Irrigation Water and Agriculture in the Jordan Valley and Southern Ghore :

The possibility of Cultivating Substitute Crops

Ali Z. Ghezawi Mohammad M. Khasawneh

The Study is financed by

The Friedrich Ebert Stiftung of Germany

Centre for International Studies
Royal Scientific Society
Amman-Jordan

Published in 1993 by :

The Centre for International Studies

The Royal Scientific Society

P.O.Box : 925819

Amman - Jordan

Phone : (9626) 844701

Telex : 21276 RAMAH JO

Fax : (9626) 844806

Printed at the Royal Scientific Society Press

Jordan's National Library Code :167/3/1993

Centre's Code : 3 - 1993 (9)

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List of Abbreviations

ACC	Agricultural Credit Cooperation
JCO	Jordan Cooperative Organization
GNP	Gross National Products
FES	Friedrich-Ebert-Stiftung
JVA	Jordan Valley Authority
O&M	Operation and Maintenance
RSS	Royal Scientific Society
USAID	United States Agency for International Development
WAJ	Water Authority of Jordan
MCM	Million Cubic Meters
M^3	Cubic meter
Ha.	10 dunums
JD	Jordan Dinar
$	U.S. dollar
KTR	King Talal Reservoir
KAC	King Abdullah Canal
l/c/d	Litter per capita per day
mm	millimeter
JVFA	Jordan Valley Farmers Association
AMO	Agricultural Markting Organization

Preface

Amajor Objective of the centre for international studies , which was established in April 1992, is to undertake and publish political-economic, and historical studies on the republics of the former soviet union, especially those in central Asia and the caucasus, This is to provide citizens and policy-makers in Arab World with socio-economic and historical information on the Muslim nations in the former USSR as a first step on the path of reviving the previous historical relations between these nations and the Arab World . It should be noted that the cultural, economic, and political ties between Arab Countries and these nations have been disconnected for more than two centuries.

In addition, the centre conducts applied economic studies on various issues pertinent to the Jordanian economiy that provide the concerned parties with policy recommendations that would overcome the arising economic problems which obstruct the development process.

Accordingly, the centre conducted this applied economic study which was partially financed by FES, and aimed at discussing the Irrigation water and agriculture problem in the Jordan Valley and southern Ghore, especialy water shortages and to point out the main obstacles in Agricultural development in this region, and come up with some recommendations in order to alleviate this problem. It should be mentioned that this study is an edited and revised version of an Arabic one which was published in May 1993.

This study reflects the continuous fruitfull cooperation between R.S.S/centre for internation studies and FES, which we hope will

continue in the future to assist in facilitating the development process by tackling the stemning economic problems.

Moreover, we hope that this study will be of value to policy makers, researchers, and other concemed parties by providing them with the necessary information on a serious economic issue in Jordan.

The centre welcomes any constructive coumments on this study which will be taken into consideration in our future studies.

Dr. F. A. Daghestani

Director

Centre for international studies

Acknoweldgement

The Centre for international studies of the Royal Scientific Society extends its thanks and gratitude to Fredrich Ebert Stiftung (FES) of Germany for financing the preparation and publication of this study.

Thanks are also due to the various public and private institutions that provided the required information and facilities. The CIS acknowledges the contribution of the computer, Technology, Training and Industrial studies centre, namely Dr. M. Shahateet the head of Industrial studies devision for preparing the computer programmes and obtaining the necessary tables. Thanks are also due to Miss Karin Farah and Mrs. Amjad Butoush and Marwan Al-Lozi for field data collection through the questionnaire (Annex 1), and also thanks to the Director of the JVFA and his colleagues for their help provided to the field team.

Especial thanks to all whom are participated in discusing the first draft of this study (Annex 2) . Finaly, thanks are extended to Mr. Ahmad Obaid for typing the study.

Dr. F. A. Daghestani
Director
Centre for international studies

Methodology

The methodology used in the preparation of this study conducted through two approaches namely, field survey and literature reviews. A representative sample for about 500 farmers in the Jordan Valley and Southern Ghore was carried out. The sample accounted for about 7% of the Jordan Valley and Southern Ghore 7000 farmers.

A special questionnaire was designed for this survey. In addition, available information and data at the concerned departments was gathered, tabulated and analyzed in the study.

The Centre for International Studies hired agricultural engineers in the fields of irrigation, soil and gardening for one month each to tackle respective aspects of the study.

After the completion of the first draft of this study by the researchers a workshop was organized by the CIS to enhance the study. The workshop was attended by several knowledgeable persons within the public and private sectors, the academic community and farmers representatives.

Introduction

Water in Jordan is a determinant factor in Socio-economic development; Scarcity of water would certainly hamper the development process. Water scarcity in Jordan has been a result of its arid climate which is characterised by relatively limited and fluctuating quantities of a rainfall.

One of the most sectors affected by quantity and quality of water, is the agriculture sector which consumed about 73% of the total water used in Jordan in 1991, for it's important role in food security, contribution in GDP, and the geopolitical issue of the agriculture. Because the shortages of water and the importance of this problem, the centre for international studies conducted this field study to discuss this problem and to provide recommendations that would overcome this arising problem. The study had the following objectives:

1) To identify the water situation and water balance in Jordan.
2) To identify the agriculture situation and water irrigation in the Jordan Valley and Southern Ghore.
3) To identify the possibility of cultivating substitute crops in the Jordan Valley and Southern Ghore.
4) To identify the current marketing process and how it could be improved.
5) Suggesting certain policies and measures to alleviate this problem.

Chapter one
Jordan's Water Resources and Uses

Introduction

Water is likely to take even greater geopolitical importance in the coming decades. The critical water situation in the region is the result of an equal distribution of resources. A large portion 65% of the region's population depends upon water resources which originates in other countries, and the current supplies are being squeezed by the demands of burgeoning population.

Currently, water is one of the most scarce resources in Jordan which depends mainly on the fluctuated amounts of rainfall. However, the average rainfall in Jordan is about 8.5 billion M^3 annually, ranges from a minimum of 6 billion M3 in dry years to over 12 billion M3 in wet years. It is worth noting, that the rainfall in the 1991/1992 season was around 13.1 billion M3 which is about 54% above the average annual rainfall.

Limited natural resources, limited fresh water availability, arid climate, high evaporations and upnormal increase in population are the common characteristics of arid and semi-arid country like Jordan. Therefore, an increasingly water deficit is expected, unless available water resources have been effeciently used, and unconventional water resources is being utilized.

1.1. Water Resources

In addition to some ground basins in the south and southeast of Jordan, the main source of water is the rainfall, which geographically fluctuates as shown in table (1). Average annual rainfall ranges between 500 mm in semi-humid areas in the North West of the country to less than 100 mm in arid deseart areas. It shows also, that just about 2.9% of the Jordan total area 92.000 Km^2 receives more than 300 mm/yr. which means, only this small portion of the area is suitable for cultivation with the prevailing climatic conditions. It is worth mentioning that, more than 85% of the rainfall is lost due to evaporation and only 5% recharge underground aquifers.

Table (1)

Jordan's Land Area Classification by average Rainfall

Region	Average Rainfall (mm)	% of the Total Area
Arid Desert	100 and Less	81.0
Desert	100-200	10.4
Marginal	200-300	5.7
Semi-Arid	300-500	1.8
Semi-Humid	500 and More	1.1
Total	-----	100.0

Source : Zahlan, A.B., The Agriculture Sector of Jordan : policy and Systems Study, p. 126, Amman-Jordan.

As a result of the development and increase in demand for water, more than 833 MCM of water was utilized in 1991, and the main resources are:

1.1.1 Surface Water

Surface water resources capacities in Jordan were estimated at 692 MCM, of which only 321 MCM or 46% were utilized in 1991. The

main suppliers of surface water in Jordan are :

1. Flood water; which is estimated at an average of 334 MCM, however due to the limited capacity of the country's dams only 110 MCM was stored in 1991.

2. Rivers and springs water; estimated at 358 MCM and only 210 MCM was utilized. The Yarmouk River is the main source of supply for the surface water, in the Jordan Valley.

As shown in Table (2), the Yarmouk River Basin considered the largest supplier of surface water in Jordan with an average discharge of 357MCM annually. However, due to the Israeli and Syrian development upstream, and the diversion of the Jordan River, only 90 MCM of the Yarmouk River water is utilized by Jordan.

Table (2)

Jordan's Average Annual Surface Water Discharge

Basin Name	Average Discharge MCM/yr
Side Wadis (Jordan River)	54
Yarmouk River	357
Zarka River	92
Dead Sea	47
Mujib	59
Hasa	36
Yutum	1
Fifa,Khunezira & Araba	11
Jafar	14
Sirhan	10
Azeraq	27
Hamad	13

Source : Elias Salameh and Ali Z. Ghezawi, Jordan Water Resources, uses and their future demands. J.F.K School of Government, Harvard University.

1.1.2 Ground Water

Ground water is the major source of water in Jordan, and consumed by all sectors. In 1991, Jordan extracted 512 MCM from it's groundwater resources. The groundwater is generated from the following two main sources :

1. Renewable groundwater : (Rainfall Recharge) The safe yield of this source estimated at 275 MCM/yr, however in 1991, to meet the water shortages in Jordan, more than 447 MCM, were pumped, which means, there was overextration of 172 MCM.

2. Non Renewable groundwater : This source is considered to be fossil water, accumulated over thousands of years, and the depletion of these sources depends on quantity of water stored and the quantity used, and the safe yield of this source about 143 MCM/yr.The Disi aquifer believed to be Jordan last under developed source of water, and contributed about 65 MCM of water in 1991[1], some studies indicated that the safe yield for Disi aquifer varies between 100-125 MCM annually. However, to determine the exact capacity and potential of this aquifer the Ministry of water and Irrigation is conducting acomplete field study.

Furthermore, in Jordan twelve ground water basins have been explored (Table 3). In most of these basins, the use has exceeded the sustainable yield, and their static water level is declining.

(1) Ministry of Water and Irrigation, WAJ open Files, Amman-Jordan.

Table (3)

Jordan's Groundwater Basins

Basin Name	Safe Yield (MCM/yr)	Notes
Amman-Zerka	94	Renewable
Side Wadis (Jordan River)	14	Renewable
Ghor (Jordan valley)	12	Renewable
Yarmouk River	53	Partly Renewable
Dead Sea	60	Partly Renewable
Wadi Araba North	8	Renewable
Wadi Araba South	8	Renewable
Jafar	27	Partly Renewable
Azraq	20	Mostly Fossil
Sirhan	5	Renewable
Hamad	5	Renewable
Disi	30	Partly Renewable

Source : Elias Salameh and Ali Z. Ghezawi, Jordan's Water Resources, uses and their future demand. J.F.K. School of Government, Harvard University.

1.1.3 Treated Waste Water

The major discharges of wastewater in the country comes from municipal treatment plants and industrial and commercial operations. Although many industries have on-site treatment facilities, they apear to be insufficient, which forced the Government to issue closure orders for more than 40 industrial firms accused of polluting the water supplies in 1990 [1]. The Government ordered these firms to install and utilize water treatment facilities as a precondition of reopening their closed industries.

In 1991, as a result of Jordan ambitious campaign during the last decade, more than 55% of the total population and 75% of the urban population has access to wastewater collection networks connected to 14 treatment plants [2], of these 6 are using waste stabilization ponds.

(1) R.S.S, Jordan's Water Resource and uses, Amman-Jordan, July 1991.
(2) Ministry of water and Irrigation, WAJ open Files, Amman-Jordan.

K.AS-Samra treatment plant considered to be the largest in the Country with a design capacity of 68.000 M3/day, but presently it is overloaded and receives about 100.000 M3/day. Table (4) shows Jordan's wastewater treatment plants capcity and type of treatment used.

Table (4)

Jordan's Wastewater Treatment Plants

Plant Name	Capacity M3/day	Type of Treatment
1- K.AS-Samra	68,000	Waste stabilization ponds
2- Mafraq	1,800	Waste stabilization ponds
3- Aqapa	9,000	Waste stabilization ponds
4- Ramtha	2,335	Waste stabilization ponds
5- Abu Nuseir	4,000	Activated sludge
6- Baq'a	6,000	Trickling Filters
7- Salt	2,442	Extended Aeration
8- Irbid	11,023	Trickling Filters
9- Jarash	1,155	Oxidation Ditch
10- Karak	,786	Trickling Filters
11- Tafila	,800	Trickling Filters
12- Madaba	2,000	Waste stabilization ponds
13- Ma'an	1,335	Waste stabilization ponds
14- Koufranja	1,800	Trickling Filters

Source : WAJ, Central operation Dept, Amman-Jordan.

Also, more than 37 MCM of treated water conformed to the WHO guidelines for public health protection were used for controlled irrigated agriculture. In addition to the public and evironmental benefits, treated wastewater is considered as an essential element in Jordan water's strategy and compensated for 6% of the fresh water used in agriculture.

1.2 Water Uses

There are several factors exert pressure on the consumption of water resources in Jordan. These are :

1. Population growth : Water shortages in Jordan resulted mainly of the imbalance between population growth and limited water resources. Two types of population growth are common in Jordan as follows:

   a. Natural growth-Jordan's population average rate of growth is 3.6% annually, and it is considered to be relatively high, in comparison to other countries, (2.8%) annual growth rate of the Arab world.

   b. Forced immigration-Jordan received three waves of refugees since 1948, and the latest one as a result of the Gulf War increased the country total population by 12% in 1991 (1).

2. Economic development : Water resources are a chief support of Jordan's national economy, and any shortages will in turns influence the economic progress . So, development of new water resources and economic development go hand in hand in arid and semi-arid countries.

3. Urbanization : Improving of life standard and internal migration increased the demand for domestic water consumption, drasticly. It's worth mentioning, that many households in the rural area used to

(1) Shakhatreh, Hussain and Belah, victor: A study of the socio-Economic characteristics of the Jordanian Returnees from the Gulf, part 1,2,and 3 (National Center for Educational Research and Development, Amman-Jordan,1991).

depend on rainharvesting wells for their daily use of water, instead of the municipal networks.

Table (5)
Jordan's Water Supply and Uses, 1991

(MCM)

Sector	Source		Total	%
	Surface	Ground		
Agricultural Sector	287	326	613	73.6
Industrial	11	31	42	5.0
Municipal	23	155	178	21.4
Total	321	512	833	
%	38.5	61.5		100.0

Source : Ministry of Water and Irrigation, Files.

According to these factors, Jordan's total water consumption amounted to 833 MCM in 1991, of which about 61.5% are ground water. As shown in Table (5) .

1.2.1 Agricultural Sector

Irrigated agriculture is an important factor in the economy of Jordan. In 1991, this sector consumed 613 MCM or 73.6% of the total water used for all sectors. This amount of water used to irrigate 609,000 dunums (60,900 ha.), of which (32.800 ha.) in the Jordan valley and Southern Ghore [1]. Furthermore, the average irrigation water consumption in the Jordan Valley and Southern Ghore is about 667.7M3 per dunum annually, which is lower than the Highland average

(1) H.K.J, Department of statistics, Annual Statistical yearbook, 1991, Amman-Jordan.

consumption of 1402 M3/dunum annually. This may due to the fact that farmers in the Jordan Valley and Southern Ghore are professional who appreciate the water shortages and climatic influence, Table (6). It's worth mentioning that about 53.2% of the water used for irrigation in Jordan comes from the ground water, basins in the Highland.

Table (6)

Average Irrigation Water Consumption by Region

	Water Consumption (MCM)	Area (Dunum)	Average Consumption (M3/dunum)
Jordan Valley & Southern Ghore	219	328,000	0667.7
Highland	394	281,000	1402.0
Total	613	609,000	1006.7

Source : 1) Table (4) and (17).
2) Department of statisics, Annual statistical yearbook 1991, Amman-Jordan.

As a result of acute water shortage in the dry season, the response to this shortage especially in the Jordan Valley and Southern Ghore has been a reduction in cropping intensity, and rigid cropping pattern aims to sustain the perennial crops.

1.2.2 Industrial Sector

About 5% or 42 MCM of the total water consumed in Jordan was utilized by the industrial sector in 1991. The bulk of this quantity consumed by the large scale industry such as Jordan Petroleum Refinery, King Hussein Thermal Power Station, Phosphate and Potash mines. By the year 2005 as a result of the expansion in this sector, the share of industrial activities consumption of water will increase to reach 125 MCM.

1.2.3 Municipal Sector

More than 97% of the Kingdom's 3.888 million people were served by municipal water networks, and consumed 178 MCM in 1991(1). This means that the average consumption per capita amounted to 46 m3 or 125 l/d compared to the use in Europe of 250-350 l/c/d, to those of Israel of 280-300 l/c/d. It can be said that Jordanians are modest water consumers due to the insufficient supply of water resources, and the acute water shortages lead the population to live at the hygienic brink.

Table (7)

Municipal Water Consumption by Governorate, 1991

Governorate	Consumption		Population	Consumption percapita
	(MCM)	(%)	(Million)	(L/c/d)
Amman	75.0	42.1	1.607645	127.8
Zarka	21.7	12.2	0.607822	97.8
Irbid	30.0	16.8	0.926103	88.7
Mafraq	15.1	8.5	0.143800	287.7
Balqa	12.5	7.0	0.264380	129.5
Karak	5.9	3.3	0.155520	103.9
Tafileh	2.1	1.2	0.054430	105.7
Ma'an	15.7	8.9	0.128300	335.2
Total	178	100.0	3.888	125.4

Source :1) Department of statistics, Annual statistical yearbook, 1991, Amman-Jordan.
2) Ministry of Water and Irrigation, WAJ, Amman-Jordan.

In 1991, Amman Governorate 1.6 million residents used 75 MCM or 42.1% of the Kingdom total municipal water consumption. As for

(1) Ministry of Water and Irrigation, WAJ Files, Amman-Jordan.

municipal water consumption per capita Ma'an Governorate ranked the highest with 335.2 litter/day and the lowest average in Irbid with only 88.7 litter/day . The high average consumption per capita in Ma'an and Mafraq Governorates, may due to the fact that people in these two Governorates use municipal water to irrigate their farm. Table (7), highlights the average consumption per capita according to Governorate.

Moreover, as a result of 30% average leakage in the national water networks the actual consumption of domestic water per capita is about $33M^3$(90 l/c/d), which is far below the world recommend consumption of 100 m3 annually(1). In addition, this leakage as a result of the aging water networks cost the country about JD 13.5 million annually, assuming the optimum level of water networks efficiency of 85% after rehabilitation, and the cost of producing one cubic meter of domestic water is JD 0.5.

Furthermore, this sector water future demand as a result of 3.6% annual natural population growth forecasted to consume 426 MCM by the year 2005, which means the necessity of utilizing all the water resource efficiently and doubling the country water resource to meet the demand for water.

1.3 Water Balance

Jordan's water balance suffer from chronic deficit as a result of the demand greater than the available resources, and in the coming decade the gab between demand and supply well widening. Table (8) shows that the deficit is increasing to reach 664.5 MCM in 2005 which is twice of

(1) Ministry of Water and Irrigation, WAF Files, Amman-Jordan.

1991 deficit. The current water deficit is being met by overpumping from the ground water aquifers, which resulted in the increase in pumping depth and cost in addition to declining water quality. Also, the table indicates that the safe yield of ground water is fixed over the mentioned period, and the potential development for new water resource will be mainly in the surface resources.

Table (8)

Jordan Water Balance

(MCM)

Sector	1991	1995	2000	2005
Available Resources	**776.5**	**870.5**	**1039.5**	**1036.5**
Surface water	321	400	555	555
Renewable G.water	275.5	275.5	275.5	275.5
Non Renewable G.water	143	143	143	143
Treated waste water	37	52	66	90
Demands	**1098**	**1449.5**	**1548**	**1638**
Agricultural *	800	1088	1088	1088
Industrial	43	61.5	101	124
Municipal **	255	300	359	426
Balance (Deficit)	**(321.5)**	**(579)**	**(508.5)**	**(574.5)**

* Assuming the utilization of all the developed irrigated area in the Jordan Valley, and Keeping the level of irrigated land in the highland as of today.

** Assuming in 1991 180 l/c/d, 1995 188 l/c/d, 2000 188 l/c/d, 2005 188 l/c/d.

Source: Ministry of Water and Irrigation, Ammau-Jordan.

Chapter Two

Agriculture Situation In The Jordan Valley And Southern Ghore

Introduction

Agricultural activites is the main source of income and employment for the Jordan Valley and Southern Ghore inhabitants. The government in the early 1970's started to implement a comprehensive integrated socio-economic development plan for the Jordan Valley aiming to achieve two main objectives (1):

- Construction of irrigation infrastructure such as Dams, Canals, and Farm roads, in order to expand the irrigated area and cropping intensity and efficiency.

- Establishing Social Services infrastructure such as Health Clinics, Telecommunication, Schools, electricity, potable water, roods, ...etc.

To achieve the above objectives the government created the Jordan Valley commission (JVC) which became to be known in 1977 as the Jordan Valley Authority (JVA) with increased personnel and responsbilities. Also, in order to fulfil the objectives the JVA invested in the development of land and irrigation facilities of the Jordan Valley.

As a result, the total area have been developed estimated to be about 334,000 dunum and cost JD 55.3 million, as shown in Table (9) .

(1) Ministry of Water and Irrigation, JVA, The Jordan Valley Development, 1987, Amman-Jordan.

The average cost of development varied from JD 57 per dunum in the first stage of the construction of King Abdullah Canal (KAC) to JD 479 per dunum in Southern Ghore, as a result of the increase of input cost, such as Labour and Raw materials.

Table (9)

Development Cost of Irrigated Land

Stage	Irrigated area (dunum)	Cost (MJD)	Average cost (JD/dunum)
1- KAC			
70.0 Km	119270 utilized	6.8	57.0
8.0 Km	14000 utilized	0.9	64.3
18.0 Km	35500 utilized	5.6	157.7
14.5 Km *	60000 not utilized	11.0	183.0
2- Side wadis	5750 utilized	8.0	139.0
3- Side Ghore	4800 utilized	23.0	479.0
Total	33400	55.3	165.4

* Because of the shortage in irrigation water.

Source : A. Qassem, Ali Ghezawi, Assessing the Sustainability of the Jordan Valley integrated project (case study), R.S.S, Amman-Jordan.

This chapter will discuss the Jordan Valley and Southern Ghore's population, climate, land classification, type of crops, labour force, productivity, and the marketing.

2.1 General Background

Three major items should be dealt with prior to any detail analysis of the agriculture situation in the Jordan Valley and southern Ghore, these items are: people, land, and the prevailing climate, in addition to water resources.

2.1.1 Population

During the last three decades, Jordan Valley and southern Ghore population fluctuated as a result of political, military activities, and poor health conditions. However, the construction of the irrigated agriculture infrastructure facilities in the Jordan Valley assisted in the settlement of the people there.

In 1973, the total population of the Jordan Valley was 64,000 and reached 250,000 in 1991 (1). The population growth rate for the period 1973-1991 has exceeded the annual national growth rate of 3.6% as a result of increased net inmigration to the Jordan valley by 2%. This increase in population due to the expansion of the irrigable land areas and the completion of development, and in turn the growth of economic opportunities in the Jordan valley and Southern Ghore agricultural activities.

2.1.2 Location and climate

Jordan Valley lies between 200-400 meters below the sea level and stretches 104 km from Lake Tiberas North to the Dead Sea South, acting like a green house to enable agriculture production allmost all year round. The Valley width Varies from, 4-16 km and surrounded by both sides with chain of mountains the highest about 900 meters above sea level.(2)

The prevailing climate in the Jordan Valley is the mediterranean one; which is hot and dry in the summer and modestly cold and wet in the

(1) Jordan Valley Authority, The Jordan Valley Development, 1987, Amman-Jordan.
(2) Ibid.

winter. The rainy season in the Valley begin in November and ends in April, the rainfall varies from the North to the South with an average of 500 mm in the North of the Valley, 280mm in the Middle and only 102 mm in the South.

2.1.3 Land Classification

In mid-1950's the Baker-Harza land survey divided the Jordan Valley land area into six grades in order to define their suitablility for irrigation purposes [1].

1- Grade 1&2 are characterized with high yield, and a minimum production cost. These Grades area estimated at 230,975 dunums.

2- Grade 3. About 48,635 dunums, this land suitable for irrigated agriculture with some utilization limitations.

3- Grade 4&5. These grades are relatively saline and require soil leaching, and amounted to 84,474 dunums.

4- Grade 6. Not suitable for Cultivation and can't be developed and estimated to be 241,756 dunums.

Accordingly, the land which can be cultivated in the Jordan valley is 279,610 dunums, and another 84,474 dunums can be potentially developed for irrigated agriculture. This means, that the total irrigated land in the Jordan Valley can reach 364,084 dunums after development.

(1) JVA, Files.
(2) Ibid.

2.2 The Cultivated Land

In 1991, 328,640 dunums were utilized and cultivated in the Jordan Valley and Southern Ghore, of which 62.4% were planted with vegetables, 23% with perennial trees (fruits), and the remaining 14% with field crops [1].

Table (10) identifies the relative contribution of vegetables, fruits, and field crops with respect to total area cultivated, productivity, and their value. Overall agricultural production amounted to JD 124.9 million, of which Citrus and Banana JD 41 million and field crops only JD 0.8 million. According to the type of crops the Tomato, Citrus and Banana pre dominated in terms of value.

Table (10)
Jordan Valley and Southern Ghore Agricultural Crops
Total area, Tonnage and Value, 1991

Crop	Area (000) du.	Area % *	Total production (000 ton)	Produc-tivity (ton/dun.)	Export (000 ton)	Yield (MJD)
Citrus	55.32	16.83	149.7	2.71	37.37	29.2
Banana	12.96	3.94	26.3	2.03	1.57	11.8
Grapes	2.59	0.79	7.2	2.80	0.42	2.2
Olives	1.94	0.59	0.4	0.19	0.21	0.2
Wheat **	24.08	7.33	3.9	0.16	--	0.6
Barely **	18.46	5.62	2.4	0.13	--	0.2
Tomato	72.10	21.94	215.3	2.99	133.49	42.2
Squash	10.98	3.34	22.4	2.04	9.60	4.9
Eggplant	16.74	5.09	59.4	3.55	24.47	0.9
Cucumbers	6.15	1.87	35.4	5.83	22.00	8.5
Potato	24.59	7.48	41.4	1.68	3.89	9.7
Cabbage	3.40	1.03	11.7	3.43	2.33	0.9
Cauliflowers	3.39	1.03	7.5	2.21	4.27	1.1
Peppers	7.90	2.41	14.6	1.86	8.80	3.4
String Beans	6.65	2.02	5.2	0.79	3.21	1.9
Jew's Melow	7.70	2.34	14.4	1.86	--	1.5
Sweet Melons	18.82	5.73	14.4	0.76	2.65	2.9
Water Melons	5.71	1.74	18.7	3.27	20.72	1.8
Onion(Dry)	5.99	1.82	6.9	1.14	3.37	1.0

* The percentages have been calculated to the total area cultivated (328.65) thousand dunum.
** It is irrigated by complementary irrigation.
Source : Department of statistics, Annual Agricultural statistics 1991, Amman-Jordan.
Exports: Enternal trade statistics, 1991, Amman-Jordan.

The overall value of the Jordan Valley and Southern Ghore agricultural production is equivalents to about 4.86% of the Jordan's GDP at the current prices.

As indicated also in Table (10), and in term of area the top three vegetables are Tomato 22%, Potato 7.5% and Eggplants 5.1% of the total cultivated area in 1991. As for crops value, Tomato ranked first among all cultivated crops with JD 42.2 million or 34% of the total Jordan Valley and Southern Ghore agricultural production value.

Overall, Citrus trees which is dominated in the Northern part of the Jordan Valley and Southern Ghore producing 67.5% of the total fruit value and banana accounting for 26% . On a regional basis, North of the Jordan Valley was dominant counting for 85% of the total Citrus area, tonnage and value. On the other hand due to the prevailing climatic condition Banana production is predominating in the Middle and South of the Valley.

2.2.1 Development of perennial treesn Cultivated area

Fruit trees are considered the highest water demanding crops in the Jordan Valley and Southern Ghore. Which required the supplying of irrigation water all year round. As a result of the shortages in irrigation water the JVA imposed control and restricted the cultivation of perennials trees such as Banana and Citrus in the Jordan Valley and Southern Ghore. Despite the imposition of Licencesing procedures for cultivating fruit trees farmers in the Jordan Valley ignored the control and expanded in cultivating these trees. This is due to the stability of production and high selling prices.

And as shown in Table (11), the area cultivated with fruit trees in the Jordan Valley and Southern Ghore, increased from about 22,000 dunum in 1973 to about 76,386 dunums in 1991, and about 72.4% of the cultivated area in 1991 was citrus trees.

Table (11)
Development of Area Cultivated with Perennial trees
(1973-1991)

(Dunum)

Crop	1973	1980	1986	1988	1989	1990	1991
Citrus	15669	35098	49328	54560.3	55134.9	52316.8	55316.8
Banana	4382	1709	8952	9842.2	11095.0	11886.2	12963.7
Other	1949	2522	4931	7439.6	7764.3	8031.8	8105.1
Total	22000	39329	63211	71842.1	73994.2	75234.8	76385.6

Source :1973-1986, Ministry of Water and Irrigation, JVA files, Amman-Jordan.
1988-1991, Department of statistics, Annual Agricultural statistics, Amman-Jordan.

Furthermore, 83.1% of the total citrus trees are planted in the North of the Jordan Valley, and only 15.8% are planted in the Middle and South of the Valley. This due to the fact that climate , quality of water, and quality of soil in the North are more suitable for citrus trees. As for the distribution of Banana trees, the Middle and South share was 77.7% of the total (Table 12).

Table (12)
Regional Distribution of Fruit trees (%)

Crop	North	M & S	Southern Ghore	Total
Citrus	83.1	15.8	1.1	100
Banana	21.4	77.7	0.9	100
Grapes	11.5	80.8	7.7	100
Guava	33.3	60.0	6.7	100
Other Fruits	45.9	48.6	5.5	100

Source :Ministry of Water and Irrigation, Amman-Jordan.

2.2.2 Development of Field Crops Cultivated area

The total area of field crops in the Jordan Valley and Southern Ghore decreased from 95,588 dunums in 1973, to 50,657 dunums in 1988, and 47,244 dunums in 1991, (Table 13). Field crops in the Jordan valley depends to alarge extent on rainfall, this explain the fluctuations in the area cultivated from one year to another. Also, Table (13) shows that wheat dominated the area cultivated with field crops during the previous period. However, the areas cultivated with wheat decreased from about 86% in 1973 to about 51% in 1991 of the total field crops cultivated area.

Table (13)
Development of Area Cultivated with Field Crops is the Jordan Valley and Southern Ghore (1973-1992)

(Dunum)

Crop	1973	1980	1986	1988	1989	1990	1991	1992 *
Wheat	82169	30284	12838	29421	20831	26535	24078	5401
Barely	9897	10476	13465	12545	4382	11734	18457	133
Other	3522	851	949	8691	3243	7149	4709	1100
Total	95588	41611	27252	50657	28456	45418	47244	6634

* R.S.S. Field Survey .
Source :1973-1986, Ministry of Water and Irrigation, JVA files, Amman-Jordan.
1988-1991, Department of statistics, Annual Agricultural statistics, Amman-Jordan.

2.2.3 Development of vegetable Cultivated Area

In 1973, the total land area cultivated with vegetables in the Jordan Valley and Southern Ghore was 153,470 dunums, and increased to about 205,010 dunums in 1991 (Table 14). Furthermore, during 1973-1991 the land area cultivated with vegetables fluctuated according to the rainfall which affected the quantity and quality of the water in Dams, especially king Talal Dam, which is considered one of the main sources of the irrigation water in the Jordan Valley, adding also, most of the vegetable crops could be cultivated in two seasons (Autumn and spring). It's worth mentioning, that plasticulture and using drip irrigation techniques in the Jordan Valley and Southern Ghore attributed to the total increase in the land area of vegetables and productivity.

Table (14)
Development of Vegetable Crops Cultivated Area In the Jordan Valley & S.G (1973-1992)

(Dunum)

Crop	1973	1980	1986	1988	1989	1990	1991	1992 *
Tomato	60511	54621	46598	45889	43973	70960	72101	38308
Squash	13321	24743	24470	17002	13604	15376	10978	15703
Eggplants	18326	22563	23584	19983	13146	15218	16740	17320
Cucumbers	11602	16649	13555	6942	6650	6301	6149	11769
Potato	--	6024	12475	20189	9685	21270	24589	14670
Cabbage	--	--	4209	1732	2958	3861	3398	7251
Cauliflowers	2503	--	--	1361	2345	4191	3387	8018
Peppers	3312	7170	13909	10331	7831	8576	7901	10285
String Beans	4583	16231	10877	10677	6915	7347	6647	3684
Jew's Melow	4754	4576	--	4068	6437	5007	7704	834
Onion (Dry)	2953	2601	5242	7568	5332	3868	5995	647
Others	31605	12196	23992	46280	37368	41411	39421	16137
Total	153470	167374	178911	192022	156244	203386	205010	144446

* R.S.S. Field Survey.
Source :1973-1986, Ministry of Water and Irrigation, JVA files, Amman-Jordan.
1988-1991, Department of statistics, Annual Agricultural statistics, Amman-Jordan.

2.3 Comparing Jordan Valley and Southern Ghore agricultural production with the kingdom total production

For the comparison purposes the cultivated area according to crops should be examined thoroughly. In 1988, Jordan Valley and southern Ghore cultivated land amounted to 14.1% of the Jordan total cultivated area and increased to reach 15.3% in 1991. As for vegetables the Jordan Valley and Southern Ghore contribution increased from about 68.6% in 1988 to about 71% in 1991 of the total area cultivated with vegetables, as shown in table (15).

Table (15)

Jordan's Cultivated Land Area (1988-1991)

Year / Region	Type			Total	
	Fruit Trees	Field Crops	Vegetables	Dunums	%
1988					
Kingdom	540909.2	1406472.3	280004.8	2227386.3	14.1
J.V & S.G*	71842.1	50657.4	192022.5	314522.0	
1989					
Kingdom	543580.1	1033560.5	223586.1	1800726.7	14.4
J.V & S.G	73994.2	28456.0	156242.3	258692.5	
1990					
Kingdom	545469.2	1289012.6	288406.9	2122888.7	15.3
J.V & S.G	75234.8	45417.6	203385.9	324038.3	
1991					
Kingdom	549136.1	1314045.0	289691.7	2152872.8	15.3
J.V & S.G	76385.6	47244.5	205010.0	328640.1	

* Jordan Valley and Southern Ghore.

Source : Department of statistics, Annual Agricultural statistics 1988-1991, Amman-Jordan.

Furthermore, 96% and 100% of the Country's Citrus and Bannana production are generated from the Jordan Valley and Southern Ghore. Also, in 1991, the Jordan Valley and Southern Ghore, contributed 65.7% of the country's Fruit production, 10.8% of the field crops and 69.9% of the vegetables (Table 16).

Table (16)

Agricultural Production In Jordan, 1991

(Ton)

Crop	Kingdom	J.V & S.G	J.V & S.G (%)
Fruit Trees	284484.1	186999.9	65.7
Field Crops	119616.7	12870.8	10.8
Vegetables	695168.0	486046.7	69.9

Source:Department of statistics,Annual Agricultural statistics,1991, Amman-Jordan

As for productivity, Table (17) below shows that the whole year productivity is almost equal in the highlands and Jordan Valley. But seasonally it varies from about 1.8 tons/dunum in the highland to about 2.4 tons/dunum in the Jordan Valley in winter season. On the contrary, highland's summer vegetables productivity is higher than the Jordan Valley. This means irrigation water could be saved by rationalizing the cultivation of some of the vegetables in Jordan Valley in summer season to be cultivated in highlands. In other words, using the saved irrigation for the benefit of other crops, especially those giving an advantage to the agricultural prodution in the Jordan Valley comparing with neighboring countries .

Table (17)

Jordan's Vegetables Productivity, 1991

(Ton/dunum)

Region	Winter	Summer	Total
Jordan Valley and Southern Ghore	2.4	2.3	2.4
High Land	1.8	2.7	2.5
Kingdom	2.3	2.5	2.4

Source : Department of statistics, statistical yearbook, 1991, Ammanu-Jordan.

2.4 Agricultural Labour Force

The majorty of the Jordan valley and southern Ghore residents depends on the agricultural as source of income and employments. In 1991, more than 18,800 workers engaged in the Jordan Valley and Southern Ghores agricultural sector, this figure is equivalent to 46% of the country total agricultural labour force (1). Furthermore, About 56% of the total Jordan Valley and Southern Ghore agricultural labour force were Jordanian, of whom only 11.2% on full time basis and the majority were seasonal workers, (Table 18). In addition to that agricultural employment in the Jordan Valley and Southern Ghore is a family affair which means at least 2-3 members of the family are unpaid farm labourer.

Table (18)
Paid Agricultural Labour Force in the Jordan Valley (1990-1992)

Type	1990		1991		1992 *	
	Jordanian	non-Jord.	Jordanian	non-Jord.	Jordanian	non-Jord.
Full time	13	2626	1179	1854	7018	8902
Seasonal	8168	9608	9383	6412	7752	37274
Total	9081	12234	10562	8266	14770	46176
%	42.6	57.4	56.1	43.9	24.2	75.8

* R.S.S. Field survey.

Source : Department of statistics, Annual Agricultural statistics 1990 and 1991, Amman-Jordan.

And as shown in table (18), the total Jordan Valley agricultural labour force was 21315 in 1990, and decreased to 18828 workers in 1991, as a result of the Gulf war, which reduced the number of non-Jordanian workers (Egyptian and Pakistanian).

(1) Ministry of labour, Annual report 1991, Amman-Jordan.

Also, the prevailing unemployment derived more than 1500 Jordanian to work in the agricultural sector which increase the Jordanian workers participation in the agricultural activities from 9081 workers in 1990 to 10562 workers in 1991.

2.5 Agricultural Marketing

Marketing their agricultural products is the major constraint facing Jordanian farmers. In 1991, as a result of the Gulf war the agricultural sector in Jordan confronted a major crises due to the fact that the GCC as the traditional market for the agricultural products was shut down. This reduced the quantity of the kingdom agricultural product exported in 1991, by 43.7% for vegetables and 29% for fruits, as shown in table (19), and in value terms it decreased by 31% .

Table (19)
Quantities of Vegetables and Fruits Exported
(000 ton)

Type	1990	1991	Decreased (%)
Vegetables	463.4	261.1	43.7
Fruits	103.7	73.6	29.0
Total	567.1	234.7	41.0

Source : Agricultural Marketing Organization, Annual report 1991, Amman-Jordan.

Table (20) summarizes Jordanian agricultural exports performance in the major markets. The GCC states are the main importer of Jordan's vegetables and fruits products. In 1991, the Kingdom agricultural exports value amounted to JD 67 Million of which 45% to Saudi Arabia and Iraq.

Table (20)

Jordan Major Agricultural Exports Markets, 1991

(Tons)

Crop	Saudi Arabia	Kuwait	Iraq	UAE	Qater	Bahrain	Lebanon	Foreign Countr.	Total	%
Vegetables	**15504**	**461**	**105690**	**58108**	**16009**	**25362**	**35761**	**4208**	**261103.0**	**78.0**
Tomatoes	7520	277	67489	41448	8626	14144	19390	119	159013.0	60.9
Eggplants	726	29	17334	693	725	1508	6289	414	27718.0	10.6
Cucumbers	450	70	8187	5472	1610	3444	4853	641	24727.0	9.5
Pepper	3157	27	1343	1586	968	1575	1824	2068	12548.0	4.8
Squash	264	17	5350	2470	1170	1071	655	77	11074.0	4.2
Others	3387	41	5987	6439	2910	3620	2750	889	26023.0	10.0
Fruits	**15407**	**61**	**1978**	**21389**	**5487**	**7859**	**20665**	**683**	**73529.0**	**22.0**
Water mealo	21	2	355	354	645	369	20361	124	22231.0	30.2
Orange	840	--	60	15567	2491	3177	1	9	22145.0	30.1
Clementines	10541	4	--	1043	592	847	--	--	13027.0	17.7
Lemons	2582	33	3	2133	876	1725	0.3	143	7495.3	10.2
S. mealon	0.1	11	14	1315	347	1062	285	3	3037.1	4.1
Banana	0.2	--	1487	--	--	--	--	--	1487.2	2.0
Others	1422.7	11	59	977	536	679	17.7	404	4106.4	5.6
Total	30911	522	107668	79497	21496	33221	56426	4891	334632.0	
%	9.2	0.2	32.2	23.8	6.4	9.9	16.9	1.5		100

Source :Agricultural Marketing Organization, Annual report 1991, Amman-Jordan.

Chapter Three

Irrigation Water In The Jordan Valley and Southern Ghore

Introduction

This chapter highlights the sources and quantity of irrigation water, irrigation methods used and their efficiency in Jordan Valley and Southern Ghore. Also, it deals with irrigation water tariff, subsidies, water productivity, Crops net irrigation water requirements and cost of agricultural production.

In 1953-1955 the Baker-Harza studies was completed and contained a very comprehensive land classification survey of the Jordan Valley, and complete schemes for irrigation by exploiting the Yarmouk River water, and several side wadis. As a result of the availability of water resources, fertile land, and favorable climatic (the crucial factors for ideal agricultural production), the government initiated an ambitious comprehensive development plan for the Jordan Valley, (see chapter 2).

Irrigation practice in the Jordan Valley dates back to the earliest days of civilization. The agriculture sector is the main source of income and employment to the Valley 250,000 residents. "Foodstuffs from the Valley were exported to nearby states at least 5,000 years ago, while irrigation networks were built at the Bronze Age, more than 4,500 years ago" (1).

(1) Rami Khouri, The Jordan Valley life and society below the sea level, 1981, London-England.

To develop the Jordan Valley water resource for irrigation purposes the government started construction on the East Ghore main canal (KAC) in 1962. The canal was designed to convey up to 20 m3/s of the unregulated Yarmouk River to irrigate the land of the East Ghore by gravity. The cost of construction the 70 km canal estimated at JD 6.8 million, funded mainly by the USAID to irrigate 12,000 ha. The canal was further extend by 8 km in 1969 to irrigate 1,400 ha. at a cost of JD 0.9 million. Furthermore between 1975-1978 the canal was extend by 18 km to irrigate 3,550 ha. at a cost of JD 5.6 million funded by the USAID. The final 14.5 km extension was implemented between 1984-1988 to irrigate 6,000 ha. at cost of JD 11 million contributed by the KFW. However, due to the shortages of irrigation water in the Jordan Valley and Southern Ghore these 6,000 ha. are not utilized. Table (21) shows Jordan Valley and Southern Ghore main irrigaton projects, during the period 1962-1988.

Table (21)

Jordan Valley Irrigation Projects (1962-1988)

Project	Function	Cost (MJD)	Implementation Date
A) KAC	**Irrigation**	**24.3**	**1962-1988**
1. 70 km	12,000 ha.	6.8	1962-1969
2. 8 km	1,400 ha.	0.9	1966-1969
3. 18 km	3,550 ha.	5.6	1975-1978
4. 14.5 km	6,000 ha.	11.0	1984-1988
B) Z.R.C	**Irrigation & Storage**	**38.3**	**1975-1987**
1. KTR	48 mcm	16.2	1979-1979
- Store	48 mcm	-	-
- Irrigation	5,076 ha.	2.1	-
2. Zarqa. Tri	1,500 ha.	10.0	1975-1976
3. Raising KTR	82 mcm	-	1983-1987
C) N.G.C	**Irrigation & Storage**	**25.7**	**1969-1985**
1. W. Zeg Dam		4.2	
- Store	4.2 mcm		1969
- Irrigation	2,760 ha.		1976-1979
2. W. Arab Dam			1982-1985
- Store	20 mcm	17	1982-1985
- Irrigation	1,250 ha.	4.5	1983-1985
D) S.G.C	**Irrigation & Storage**	**2.9**	**1966-1978**
1. Kafrein Dam	4 mcm	-	1966-1968
2. Hisban & Kafrein	1,550 ha.	-	1976-1978

Source : Ministry of water and Irrigation, JVA open files, Amman-Jordan.

3.1 Main Sources of Irrigation Water in the Jordan Valley and Southern Ghore

The main water resources available in the Jordan Valley and Southern Ghore comprise of the following:

- Flows diverted from the Yarmouk River
- Inflows from Zerqa River
- Inflows from Side Wadis
- Return flows from waste water
- Ground water resources

Table (22)

Jordan Valley and Southern Ghore Irrigation Water Resources, 1991

Jordan Valley		Southern Ghore	
Source	**MCM**	**Source**	**MCM**
Yarmouk River	95.25	Wadi Hasa	17.67
KTR	46.30	Wadi Iben Hamad	7.30
Mukhaibeh Wells	18.60	Wadi Karak	3.97
Wadi Arab Dam	15.63	Wadi Fifa	2.82
Kuffrain Dam	8.23	Wadi Khunazireh	0.96
Shurhabeel Dam	4.43	Wadi Thira'a	1.33
Wadi Shuaib Dam	3.67	Wadi Araba Wells	0.60
Side Wadis	11.64		
Total	**203.75**	**Total**	**34.65**
Irrigation water	184.60		34.65

Source : Ministry of water and Irrigation, JVA open files, Amman-Jordan.

In 1991, these resource provided 238.4 MCM of water for the Jordan Valley (203.75 MCM) and Southern Ghore (34.65 MCM). However, due to the water shortages in the domestic sector, 9.41% of the Jordan Valley available water were pumped to Amman via Deir Alla Station, and as shown in table (22), Yarmouk River and KTR provided 46.7% and 22.7% of the total Jordan Valley irrigation water, and wadi Hasa provided about 51% of the southern Ghore irrigation water.

3.2 Irrigation Water Quality

Irrigation water quality refers to the characteristics of the supply of irrigation water that will influence its suitability for specific use. The quality of water dictates its use, and water shortages in Jordan requires the monitoring and protection of this precious resources, so that it does not deteriorate and be lost as a source of water. To protect the water resources the Ministry of Water and Irrigation initiated a periodical monitoring programs to indentify and prevent any source of water pollution before it occurs.

Water quality is a major factor in the reduction of crops yields, poor quality and leads to health hazards. According to the FAO guidelines the irrigation water in the Jordan Valley and Southern Ghore is divided into two Grades:

1) Grade one-According to the FAO guidelines (No restrictions to be used in agriculture) such as the Yarmouk River Water, water in KAC north of Zarqa River, Wadi Arab Dam, and Shurhabeel Dam Water. As for the Southern Ghore irrigation water this include wadis Iben Hammad, Thiraa, Hasa, Fifa, and Khunazireh.

2) Grade Two-Also according to the FAO guidelines (to be used in agriculture with limited restrictions) such as the Water in King Talal Reservoir (KTR) .

3.3 Water Requirements

According to the Ministry of Water and Irrigation records there are 344,800 dunums developed for irrigated agriculture, with a cropping intensity of 104%, and this required 496.24 MCM of irrigation water in 1991. However, only 219.25 MCM or 52% of the total irrigation water requirements was available, which means a deficit of 276.99 MCM, and in turn left a large areas of developed land under fallow, and the reduction of land productivity. Table (23) shows Jordan Valley and Southern Ghore water requirments in 1991.

Table (23)

Water Requirements in the Jordan Valley & Southern Ghore, 1991

(Cropping Intensity of 104%)

Location	Developed Land (Dunum)	Water Requirements (m3/dun./yr)	Total Water Requirements (mcm)
N. Jordan Valley	87410	1460	127.62
M. Jordan Valley	90810	1276	115.87
S. Jordan Valley	57150	1615	92.30
14 km Extension	60000 *	1895	113.70
Southern Ghore	46500	942	43.80
Wadi Araba	2000	1477	2.95
Total	-	-	496.24

* Not utilized .

Source : Ministry of water and Irrigation, Amman-Jordan.

As for net irrigation, water requirements in the Jordan Valley and Southern Ghore, varies from one crop to another, and varies for the same crop in different geographic locations . Table (24) shows that the crops in the Northern part of the Jordan Valley where the precipitation is higher and the temperature is lower than the Middle and South of the Jordan Valley, and Southern Ghore requires less irrigation water. In comparison Banana trees considered to be the highest irrigation water demanding crop in all the region of the Jordan Valley and the southern Ghore. It requires about 1986 m3/yr in the North of the Jordan valley, and about 2353 m3/yr in the Southern Ghore. This requirements is double the Citrus trees and three to four times greater than the average vegetables net irrigation water requirements.

Table (24)
Net Irrigation Water Requirements

(M^3/yr)

Crop	Jordan Valley		Southern Ghore
	North	Middle & South	
Wheat	323	437	454
Barely	323	434	454
Tomato	468	530	671
Cucumber	424	468	580
Potato	318	421	496
Squash	424	468	580
Cabbage	424	497	610
Cauliflowers	478	513	610
String Beans	321	373	392
Onion	430	492	625
Eggplants	664	754	931
Pepper	682	754	931
Melons	508	584	707
Banana	1686	1825	2353
Citrus	876	991	1236
Grapes	642	889	915

Source : Ministry of water and Irrigation, JVA open files, Amman-Jordan.

As for net irrigation water requirement according to region, the table shows that Citrus trees in the Southern Ghore consumes 141% of the required irrigation water in the North of the Jordan valley. Also, the irrigation water needed for one dunum of Banana in the Southern Ghore can be used to irrigate 6 dunums of string beans, 3 dunums of Grapes, or 1.9 dunums of Citrus .

3.4 Irrigation Techniques Used in the Jordan Valley

Prior to the construction of the KAC in early 1960's farmers in the Jordan Valley used to flood their Land with irrigation water. The distribution of irrigation water between farmers was according to agreed historical rights. However, after the construction of KAC the government developed the land and divided it into irrigated units each one consist of an average of 30 dunums served by basic infrastructure such as farm roads and networks of field canals connected to KAC to be irrigated by gravity.

In 1976, the drip irrigation technique was introduced and used for the first time in the Jordan Valley, and from that date this method was expanded rapidly (1). In march 1991, JVA surveyed more than 114,000 dunums of the Jordan Valley irrigated land, of which 48,000 dunums were cultivated with Citrus trees . This survey aimed to determine the irrigated land according to the type of irrigation technique used on farm. The survey results showed that about 68.8% of these dunums using the traditional surface irrigation method, and mainly located in the Northern part of the Jordan Valley. This due to the fact that old Citrus trees are pre

(1) Ministry of water and Irrigation, JVA open files, Amman-Jordan.

dominating in the North were drip irrigation is not sufficient. Also, the survey indicated that only 4.1% of the 114,000 dunums used sprinklers and concentrated in the North of the Jordan Valley. As for the area used drip irrigation, the survey indicated this method was concentrated in the Middle of the Jordan Valley and Southern Ghore. However, the R.S.S field survey conducted in December of 1992 for the same purposes showed that 65.8%, 25% and 9.2% of the farmers interviewed used drip, surface and sprinkler irrigation techniques respectively.

In order to conserve in the irrigation water and eliminate Leakage the government initiated a schemes to replace the open field canals networks in the Jordan Valley with pressurize pipes. Presently, more than 230,000 dunums are being irrigated by the pressurize pipes, which conserves 18 MCM of irrigation water annually and cost JD 10 million. In December of 1992, the JVA awarded a contract to convert the remaining 73,000 dunums served by open canal to be irrigated by pressurize pipes (1). This replacement will cost the country about JD 28 million to conserve 20 MCM of irrigation water annually.

3.5 Efficiency of Irrigation Techniques Used in the Jordan Valley and Southern Ghore

3.5.1 on-farm

Given the water shortages, Jordanian farmers used and procured new irrigation technique in order to use the water efficiently, desspite the high cost of instaling these techniques. As shown in Table (25) the drip irrigation technique is the best type with 85% overall efficiency, followed

(1) Ministry of water and irrigation, JVA open files, Amman-Jordan.

by the sprinklers with 75%, and the old method of surface with efficiency between 45-50% .

Table (25)
On-Farm Efficiency

Type of Irrigation	Average Efficiency
Surface	45-50 %
Drip	85 %
Sprinklers	75 %

Source : Ministry of water and Irrigation, JVA files, Amman-Jordan.

For example, in order to irrigate one dunum of Citrus trees by sprinklers technique in the North of the Jordan Valley which needs a net irrigation water of 876 m3/yr, a total of 1168 m3/yr is actually needed to compensate for this type efficiency losses of 25%.

3.5.2 Conveyance Efficiency

Conveyance efficiency covers water losses in the main canal between the intake headwork and the turnout into the field canals. Field canal efficiency defines losses between the filed canal turnout and the farm headgate. Overall conveyance efficiency equals the main canal efficiency times the field canal efficiency. It has been estimated that the KAC conveyance efficiency South of Zerqa River is 85% and it drops to 80% North of the Zerqa River due to the aging of the canal. Table(26) shows that the overall conveyance efficiency of KAC is relatively low both South and North of Zerqa River, Which means a great losses of needed irrigation water. However, some of the losses can be saved by the Rehabilitation and maintance of the Canal.

Table (26)

Conveyance Efficiency of KAC project

Efficiency	KAC	
	N. of Zerqa River	S. of Zerqa River
Main Canal	80 %	85 %
Field Canals	73 %	78 %
Overall *	58 %	60 %

* Overall efficiency = Main canal efficiency× Field canals efficiancy

Source : Suzan Taha, Ministry of water and Irrigation, (unpublished report), Amman-Jordan.

3.6 Irrigation Water Tariff and Subsidies

In 1961 the first irrigation water tariff was introduced in the Jordan Valley at fixed rate of 1 fills/m3, and modifyed in 1966 to be 1 fills/m3 for the first 1800 m3 and 2 fills/m3 above that quantity [1]. The tariff was increased to fixed rate of 3 fills/m3 in 1974, then in 1989 increased to 6 fills/m3 regardless of the quantity of irrigation water consumed, Table (27) shows the development of irrigation water tariff.

Table (27)

Irrigation Water Tariff

Year	Fills/m3	Notes
1961	1	Fixed
1966	1	first 1800 m3
	2	1801 m3 and more
1974	3	Fixed
1989	6	Fixed

Source : Ministry of Water and Irrigation, JVA files, Amman-Jordan.

(1) Ministry of water and Irrigation, JVA Open Files, Amman-Jordan.

Several studies conducted on the production cost of the irrigation water in the Jordan Valley concluded that the present tariff charged is not even covering the cost of Operation and Maintenance (O&M). This imply that irrigation water is heavily subsidized and there is no cross subsidy as in the case of domestic water tariff, where the high block water consumers subsidize the lower block consumers. In 1991, the Government Contributed JD 1.44 million in subsidize to cover the production cost of irrigation water. Furthermore, the cost of operation and maintenance estimated at JD 2.18 million and only JD 737,000 or 34% of the cost of O&M was collected from farmers, in the same year[1].

A recent study, conducted on the cost of irrigation water in the Jordan Valley stated that the cost depends on the quantity of irrigation water sold to farmers which also depends on the rainfall fluctuation .

To estimate the cost of irrigation water the capital, and operation and maintenance cost were incorporated in the calculation. The estimated cost at dry year when only 100 MCM/yr of irrigation water was sold the cost was 59.8 fills/m3 of which 17.4 fills for operation and maintenance. In wet year an average 175 MCM was sold, the cost decreases to 37.5 fills/m3 of which 9.9 fills for operation and maintenance. Table (28).

Table (28)

Cost of Irrigation Water in the Jordan Valley

Item	Dry years	Wet years
Water Sold	100 mcm	175 mcm
Total Cost	59.8 fills/m3	37.5 fills/m3
O & M Cost	17.7 fills/m3	9.9 fills/m3
Government Subsidy	53.8 fills/m3	31.5 fills/m3

Source : Peter ohlmayer, Cost of irrigation water in the Jordan Valley and Southern Ghore, 1991, Amman-Jordan .

(1) Ministry of water and Irrigation, JVA, Amman-Jordan.

It's worth mentioning that the government invested JD 380 million in the comprehnsive development scheme of the Jordan valley and Southern Ghore of which JD 127 million for Dams and irrigation projects development to improve 345,000 dunums, at an average cost of JD 368 per dunum [1]. In order to minimize waste and to allocate water resources optimally to maximize the net benefit from the irrigation projects to the national economy, an efficiency price of water must be imposed , which takes into consideration the farmers affordability to pay this price. The afforedability to pay the efficient price must also incorporate the Jordan Valley and Southern Ghore agricultural Cycle. This means a full analysis of the agricultural production cost and the crucial marketing system is needed.

3.7 Cost of Agricultural Production in the Jordan Valley and Southern Ghore

The share of water in total agricultural production cost is relatively low, even water intensive crops such as Banana and Citrus trees irrigation water cost share of total production is low in comparison to fertilizers and labour.

3.7.1 Vegetables

As shown in Table (29) the cost of irrigation water does not exceed (0.6%) of the agriculture production cost for all crops. For examples, the total cost of cultivating one dunum of cucumber in green house is JD 1011, only JD 6 of this cost goes for irrigation water.

(1) J. Price Gittinger, Economic Analysis of Agricultural Projects, EDI-The World Bank, p. 223.

Table (29)
Average Cost of Vegetable Production in the Jordan Valley and Southern Ghore, 1991
(JD/Dunum)

Crop	Seedlings	Fertilizers	Water	Pesticides	Labour *	Total
Wheat	1.4	8.5	4.5	5.0	5.4	24.8
Barely	0.8	8.5	4.5	5.0	5.4	24.8
Maize	1.4	43.0	3.3	5.0	9.6	62.2
Tomato	16.0	39.0	3.0	50.0	61.7	169.7
Tomato (G.H)	48.0	119.5	4.5	270.0	66.1	508.1
Onion	10.0	12.5	2.4	25.0	45.9	95.8
Garlic	12.5	12.5	2.4	25.0	45.9	98.3
W. Melons	6.7	35.1	3.6	30.0	40.4	115.8
Peppers	25.0	48.7	4.5	30.0	58.7	166.9
Peppers (G.H.)	56.0	106.2	6.0	150.0	352.6	670.8
Gauliflower	27.5	26.1	2.4	35.0	52.3	143.3
Culflowers (G.H)	33.0	26.1	3.0	35.0	60.3	157.4
String Beans	21.6	27.6	3.0	30.0	56.7	138.9
S.Beans (G.H)	15.0	77.1	4.5	100.0	403.4	600.0
Eggplant	27.5	40.8	3.5	30.0	70.7	172.5
Squash	65.0	22.5	3.0	30.0	70.7	191.2
Cucumber	14.0	36.3	3.0	40.0	49.9	143.2
Cucumber (G.H)	272.0	117.5	6.0	300.0	315.6	1011.1
Potato	100.0	42.0	4.2	30.0	46.4	222.6

* Including mechanical and manual work.
Source :Agriculture Credit Cooperation, (unpublished report), 1992, Amman-Jordan.

3.7.2 Fruit Trees

As for perennial trees the cost of irrigation water contributed only 5% of the total production cost. Banana trees are the highest irrigation water demanding crops and the cost of irrigation water amounted to 28% of the total production cost. Apples and Grapes cost of irrigation water consumption are the lowest with only 5% of the total production cost as shown in table (30).

Table (30)
Average Cost of Fruit Production in the Jordan Valley and Southern Ghore, 1991
(JD/Dunum)

Crop	Plants	Fertilizers	Water	Pesticides	Labour *	Total
Citrus						
1-3 years	40	29.1	3.6	7.0	34.6	114.3
4-7 years	-	68.8	4.8	10.0	54.7	138.3
8 + years	-	94.5	6.0	12.0	95.5	208.0
Grapes						
1-3 years	20	15.1	1.8	2.5	34.2	73.6
4-7 years	-	25.6	3.0	4.6	54.0	87.2
8 + years	-	33.3	4.8	5.7	68.9	112.7
Apples						
1-3 years	20	13.6	2.6	1.1	23.8	61.1
4-7 years	-	27.4	3.1	2.1	39.8	72.4
8 + years	-	37.9	4.2	4.5	71.1	117.7
Banana						
1 year	110	62.1	9.0	5.0	38.9	225.0
2-8 years	-	14.5	12.0	7.0	9.8	43.3

* Including mechanical and manual work.
Source : Agriculture Credit Cooperation, (unpublished report), 1992, Amman-Jordan.

3.8 Irrigation Water Productivity (JD/M^3) in the Jordan Valley and Southern Ghore

The following formula, calculate the irrigation water productivity or the financial return for every m3 of irrigation water utilized per crop:

Irrigation water productivity (JD/m3) =

$$\frac{\text{Average yield (Ton/dunum)} \times \text{selling price (JD/Ton)}}{\text{Net IrrigationWater requirement (m3/dunum)}}$$

The formula shows that the irrigation water productivity (JD/m3) effected positively with crop yields and selling prices, and negatively with net irrigation water requirements. The water productivity in the Northern part of the Jordan Valley is higher than in the Middle and South

of the Valley and Southern Ghore, this due mainly to less irrigation water requirements. Table (31) compare the average irrigation water productivity between the North, Middle, South of the Valley and Southern Ghore over the last four year. The highest financial return generated from cucumber in G.H with JD 4.24 per m3 in the North and JD 2.4 per m3 in the middle and JD 1.5 per m3 in the South of the Jordan Valley.

Table (31)

Water Productivity (JD/m^3)

Crop	Price (JD/Ton)	Average Productivity			Net Water requirments			Irrigation water productivity *		
		N.V	M & S.V	S. G	N.V	M&S.V	S . G	N.V	M & S.V	S.G
Citrus	242	2.89	1.04	0.71	876	991	1236	0.80	0.25	0.14
Banana	400	1.98	2.09	0.62	1686	1825	2353	0.47	0.46	0.11
Grapes	213	2.09	2.35	1.87	642	889	915	0.69	0.56	0.44
Tomato	130	6.27	3.28	3.47	468	530	671	1.74	0.80	0.67
Squash	188	2.25	1.51	1.31	424	468	580	1.00	0.61	0.42
Eggplant	97	3.41	3.68	1.91	664	754	931	0.50	0.47	0.20
Cucumbers	219	8.20	5.20	3.94	424	468	580	4.24	2.43	1.49
Potato	187	2.84	2.13	2.32	318	421	496	1.67	0.95	0.87
Cabbage	46	3.21	2.43	1.79	424	497	610	0.35	0.22	0.13
Cauliflower	108	2.22	1.46	1.48	478	513	610	0.50	0.31	0.26
Peppers	258	2.60	2.21	0.98	682	754	931	0.98	0.76	0.27
String Beans	306	1.17	1.25	0.85	321	373	392	0.12	1.02	0.66
W. Mellon	73	2.38	2.49	1.86	508	584	707	0.34	0.31	0.19

* Calculated by the researchers.
N.V : North of the Jordan Valley.
M&S.V : Middle and South of the Jordan Valley.
S.G : Southern Ghore.
Source : - Department of statistics, Annual Agricultural statistics, 1988-1991, Amman-Jordan.
- Agricultural Marketing Organization, (different annual reports), Amman-Jordan.
- Ministry of water and Irrigation, JVA open files, Amman-Jordan.

Chapter Four

The Possibility of Cultivating Substitute Crops in the Jordan Valley and Southern Ghore

Introduction

The Jordanian agricultural sector in general, and in the Jordan Valley and Southern Ghore in particular, has been constrained by several shortcomings, namely, the scarcity of irrigation water, deterioration of soil fertility, and temporary loss of some of the traditional markets of vegetables and fruits because of the Gulf crisis.

Presently, available water resources in the Jordan Valley and Southern Ghore can merely provide the much needed irrigation water for cultivated land. Between the months of April and October, crops suffer severely from shortages of irrigation water. In dry years, the Jordan Valley Authority (JVA) rationalizes irrigation water allocated for perennial trees and limit the area cultivated with vegetables, which leads to decline in agricultural productivity, and cropping intensity and deterioration of soil quality.

In the light of the aforementioned facts, the importance of this chapter stems from the need to examine the possibility of cultivating substitute crops that would save on water consumption, especially during the summer season.

4.1 The Willingness to Cultivate Substitute Crops

The R.S.S field survey, shows that about 88% of the farmers interviewed are willing to cultivate substitute crops in order to improve their economic position. Hence, most of the farmers are facing a major debt problem (about JD12 million to ACC an JCO) resulting from the increase in the production cost and market constraint, so they believe by cultivating substitute crops this may improve their income. Only 12% of the farmers surveyed are not willing to try the cultivation of substitute crops, of whom 63% are located in the North of Jordan Valley, Table (32).

Table (32)

Distribution of Farmers Willingness to Cultivate Substitute Crops

Willingness	Region			Total	%
	N. Jordan Valley	M & S Jord.Vly	Southern Ghore		
Yes	137	248	55	440	88.0
No	38	15	7	60	12.0
Total	175	263	62	500	
%	35.0	52.6	12.4		100

Source : The R.S.S Field Survey, 1992.

As for the reasons for cultivating the substitute crops, the majority or 41.2% of the interviewed farmers cultivated it just for the purpose of trying, 21.1% due to their high productivity, and 13.2% believe it is easy to market. Table (33).

Table (33)

Distribution of Farmers Who Cultivated Substitute Crops

Reason	Region			Total	%
	N. Jordan Valley	M & S Jord.Vly	Southern Ghore		
High productivity	7	15	2	24	21.1
Low product cost	2	5	0	7	6.1
High selling Prices	3	8	2	13	11.4
Easy to market	3	12	0	15	13.2
Less water consu.	3	5	0	8	7.0
Other (Trying)	12	35	0	47	41.2
Total	30	80	4	114	
%	26.3	70.2	3.2		100.0

Source : The R.S.S Field Survey, 1992.

Table (34) shows that 55.3% of the Farmers reluctant to cultivate substitute crops is mainly because they believe it riskey and there are no enongh information about, and 38.2% are not convenience that this substitute crops is profitable .

Table (34)

Frequency Distribution of Farmers Reluctant to Cultivate Substitute Crops by Region and Reason

Reason	Region			Total	%
	N. Jordan Valley	M & S Jord.Vly	Southern Ghore		
Risky	30	7	5	42	55.3
Not convenience	13	13	3	29	38.2
Others	3	2	0	5	6.6
Total	46	22	8	76	
%	60.5	28.9	10.5		100.0

Source : The R.S.S Field Survey, 1992.

4.2 Substitute Crops Irrigation Water Requirements

In order to conserve in irrigation water the study introduce the possibility of cultivating new crops suitable for the Jordan Valley and Southern Ghore climate and require less irrigation water than Citrus and Banana. Also, the suggested crops supposedly are easy to market with a potential high financial return to farmers. Some of these substitute crops suggested by this Study are Grapes, Guava, Apples, Avocado, Palm trees, sweetapples, and Annona.

As indicated by Table (35) all substitute crops consumes less water than Citrus by 7% and Banana by 52% and regardless of the region.

Table (35)
Net Water Requirements for Fruit trees

(M3/yr)

Crop	N. Jordan Valley	M & S Jord.Vly	Southern Ghore
Citrus	876	991	1236
Banana	1686	1825	2353
Grapes	642	889	915
Guava	495	568	709
Apple	809	845	920
Avocado	809	845	920
Papaya	809	845	920
Mango	809	845	920
Dates	650	700	760

Source : Ministry of water and Irrigation, open Files, Amman-Jordan.

Guava considered the least water demanding crops among all the perennial trees, which consumes only 50% of the net irrigation water requirements of Citrus and 30% of that for Banana trees. This means switching one dunum of Citrus or Banana with these substitute crops will save 67 m3/yr and 877 m3/yr respectively. Furthermore, if 10% or 5532

dunums of the Citrus trees in the North of the Jordan Valley was eliminated and cultivated with any type of substitute crops, about 485,000 m3/yr of irrigation water will be saved, and this amount of water is enough to irrigate 5990 dunums of any type of these substitute crops. This is an additional increase of 458 dunums of perennial trees to be cultivated and irrigated. However, to eliminant Citrus or Banana trees and cultivating new perennial trees a detailed economic analysis is required, (see section 4.4).

4.3 Water Productivity of the Substitute Crops

Despite the fact that the land productivity of these substitute crops is less than that of Citrus and Banana trees, in contrast their water productivity is much higher than that of Citrus and Banana. The high water productivity of the substitute crops is due mainly to less irrigation water requirements and higher selling price in comparison to Citrus and Bananas. Table (36) shows the water productivity of perennial trees and the substitute Crops.

Table (36)
Substitute Crops Water Productivity in the Jordan Valley and Southern Ghore

(JD/M^3)

Crop	Price (JD/Ton)	Productivity Ton/dunum	Water requirments			water productivity		
			N.V	M&S.V	S . G	N.V	M & S.V	S.G
Citrus	242	2.71	876	991	1236	0.75	0.66	0.53
Banana	400	2.03	1686	1825	2353	0.48	0.44	0.34
Grapes	213	2.80	642	889	915	0.93	0.67	0.65
Guava	300	0.85	495	568	709	0.51	0.45	0.36
Apple	400	1.30	809	845	920	0.64	0.61	0.56
Avocado	1000	2.00	809	845	920	2.47	2.37	2.17
Papaya	1000	1.50	809	845	920	1.85	1.77	1.63
Mango	2000	1.50	809	845	920	3.71	3.55	3.26
Dates	420	0.63	650	700	760	0.41	0.38	0.35

Source : - Department of statistics, Annual Agricultural statistics, 1988-1991, Amman-Jordan.
- Agricultural Marketing Organization, (different annual reports), Amman-Jordan.
- Ministry of water and Irrigation, JVA open files, Amman-Jordan.

Morever, Palm trees can be cultivated in the Jordan Valley and Southern Ghore, and irrigated with saline water. Some of the types of palm dates that can be cultivated is shown in Table (37).

Table (37)
Palm Dates Yeilds and Selling Prices

Dates kind	Yield (ton/dunums)	Selling price (JD/Ton)	Land productivity (JD/dunums)	Water productivity (JD/m3)*
Tunisian	2.9	400	1160	1.56
Zagloli	1.3	500	650	0.85
Maktoum	1.4	400	560	0.74
Red	1.9	500	950	1.25
Yellow	1.2	300	360	0.47

* Assuming the palm Dates are in the Southern Ghore.

Source : M.T. Hanbli, palm Trees Cultivation in the Jordan Valley, Ministry of water and Irrigation, Amman-Jordan.

4.4 Cost of Cultivating Substitute Crops

Due to the shortages in irrigation water in the Jordan Valley and Southern Ghore, the Ministry of Water and Irrigation curtailed the cultivation of perennial trees and stop the issuing of new plantation licenses. As mentioned earlier in this chapter the study aims to conserve in irrigation water through the introduction of less water consumption substitute crops.

In order to estimate the cost of cultivating one dunum of substitute crops by switching from Citrus, the opportunity cost of the resources (land and irrigation water) must be incroporated. Opportunity cost is defined as the value of the resource in it's next best use (substitute crops).

Also, the following calculation is needed:

1) Cost of the elimination of the Citrus trees. The replacement of one dunum of Citrus trees will lead to the destruction of an average of 25 citrus trees. The elimination of the 25 Citrus trees at an average cost of JD 50 per tree will cost the farmers (1) :

   JD 50/Tree × 25 Trees/dunum = JD 125

2) Cost of planting substitute crops. Adding to the cost of replacement, the cost of planting the substititute crops, which estimated at JD 150, and it requires three years to start production as follows:

   One dunum × JD 150 × 3 years = JD 450

3) Benefit forgone (Production losses), In addition to that the cost of production lost should be incorporated. In this case the average productivity of Citrus trees is about 2.71 Tons per dunum, and the average selling price of one Ton of Citrus is about JD 242. The production losses in three years which is equals the period required for the substitute crops to start production.

   2.71 Tons/dunum × JD 242/Ton × 3 years = JD 1967.4

4) Total cost = 1 + 2 + 3 = JD 3667.4/dunum

As for the irrigation water that will be saved by switching one dunum of Citrus with a substitute crops and estimated at 381 m3/yr (876 m3/dunum/citrus-495 m3/dunum/Guava). This means the cost of one cubic meter conserved from this process is JD 3.21, which is relatively high to be borne by the national economy. Morever, the suitability of soil, water quality and climate for Citrus is not necessarily the same for the

(1) Ziad Elias and M.T. Hanboli, cost of elimination citrus trees in the Jordan Valley, 1992, (unpublished report), Amman-Jordan.

plantation of substitute crops. Moreover, in 1990, as a result of dry year the Citrus trees in the Jordan Valley received 20% less than it's irrigation water requirments and the trees withstand the decrease.

Furthermore, the demand for citrus is raising as a result of the population growth, and the future deficit for citrus will be covered by importing. The present per capita consumption of Citrus is about 32 Kg/yr, which considered moderate for a country in which Citrus is very common among its residents. By the year 2005 the per capita consumption will decline to about 12 Kg, assuming that area planted with Citrus remained constant. In 1991, Jordan exported 37370 tons of Citrus production at a cost of JD 7 million, and imported JD 3.45 million of the substitute crops products (1). This indicate that the exported value of Citrus compensated for the import bills of these substitute crops, and resulted in a net export surplus of JD 3.55 million.

In addition to this, some of substitute crops could be cultivated in highland, for example, the highland cultivated with grapes and peaches expanded from (22.5) and (0.2) thousand dunums in 1980 to about (54) and (9.6) thousand dunums in 1992, respectively (2).

It is worth mentioning, in one hand, the Jordan Valley farmers became especialists in planting Citrus, on the other hand the substitute crops are not known widly in Jordan and can't sustain and tolerate frost, especially the northern part of the Valley.

In conclusion, the substitute crops which may consume less water are not economically feasible.

(1) Department of statistics, External trade statistics 1991, Vo. 1, Amman-Jordan, p. 30.
(2) Department of statistics, Annual statistical yearbook 1991, Amman-Jordan, p. 120.

Chapter Five
Marketing of Agricultural Products

Introduction

Marketing of agricultural products is one of the main obstacles confronting Jordan's agricultural sector. In 1991, Jordan's product export have suffered a sever set back because of over-production on one hand and the competition of other agricultural producing countries in the traditional market. The Gulf Crisis restricted the economic relations between Jordan and the Gulf Cooperation council (GCC) traditional markets for its agricultural produce.

Furthermor, Lack of management, and organizational efficiency, duplication of responsibilities and infrastructure constraints impose negative impacts on both farmers and consumers. Also, weak marketing standards and unexperienced of the parties involved in the process resulted in low prices of agricultural products, which force farmers to abandon farming or force them to borrowing to compensate for their losses, and sustain and continue production.

In 1987, the government established the Agricultural Marketing organization (AMO), with the responsibilities of setting marketing strategies, development and organization of the country agricultural products locally and abroad (1). Unfortunately AMO didn't achieve its objectives, completly.

(1) Agricultural Marketing Organization, Annual report 1991, Amman-Jordan.

This Chapter will investigate the present agricultural marketing process and the contribution of the Substitute crops in the country agricultural production, and the marketability of these crops in local and Foreign markets.

5.1 Agricultural Marketing Process

Jordan Valley and Southern Ghore agricultural products pass through three major Stages namely [1]:

1) Picking and packing of the products on Farm. Presently, farmers grade their products into two grades according to their own specification. However, it appears that the agricultural products container contain mixture of size, maturities, and qualities.

2) Transporting the products to the central and wholesale markets to be sold through auctioning. Many of the transportation vehicles carrying the agricultural products lack the required specification of cooling and airing facilities which effects the quality of products.

3) Selling the products by the retailers to the consumers. The retail price of the crops is determined by a committee from the municipality staff, by collecting the central market commission agents sales books in order to calculate the retail price for the last two days and to take the highest price .

It's worth mentioning, that there are two periods to market agricultural products in the central markets (morning and evening). The

(1) Jordan Valley Farmers Association files, Amman-Jordan.

commission agents charge fees between 4-5% of the sold products value, and both sellers and buyers pay 2% as marketing services to the concerned municipality. In addition to that the cost of containers, packing and transporting is paid by the farmers.

Despite the simplicity of the agricultural marketing process. The problem of marketing is ranked as the second most obstacles facing the farmers and the agricultural sector as whole. The R.S.S Field survey showed that 56% of the farmers interviewed are suffering from difficulties in marketing of their production. This due mainly to the fact that Jordan's agricultural products depends on the traditional markets, which determined by the prevailing political situation and not on signed trade protocols. The loss of the traditional markets of the Gulf cooperation council countries (G.C.C) caused the disturbance in the agricultural sector and surplus in supply due to the local market size and limited locally demand.

In order to confront such marketing crises in the future and reduce the dependency on these traditional markets, an agricultural marketing strategy is highly needed, aiming to integrate agroindustry with agricultural exports. This will help in coping with any marketing crises and to keep such important and vital sector to provide job opportunities, inflow of foreign currencies and enhance the further development of the agricultural sector.

5.2 The Expected Contribution of the Substitute Crops in GDP, Agricultural Income and Trade Balance

In 1991, Jordan import bills of these substitute crops estimated at

JD 3.45 million or 0.2% of the country total imports and equivalent to 0.4% of the trade deficit. This means producing these substitute crops in Jordan will reduce the trade deficit by only 0.4% only [1]. Table (38) shows the value of imported substitute crops in 1991.

Table (38)
Value of the Imported Substitute Crops, 1991

Crop	Value (JD)
Avocado, Papaya	50360
Mango	246909
Palm Dates	3134910
Total	3450179

Source:Department of statistics, Unpublished data.

Beside, the expected value of these substitute crops is equivalent to 2% of the agricultural production value, and 0.1% of the kingdom GDP in 1991. Furthermore, the land which can utilized for the production of Citrus and Banana trees is limited. Therefore, there will be no economic value of eliminating Citrus or Bananas in favour of any other substitute crops.

5.3 The Marketability of the Substitute Crops

In order to determine the demand for these substitute crops, the assumption will be that it will equal the demand of it's present import value and in this case JD 3.45 million. This value equal only 11.6% of the estimated losses of eliminating 10% of the Citrus trees and planting

(1) Department of statistcs, statistical Annual yearbook 1991, Amman-Jordan.

substitute crops. Furthermore, due to their high selling prices, and the fact that few consumers already developed the taste for these crops, marketing them will be limited to specific segment of the country population.

Chapter Six

Findings and Recommendations

The study came up with the following findings and recommendations. Hoping these recommendations will contribute to the upgrading and improvement of the agricultural sector in the Jordan valley and Southern Ghore.

6.1 Findings

1) About 512 MCM or 61.5% of Jordan's water resources used in 1991 originated from the ground water. The bulk or 64% of the ground water resources consumed mainly by the agricultural sector in the highland.

2) Jordan's water balance suffers from chronic deficit where demand exceeds the supply for all sectors. In the year 2005 the deficit estimated to be about 40.6% of the needed water.

3) Irrigated agriculture in the Jordan valley and Southern Ghore depends mainly on the surface water. The main source of water resources in the Jordan Valley is the Yarmouk River which contributed about 40% of the total irrigation water in the Jordan Valley, and in Southern Ghore, wadi Hasa was the main source and contributed by 51% of irrigation water in 1991.

4) More than 22% of the Jordan Valley and Southern Ghore irrigated land are cultivated with perennial trees, and consumed 41% of the total irrigation water in the Valley.

5) Also, in 1991, the highland irrigated land reached 281,000 dunums and consumed 384 MCM of irrigation water. On the other hand the Jordan Valley and Southern Ghore 345,000 irrigated dunums consumed only 219 MCM of irrigation water .

6) In 1991, Jordan Valley and Southern Ghore agricultural production contribution amounted to 70% and 65.7% of the country's vegetables and fruits production respectively.

7) Furthermore, in 1991, the foreign labourer working in the Jordan valley and Southern Ghore declined from 57.4% in 1990, to 43.9% in 1991 of the total labour force, even though this percentage is still high.

8) The Gulf Cooperation Council Countries (GCC) are the traditional market for Jordan's Winter agricultural products. As a result of the Gulf war, Jordan agricultural exports to the GCC decline by 41% and 31% in terms of quantity and value respectively in 1991 from the previous year.

9) In 1991, the cultivated irrigated land in the Jordan valley and Southern Ghore estimated at 345,000 dunums (34,500 ha.) and required 423 MCM of irrigation water. However, only 52% of the required water were secured. Furthermore, there are 60,000 dunums (6,000 h.a) in the Jordan Valley developed but not utilized due to the shortages in the irrigation water resources.

10) Comparing the irrigation techniques used in the Jordan Valley and Southern Ghore, the drips irrigation method is considered to be the

most efficient with an overall efficiency of 85%. On the other hand, the overall efficiency of the surface irrigation, and sprinklers does not exceed 50%, and 75% respectively.

11) The conveyance efficiency of King Abdallah Canal (KAC) reached an average of 60% South of Zerqa River and decline to 58% North of Zerqa River.

12) The production cost of irrigation water varies from 59.8 fills/m3 in dry years to 37.5/m3 fills in wet years. The cost of operation and maintenance (O&M) also varies from 17.4 fills/m3 in dry years to 9.9 fills/m3 in wet years. However, Jordan Valley Authority (JVA) provides the irrigation water for the farmers with only 6 fills/m3. This means that irrigation water is subsidized, and the price of water contributes only 11% to the total cost in the dry years and 16% in the wet years.

13) In the Jordan Valley and Southern Ghore the cost of irrigation water does not exceed 5% of the vegetables and fruits production cost.

14) The water productivity (JD/m3) in the North of the Jordan Valley is higher than in the Middle and the South of the valley. The rate of return per m3 in the North varies from 0.35 JD/m3 for cabbages to high 4.24 JD/m3 for cucumbers. As for fruit trees, Citrus ranked the highest with 0.8 JD/m3 and 0.47 JD/m3 for Banana.

15) The R.S.S field survey showed that 88% of the farmers in the Jordan Valley and Southern Ghore favor cultivating new Substitute crops.

16) In 1991, the farmers in the Jordan Valley and Southern Ghore total

debt to the Agriculture Credit Cooperation (ACC) and Jordan Cooperative Organization (JCO) reached JD 12 million (JD 35/dunum). This amount did not include their debts to the private banks and Commission agents.

17) Despite the fact that some of the newly suggested crops consume less water than the traditional perennial trees such as Banana and Citrus, the study concluded that it's not economically feasible.

18) Despite the fact that the financial return JD/m3 used in cultivating palm date are lower than Citrus and Banana with an average of 0.38JD/m3, palm trees has greater tolerance to salinity.

19) Air transport is a major constraint to market agriculture products to Europe, especially Eastern Europe which requires less standards and has no winter crops.

20) Marketing their agricultural products is the crucial problem facing farmers in Jordan, and in order for them to preserve their share in the regional markets this will require to install adequate grading and standards for the agricultural production.

6.2 Recommendations

The study came up with four sets of recommendations namely, enhancing water supply and conservation, Improve Marketing procedures, Agricultural Development, and cultivating new substitute crops.

6.2.1 Enhancing Water supply Conservation

1) The Construction of diversion and storage dams where ever it's possible and feasible in order to store flood water in the winter to be used in the summer.

2) The Rehabilitation of the municipal water networks will reduce water leakage estimated presently between 30-35% of the total water pumped. This will save at least 28 MCM/yr, cost the country about JD 14 million annually.

3) Increase the irrigation methods efficiency.

   a) On-farm-Through the converting from the traditional irrigation methods such as surface to drip and sprinkler techniques.

   b) Outside the farms-Through Rehabilitation of KAC and converting from the open field canals to pressurize pipes.

4) Also, to adopte a progressive irrigation water pricing mechanism, to eliminate waste and allocate water optimally.

5) Conducts studies on the local environment to determine the actual water requirements per crops and region.

6.2.2 Improve Marketing Procedures:

1) The establishment of agricultural marketing data bank, to provide the necessary information and data on the foreign markets and their standards and specification, regulation, fees, competition ... etc.

2) The expansion in the plantation of the agroindustrial crops. Also the adoption of pre contracting cultivation agreement between the farmers and the commission agents.

3) Expansion in crops cultivation for exports purposes, especially those crops which has climatic advantages with other regions.

4) The coordination between the concerned authorities in agricultural sectors such as the Ministry of Agriculture, AMO, commision agents ...etc. to minimize the road and air transport cost and to monitor quality of exported products. Also, to reduce the production cost of agricultural input such as seeds, fertilizers, and pesticides which in turn will give the sector greater advantage to maintain its share in the regional market.

5) The introduction of the Jordan Valley and Southern Ghore agricultural products in the bilateral trade protocol with the Arab and foreign countries on the basis of barter.

6) Initiating a countract farming for export purposes.

6.2.3 Agricultural Development:

1) To implement flexible crops patterns suitable for the marketing and agroindustial policy in the country.

2) To enhance the role of R&D through the enhancement of research and extension services in the sector.

3) The reduction of the agricultural production cost, and to consider the irrigation water as an economic imput in the production cost.

6.2.4 Cultivating Substitute Crops:

The study does not recommend the elimination of the traditional perennial trees (Banana and Citrus trees) and cultivating the newly suggested substitute crops due to the following facts:

1) Economically:-the cost of switching one dunum of land of Citrus with Guava the least water consuming crop is JD 3667.4. This means the cost of one cubic meter of irrigation water saved by the plantation of substitute crops is JD 3.21. Furthermore, heavy investment put in growing Citrus; plantation, land preparation on farm equipment cannot be easily compensated. In addition to that, the good margin of profit of Citrus has encouraged farmers to be more selective on the planted varieties and more keen on production.

2) Climate:- due to several sever winter confronted the Kingdom in the last years, many of these crops can not be sustain and tolerate frost, like citrus.

3) Marketing:-Jordan consumer needs more time to develop taste for these substitute crops, also the retail price will be relatively high.

4) Know-how:-Jordanian farmers are not will a ware of cultivating these crops, in contrast they are specialists in cultivating and producing varieties of excellent quality of Citrus.

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Annex (1)

Royal Scientific Society
Centre for International Studies

Questionnaire
Irrigation water and Agriculture in the Jordan Valley and Southern Ghore
The Possibility of Cultivating Substitute Crops

November 1992

"In according with the statistics law No. (24) of 1950, and it's amendments, all information in this questionnaire are only for statistical purposes and are confidential".

Question 1 :

Region : .....

Question 2 :

Area ..... dunums

Cultivated (.....) dunums

Not cultivated (.....) dunums

Question 3 :

What are the main reasons for not cultivation all the area :

( ) shortages of irrigation water

( ) Quality of soil

( ) Financial constraints

( ) Marketing constraints

( ) others

Question 4 :

Type of ownership

(1) Rent (2) ownership

(3) shares holders (4) others (specify)

Question 5 :

Type, area and productivity of crops cultivated in your land:

Crops	Area(dunum)	Productivity (Ton/dunum)
A) Perennial Trees		
- Citrus		
- Banana		
- Olive		
- Grape		
- Guava		
- Peache		
- Date-palm		
- Others		
B) Field crops		
- Wheat		
- Barely		
- Others		

C) Vegetables

Crops	Spring		Autumn	
	Area	Productivity	Area	Productivity
- Tommato				
- Squash				
- Eggplants				
- Cucumbers				
- Potatoes				
- Cabbages				
- Cauliflowers				
- Hot pepper				
- Sweet pepper				
- Broad Beans				
- Peas				
- Cow-peas				
- Jew's Mallow				
- Okra				
- Lettuce				
- Sweet Melons				
- Water Melons				
- Spinach				
- Onions (green)				
- Onions (Dry)				
- Snake cucumber				
- Others				

Quesion 6 : What is the main criteria for selecting the crops ?

(1) Selling price
(2) Quality of soil
(3) Irrigation water availability
(4) Quality of water
(5) Marketability
(6) Climate
(7) Others

Question 7 : Number of workers in the farm :

(1) Local Seosinal .....
Full time .....
(2) Expatriate Seasonal .....
Full time .....

Question 8 : Sources of Irrigation water :

(1) Stream (2) Spring
(3) Wells (4) Canal
(5) Others (specify) .....

Question 9 : Quality of Irrigation water :

(1) Good (2) Saline
(3) Polluted (4) Others (specify) .....

Question 10 : If used , what are the advantages for using Green houses :

(1) saving water (2) Increasing productivity
(3) Improving quality (4) Others (specify) .....

Question 11 : Types of Irrigation techniques used on farm

(1) Surface (2) Drip

(3) Sprinkles (4) Others (specify) .....

Question 12 : Efficiency of the Irrigation techniques used :

(1) Saving on irrigation water consumption

(2) Reducing the leakages

(3) Saving on irrigation water

(4) Others (specify) .....

Question 13 : Weekly irrigation times and quantity ?

Season	How many times	M3/dunum
Spring		
Summer		
Autumn		
Winter		

Question 14 : Is the accesbility of receiving irrigation water

(1) Easy (2) Resonable (3) Difficult

Question 15 : Is the quantity of irrigation water received

(1) Enough (2) Resonable (3) Not enough

Question 16 : If the irrigation water is not enough, what are the alternatives ?

(1) Municipal Networks

(2) Tannkers

(3) Others (specify) .....

Question 17 : What do you know about the water situation in Jordan :

(1) Good (2) Average

(3) Difficult (4) I do not Know

Question 18 : Is the irrigation water price :

(1) Cheap (2) Moderate (3) Expensive

Question 19 : What are the services provided to you by :

Ministry of Agriculture	JVFA	ACC	JCO
- Soft loans			
- Compensations			
- Tools			
- Fertilizers			
- Seeds			
- Pesticides			
- Marketing			
-Others			

Question 20 : Where do you market your agricultural products ?

(1) Central markets for local consumption

(2) Central markets for Export

(3) Directly to the consumer

(4) Directly for Export

(5) Others (specify) .....

Question 21 : Is the pesticides and Fertilizers prices:

(1) Expensive (2) resonable (3) Cheap

Question 22 : In the last few years; had you suffered a reduction in yeild productivity :

( ) yes ( ) No

Question 23 : In the previous question, If the answer is (yes) , what are the reasons :

1) .....

2) .....

3) .....

Question 24 : Have you tried cultivating substitute crops, and why?

Yes	No
a) High productivity	a) Not desirable
b) Low production cost	b) High production cost
c) Higher price	c) Hard to market
d) Easy to market	d) consumes water
e) consume less irrigation water	e) Do not want to risk
f) Others (specify)	f) Others (specify) .....

Question 25 : What are the substitute crops that can be cultivated in your farm ?

1) .....

2) .....

3) .....

.Question 26 : If there are substitute crops with high economic return , easy to market locally and abroad, and consumes less irrigation water, will you try it in your farm ?

( ) Yes ( ) No

Question 27 : In the previous question, if the answer is No, Why ?

( ) Risk involve

( ) Not convinced

( ) Others (specify) .....

Question 28 : What are the main problems confroting you as a farmer?

(1) Shortages of irrigation water

(2) Bad quality of irrigation water

(3) Problems in Marketing

(4) High production cost

(5) Bad quality of soil

(6) Others (specify) .....

Question 29 : What do you suggest to solve these problems ?

1) .....

2) .....

3) .....

Annex (2)

Map of the Jordan Valley