarcity for all sectors will be achieved through better management and utilization of water Both policy makers and farmers expressed strong reservations on intersectoral water transfers

Descriptive Indicators Research Type S2, References 20 (2), Potential Contribution of Research 2, Overall Coverage of Results 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

Bibliography of Published or Reported Work in the Field of Agriculture and Allied Sciences in Jordan

Researchers	Qasem, S , Tukan, S
Affiliation	University of Jordan
Publisher	Jordan Research Council
Document Location	Ministry of Water & Irrigation Library, Amman - Jordan
Year	1974

Description The vast volume of information accumulated over twenty five years proceeding 1974 was received, collected and reviewed by the authors The importance of such collection tasks were highlighted

Results The collected reports, publications, and other materials were grouped alphabetically under six headings plant production, animal health, soil and irrigation, agricultural economics, miscellaneous, and allied sciences

Descriptive Indicators Research Type P2, References approx 1,000 (1), Potential Contribution of Research 1, Overall Coverage of Topic 1, Benefit to Farmers 1, Potential Application at the Farm Level 1

Zarqa River Basin Project

Researcher	Agrar Und Hydrotechnik
Affiliation	Private Sector Consultants
Publisher	Project Report
Document Location	Ministry of Water and Irrigation Library
Year	1986

Description This Feasibility Study of the Lower Zarqa Catchment (LZC) was originally envisaged to be undertaken in 1984/85 following the completion of three years of pilot activities The date was brought forward at the request of the Government less than one year after the initiation of the pilot programme

Results The project formulated in the study seeks to overcome these problems by fostering appropriate use of the land as the main means of controlling soil erosion, the construction of various soil conservation measures (e g contour stone walls), and encouraging husbandry practices which are consistent with good erosion control principles To achieve these objectives three sub-projects were formulated

Descriptive Indicators Research Type P2, References 0, Potential Contribution of Research 2, Overall Coverage of Topic 2, Benefit to Farmers 2, Potential Application at the Farm Level 2

EXTENSION INFORMATION PIECES CURRENTLY AVAILABLE

This section presents a listing of the available extension bulletins, newsletters, and information pieces that have been developed over the years by different organizations in Jordan The listing contains pieces that are concerned mostly with irrigation, plant production and protection, and allied fields in agriculture The listing is not intended to be exhaustive but representative of the variety of available pieces Most of the pieces identified below are in Arabic and some are undated

Agricultural Extension Agent, A Monthly Professional Newsletter, published by Agricultural Extension & Information Department/MOA, pp 8, 1996

The Agricultural & Technology Transfer, by Deir Alla Regional Center, Volume 2, pp 4, 1997

Center News, A Monthly Newsletter from NCARTT, pp 16, 1997

Farmers Guide for the Purchase of Seeds, Majed F Al-Zubi, NCARTT/MOA

Insects and Pests of Fruit Trees, Abdel-Kader Qasem & Mary Bahadousha

Windbreakers for Agriculture in Jordan, NCARTT/MOA, Abdel-Mouty M AL-Tlawi

Agricultural Extension Agent Guide for the Most Important Insects and Pets of Olive Tress, Mary Dahadousha, AEID/MOA

The Role of Water Quality and its Impacts on Irrigation Systems Management, NCARTT/MOA, Iysmat Kharatsha, newsletter no 95

Water Standards for Irrigation, NCARTT/MOA, Monther Kharaz, newsletter no 56

Honey Farms in Jordan and How to Establish Your Own Honey Farm, NCARTT/MOA, by Saif Al-Deen Shihadeh, newsletter no 48

Biological Control of White Fly & Other Agricultural Pests in Jordan, NCARTT/MOA - Biological Control Section, by Jordanian - German Technical Cooperation

Protection Against Contagious Diseases in Cows and Sheep, NCARTT/MOA, by Mohammed F Kailany, newsletter no 47

Virus Induced Stunting and Yellowing of Eggplants, by Dr Abdalla Al-Musa & Dr Mani Skaria, MOA/Plant Pathology

Extension Exhibitions and Field Days, by David Youmans & Mazen Khassawneh,MOA/ Extension

Agricultural Extension in the Jordan Valley, by David Youmans & Mazen Khassawneh, MOA/ Extension

Blackleg and Bacterial Soft Rot Diseases of Potato, by Dr Jack Altman & Mohammed Jalboush, MOA/Plant Pathology

Barley Yellow Dwarf Virus, by Dr Mani Skaria & Dr Abdullah al-Musa & Mohammad Zoubi, MOA/Plant Pathology

Growing Asparagus in the Jordan Valley, Part I, by Dr Darrel R Bienz & William P Ford, MOA/Horticulture

Growing Asparagus in the Jordan Valley, Part II, by Dr Darrel R Bienz & William P Ford, MOA/Horticulture

Producing Tomato Seed in Jordan, by Dr Darrel R Bienz & William P Ford, MOA/Horticulture

Producing Fennel in the Jordan Valley, by Dr Darrel R Bienz & William P Ford & Samieh Abu-Baker, MOA/Horticulture

Grape Culture II Irrigation, Nutrition, Girdling, Thinning, by Dr Fenton E Larsen & Dr Ayed Al-Wir & Abdul Raheim Al-Sheikh, MOA/Horticulture

Citrus Phytophthora Root Rot, by Dr Jack Altman & Mohammed Jalboush, MOA/Plant Pathology

The Elisa Test for Plant Disease Detection, by Dr Mani Skaria & William P Ford, MOA/Plant Pathology

Lettuce Mosaic Virus, by Dr Abdalla Al-Musa & Dr Mani Skaria, MOA/Plant Pathology

Tomato Yellow Leaf Curl, by Dr Abdalla Al-Musa & Dr Mani Skaria, MOA/Plant Pathology

Vein Yellowing on Cantaloupe and Watermelon, by Dr Abdalla Al-Musa & Dr Mani Skaria, MOA/Plant Pathology

Physical Properties of Processing Tomatoes, by Samieh Abu-Baker & William P Ford, MOA/ Horticulture

Whitefly, by Dr Lynell K Tanigpshi & Mariam Bashir,MOA/Entomology

Mosaic Diseases of Squash, by Dr Abdalla Al-Musa & Dr Mani Skaria, MOA/Plant Pathology

Citrus Brown Mite, by Dr Lynell K Tanigoshi & Mary Dahdousheh & Rita Sawaqed, MOA/Entomology

Downy Mildew of Cucumber, byDr Jack Altman & Mohammed Jalboush, MOA/Plant Pathology

Citrus Virus and Virus - Like Disorders, by Dr Abdalla Al-Musa & Dr Mani Skaria, MOA/Plant Pathology

Citrus Dry Root Rot, by Dr Jack Altman & Mohammed Jalboush, MOA/Plant Pathology

Cucumber Powdery Mildew, by Dr Jack Altman & Mohammed Jalboush, MOA/Plant Pathology

Plant Protection Services Available at the Jordan Valley Agricultural Services Project, by William P Ford & Dr Mani Skaria & Dr Jack Altman, MOA/Plant Protection

Avocado Culture, by Dr Fenton E Larsen & Dr Ayed Al-Wir, MOA/Horticulture

Papaya Culture, by Dr Fenton E larsen & Dr Ayed Al-Wir & Fatima Balasmeh, MOA/Horticulture

Mango Culture, by Dr Fenton E larsen & Dr Ayed Al-Wir, MOA/Horticulture

Persimmon Culture, by Dr Fenton E larsen & Dr Ayed Al-Wir, MOA/Horticulture

Lowchill Deciduous Fruits, by Dr Fenton E larsen & Dr Ayed Al-Wir, MOA/Horticulture

Banana Culture, by Dr Fenton E larsen & Dr Ayed Al-Wir & Abdul Raheim Al-Sheikh, MOA/Horticulture

Mosaic Diseases of Cucumbers, by Dr Abdalla Al-Musa & Dr Mani Skaria, MOA/Plant Pathology

Olive Culture, by Dr Fenton E larsen & Dr Ayed Al-Wir, MOA/Horticulture

Guava Culture, by Dr Fenton E larsen & Dr Ayed Al-Wir, MOA/Horticulture

Training & Pruning Olives, by Dr Fenton E larsen & Dr Ayed Al-Wir, MOA/Horticulture

Growing Sweet Potatoes in the Jordan Valley, by Samieh Abu-Baker & William P Ford, MOA/Horticulture

Grape Culture I Sites, Varieties, Spacing, Supports, by Dr Fenton E larsen & Dr Ayed Al-Wir & Abdul Raheim Al-Sheikh, MOA/Horticulture

Strawberry Culture, by Dr Fenton E larsen & Dr Ayed Al-Wir & Fatima Balasmeh, MOA/Horticulture

Citrus Culture, by Dr Fenton E larsen & Dr Ayed Al-Wir, MOA/Horticulture

Biological Control of the Spherical Mealybug, by Syed Khasimuddin & Mariam Bashir & Mary Bahdousheh, MOA/Entomology

Growing Broccoli in the Jordan Valley, by Dr Darrel R Bienz & William P Ford & Samieh Abu-Baker, MOA/Horticulture

Vein Yellowing of Cucumber, by Dr Abdalla Al-Musa & Dr Mani Skaria, MOA/Plant Pathology

Soil Chemistry and Soil Analysis Services Available at Deir Alla in the Jordan Valley, by Dr Uusuf Nimr Tamimi & Dr Karim Farid Rabadi & William P Ford, MOA/Soil Science

Broad Mite, by Dr Lynell K Tanigoshi & Rita Sawaqed & Marry Bahdousheh, MOA/Entomology

Peach and Nectarine Culture, by Dr Fenton E larsen & Dr Ayed Al-Wir, MOA/Horticulture

Training & Pruning Grapes, by Dr Fenton E larsen & Dr Ayed Al-Wir, MOA/Horticulture

LITERATURE SEARCH METHODOLOGY

The mechanisms by which information and materials were obtained include the following

(i) Personal communication with many of the leading extension researchers in the field will lead to many important sources of information The contacts with individuals ranged from brief interviews to report collection

(ii) Access to electronic databases, e g , AGRIS (FAO), AGRICOLA (Agricultural On-Line Access of the National Agricultural Library of the U S), CABI (Commonwealth Agricultural Bureau International), and others, were accessed at NCARTT Other centers of information included the University of Jordan Deanship of Scientific Research, public access to bulletins containing professors' publications (books and articles), University project reports, Master's and doctoral dissertations Other sources included the libraries of Mu'ta University, Yarmouk, the University of Science and Technology, and Applied Science University

(iii) Regular Ministerial Channels - MOA and MOP libraries were accessed through formal letters issued by MWI/DAI requesting assistance for the ERMC team conducting the work

FURTHER WORK

Ranking of Extension Titles

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

- The initial results of the audit (subject completeness, gaps, etc)
- Perceived needs (through a focus group participatory approach with farmers and extension agents)

The list of titles will be presented to MWI for approval by the middle of August, 1997 This list forms the basis of the next task, the actual preparation of IPs

Design of Informational Pieces

According to the project scope of work, 25 information pieces will be prepared The format, content, graphics, and language structure will be arranged to produce valuable IPs that can be used for irrigation training The potential technical areas for the IPs include

- Crop water consumption, irrigation timing, ad duration of irrigation applications throughout the growing season
- Irrigation scheduling
- Low quality water management
- Leaching requirements
- Fertigation

The IPs will be delivered in both English and Arabic by the end of September 1997

ANNEXES

SCOPE OF WORK

Background

On-farm irrigation in the Jordan Valley is changing from surface methods, primarily furrow for vegetables and small basins for orchards, to trickle and micro-spray irrigation The more modern methods offer savings in labor costs, higher yield potentials (giving higher returns per cubic meter of water used), and less fertilizer and chemical usage Compared to surface irrigation methods, trickle and micro-spray irrigation also offers opportunities for reductions in the volume of water used for a crop because a smaller surface area and soil volume should be wetted at each irrigation

Trickle irrigation is equipment oriented and to gain the full benefits from the water requires sophisticated management Technical assistance and information, in a readily useable format, on trickle irrigation system operation and maintenance is not currently available to the farmer Weather information required for irrigation under mulch and plastic house conditions, and extension literature covering all aspects of on-farm irrigation water management, operation, and evaluation are unavailable

To enable farmers to reap the full benefits from micro irrigation systems water management extension literature is needed Packages of farmer appropriate irrigation management recommendations are needed for

* the major irrigated crops produced in the Jordan Valley,
* the methods of crop production used (open field micro, trickle in plastic houses and tunnels), and
* summer and winter growing seasons

Scope of Work

The Subcontractor shall conduct a thorough audit of applicable research completed in Jordan, all research institutions will be surveyed Research results referenced by the audit shall include the title of the research, researcher, researcher affiliation, location of research, and year(s) research was conducted A qualitative evaluation, a brief discussion, of the results from each research shall be made

The Subcontractor shall prepare a minimum of twenty-five extension informational pieces selected from the following technical areas

* Crop water consumption, irrigation timing, ad duration of irrigation applications throughout the growing season
* Irrigation scheduling
* Low quality water management
* Leaching requirements
* Fertigation

The title, content, and format of each piece shall be agreed upon in consultations between the Subcontractor and DAI before material preparation commences

Deliverables
The deliverables for this Subcontractor will consist of the following

Audit Report Audit of applicable research completed in Jordan - Research identified in the audit shall include the title of the research, researcher, researcher affiliation, location of research, and year(s) research was conducted A qualitative evaluation, a brief discussion, of the results from each research shall be made The report shall be in English

Selection of Extension Titles - Report listing the titles of Water Management Extension Materials proposed for preparation, for each piece there will be brief discussion of the content and a listing of Jordanian research results available for the preparation of the piece Titles shall be ranked according to perceived farmer need for the information and completeness of available research The report should list as many titles for extension materials as the information warrants The report shall include a proposed standard format for the Extension Informational Pieces

Extension Informational Pieces (minimum of 25 pieces) - Each piece shall be delivered in draft, in English to DAI The final English version of each piece shall incorporate all revisions mutually agreed upon between DAI and the Subcontractor after receipt of DAI's comments on the draft After approval of the final English version, a draft of the Arabic version will be prepared The final Arabic version of each piece shall incorporate all revisions mutually agreed upon between DAI and the Subcontractor after receipt of DAI's comments on the draft piece

The approved English Arabic final versions shall be delivered in an original format suitable for mass reproduction on a photocopy machine All figures and graphics shall be in high definition black and white, no other colours shall be used

The Subcontractor shall provide DAI with electronic copies of all deliverables specified in Section F

PERSONS CONTACTED

Abdul Hameed Shouman Library
Yusra Abu-Ajamiah, Library Director

Agricultural Credit Corporation
Dr Ibrahim Nsour, Deputy Director
Sameer Al-Omari, Assistant Director
Anwar Haddad, Director of Studies and Planning
Muna A Salem, Library Director

Agricultural Marketing Organization
Dr Salem Al-Lawzi, Director
Akef Zu'bi, Head of Studies Department
Mohammed Arabiyyat, Researcher
Abla Hiyari, Researcher
Mahmood Hiyari, Regional Marketing Project
Nahla Bashiti, Library Director

Amman Municipality Library
Mohammed Subaihi, Library Director

Jordan Valley Authority
Dr Bilal Basheer, Director, Soils and Environment
Avedis Serpekian, Director of Studies Department
Ilham Abu-Aisha

Jordan Valley Farmer's Association
Rakan Al-Faour, President
Mohammad Al-Amayra, Agricultural Engineer

Jordan University
Dr Elias Salameh, Professor of Hydrogeology
Dr Mohammad Shatanawi, Water and Environment Research & Study Center *
Dr Ibrahim Ghawi, Professor of Agriculture
Dr Ahmad Abu-Awwad, Associate Professor of Agriculture *

Jordan University of Science and Technology
Dr Rida Shibli, Director of Agriculture Center
Sultan Shuyyab, Director of Engineering Library
Dr Qais Fattah, Chairman, Department of Agricultural Engineering
Issa Lallo, Director General, University Libraries

Ministry of Agriculture
Khalil Al-Jarn, Director of Information, Extension Department, Baq'a
Rateb Abu-Zuneimah, Director, Central Jordan Valley Agricuture

Ministry of Planning

Mr Boulos Kefaya, Director, Infrastructure Department
Ms Nahla Natour, Director of MOP Library
Khamees Habayeb, Director of Computers and Documents
Omar Tantour, Database Search Assistant

Ministry of Water and Irrigation

Dr Ross Hagan, DAI Irrigation Management Specialist
Yasser Nazzal, Irrigation Engineer
Ms Hala Abu-Nuwwar, Agricultural Engineer
Dr Hani Rashid, Water Resources Engineer
Dr Peter Ohlmeyer, GTZ Advisor

Mutah University

Dr Khaled Tarawneh, Dean of Agriculture
Dr Ayed Omari, Assistant Dean, College of Agriculture
Dr Farah Rabadi, Professor of Agriculture
Ra'fat Tarawneh, Agricultural College Library
Mohammed Sarayreh, Computer Search Assistant

National Center for Agricultural Research and Technology Transfer

Dr Awni Taimeh, Director General
Jordana Baqa'in, Database Director
Dr Jamal Irsheidat, Director of Technology Transfer Department
Dr Raed Yacoub, Director of NCARTT Library
Radiyya Ali Huwarat, Library Director at Deir Alla

Private Farmers in the Jordan Valley

Khalil Abu-Ghannam
Yousef Baraket
Mazen Odeh
Nabil Al-Taji

Royal Scientific Society

Ayman Al-Hasan, Director of Environment Research Center

* These individuals were contacted for information and input, but they did not provide any assistance to the team in collecting data for