

# National Master Plan for the Jordan River Valley

Kingdom of Jordan

Prepared By

Royal HaskoningDHV in partnership with:
MASAR Center Jordan. April, 2015.

For:
SIWI - Stockholm International Water Institute
GNF - Global Nature Fund &
EU - SWIMP

WEDO / EcoPeace NGO Master Plan (SWIM-JR) Project is supported by the European Union's Sustainable Water Integrated Management (SWIM) Program.

# National Master Plan for the Jordan River Valley

*"Protecting the Environment" means to change our global perception: to change from a culture (and policy) that enables and even encourages excess consumerism that creates more and more system-wide problems and consumes natural resources, to a culture (and policy) based on wise consumption and maximum efficiency, that will improve the quality of life of the consumers and not only the volume of consumption. This applies especially to the policy regarding the water resource in our region that must be managed in a sustainable manner for current and future generations.*

## TABLE OF CONTENTS

## LIST OF FIGURES

## LIST OF TABLES

## ACKNOWLEDGMENTS

We would like to thank the Jordan Valley Authority for the data that they provide and share, without which this study would not have been possible. In particular, we are indebted to his Excellency the Secretary General of the Jordan Valley Authority Engineer Sa'ed Abu Hammour for his continuous advice and support throughout the duration of this project. Our appreciation also extends to the Jordan Valley Authority Engineers Qais Owais, Fuad Ojeilat, Zainab Abu Zaid and to Dr. Khaleel Al Absi for their significant input.

In addition, we thank the Department of Statistics for their detailed surveys on population and cropping pattern in the Jordan Valley which were immensely helpful to this project.

We would also like to express our gratitude for the work of Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ) within Jordan‘s water sector. Their analyses of crop water requirements in the Jordan Valley have been invaluable for their attention to detail not just with regard to the technical aspects of water management but also with regard to the social, economic and environmental impacts of Jordan‘s actions within this domain.

Additionally, we would like to thank the following for their contribution to this project: Adnan Al Budeiri, Anwar Abu Hammour, and Nour Abu Laban.

Finally, our appreciation extends to the many individuals who attended the two stakeholders consulting meetings for their valuable input.

.

# PREFACE

The Jordan River, the river with the lowest elevation in the world, originates on the slopes of Jabal al-Sheikh (Mount Hermon) on the Syrian-Lebanese-Israeli border, flows southward through northern Israel to the Lake of Tiberias, and then divides Israel and the occupied West Bank on the west from the Kingdom of Jordan on the east before emptying into the Dead Sea at an elevation of about 400 meters below sea level.

The Lower Jordan River is the section of the Jordan River that flows between the Lake of Tiberias and the Dead Sea. As it flows out of Tiberias Lake, the Lower Jordan River intercepts with the Yarmouk River and next meanders for 200 km through the Jordan Valley down to the Dead Sea. The Lower Jordan River basin, the focus of this report, is shared by Jordan, Israel and Palestine and is renowned around the world for its remarkable geographic features, its ancient civilizations and its religious relevance. The environmental and ecological values of the basin have declined drastically during the last sixty years: its water has been diverted; its ecological systems crimpled and its natural absorption capacities have been pushed to the limits. Large flows of untreated wastewater and saline water are discharged directly into the basin and substantial parts of the basin are no longer accessible for the inhabitants who live there.

Water and Environment Development Organization under the umbrella of EcoPeace Middle East in partnership with the Stockholm International Water Institute (SIWI) and the Global Nature Fund (GNF) have assigned Royal HaskoningDHV and its partner MASAR in Jordan to develop this National Master Plan for the Jordan River Valley (JRV). The aim of the plan is to identify feasible interventions that will restore the valley‘s environmental and ecological values within a realistic financial and economic framework. This Master Plan has been developed with full support from the Jordan Valley Authority (JVA).The Master Plan will be used by EcoPeace and partners as an advocacy tool towards decision makers and the international community for the implementation of the proposed interventions.

An estimated 500,000 Jordanians live on the east bank of the Jordan River, half of which are registered original inhabitants, and the other half consisting of informal workers, often originating from Egypt and more recently from Syria. This Master Plan provides first a description of the current status of the valley in terms of its land use and its natural and cultural resources; next it describes the people living in the valley, including their socio-economic circumstances and the different economic sectors and related water demands; and it describes the current governance of the valley. Next, this Master Plan shows projected population and economic figures for the years 2025 and 2050 and related land and water requirements, and it identifies the major challenges to be addressed.

Next, it presents a prioritized list of interventions that aim at restoring the valley's water, environmental and ecological challenges within a realistic financial and economic framework, leading to a sustainable and economic prosperous region within a safe and politically stable environment, and a healthy and lively Jordan River. Finally it describes the organizational, financial and planning aspects related to these interventions.

This Master Plan has been developed in close co-operation with a number of important stakeholders in Jordan. During three separate workshops, these stakeholders have been consulted and participated in discussions to identify the major problems in the valley and to formulate and prioritize the appropriate interventions to address these problems.

## LIST OF ABBREVIATIONS

| | |
|---|---|
| CA | Current Accounts (WEAP) |
| DOA | Department of Agriculture (Jordan) |
| ds/m | Deci Siemens Per Meter |
| Dunum | Surface Area Unit equal to 0.1 ha |
| EX | Electrical Conductivity |
| EIA | Environmental Impact Assessment |
| ET | Evapotranspiration |
| EXACT-ME | Executive Action Team - Middle East |
| FMS | Frequent Maximum Salinity |
| FU | Farm Unit |
| EcoPeace | EcoPeace Middle East |
| GDP | Gross Domestic Product |
| GIZ | Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH |
| GLOWA | Global Change and the Hydrological Cycle |
| GoJ | Government of Jordan |
| ha | hectare |
| HEIA | High External Inputs Agriculture |
| IWA | Israeli Water Authority |
| IWRM | Integrated Water Resources Management |
| JAD | Junction Agricultural Demand (WEAP) |
| JD | Jordanian Dinar |
| JMD | Junction Municipal Demand (WEAP) |
| JNCW | Jordanian National Commission for Women |
| JR | Jordan River |
| JRV | Jordan River Valley |
| JVA | Jordan Valley Authority (Jordan) |
| JVWA | Jordan Valley Water Association (Israel) |
| JWC | Joint Water Committee |
| KAC | King Abdullah Canal (Jordan) |
| $Km^2$ | Square Kilometers |
| KTD | King Talal Dam |
| kWh | Kilowatt Hour |
| LEISA | Low External Input Sustainable Agriculture |
| LJR | Lower Jordan River |
| L/s | Liter Per Second |
| MCM | Million Cubic Meters |
| mg/L | Milligram Per Liter |
| MJD | Million Jordan Dinar |
| $m^3/s$ | Cubic Meter Per Second |
| MoA | Ministry of Agriculture |
| MoE | Ministry of Environment |
| MoMA | Ministry of Municipal Affairs |
| MoPIC | Ministry of Planning and International Cooperation |
| MoT | Ministry of Transport |
| MoTA | Ministry of Tourism and Antiquities |
| MoU | Memorandum of Understanding |
| MSL | Mean Sea Level |
| MWI | Ministry of Water and Irrigation |

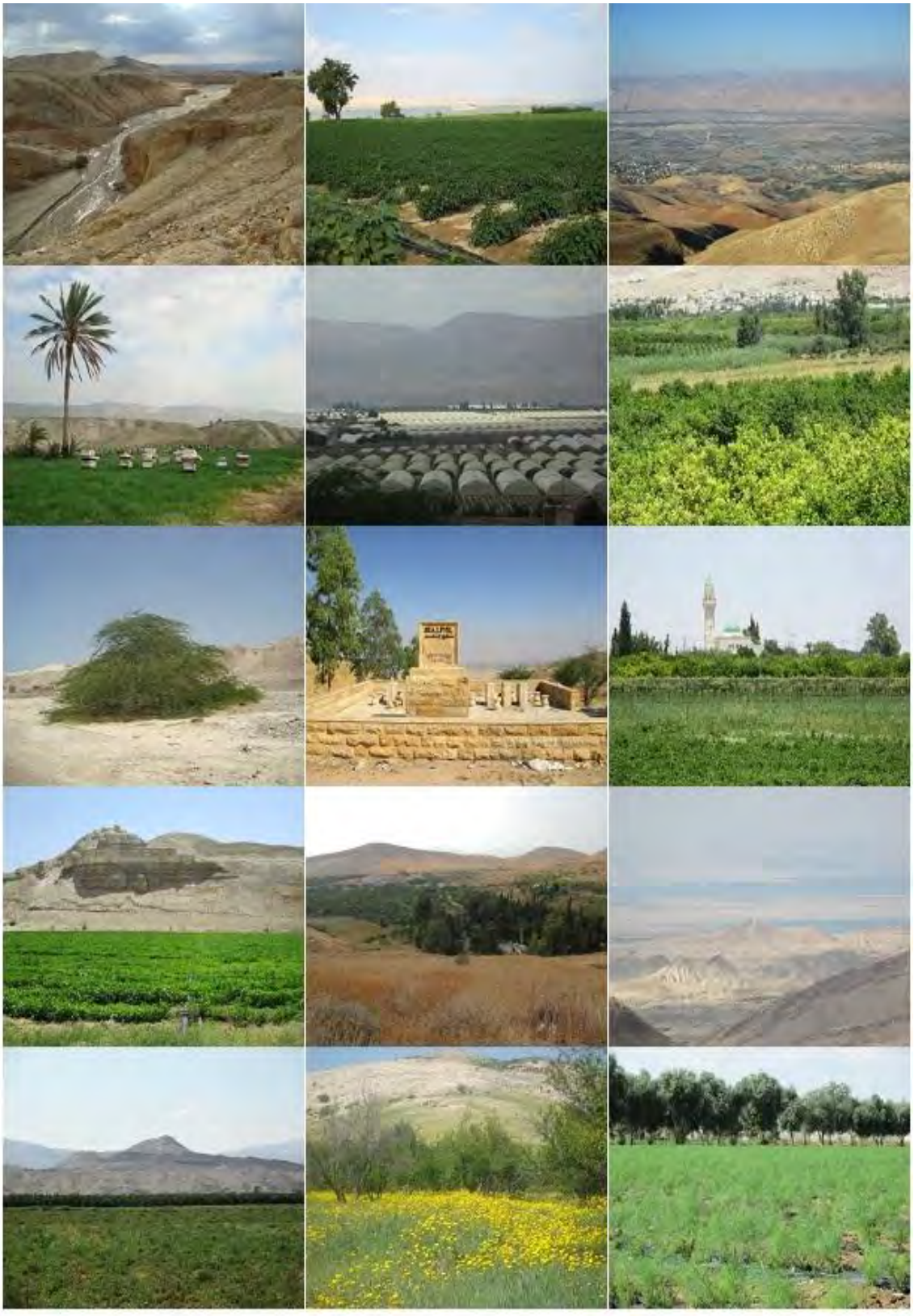
| | |
|---|---|
| NCARE | National Centre for Agricultural Research and Extension |
| NDVI | Normalized Difference Vegetation Index |
| NGO | Non Governmental Organization |
| NWC | National Water Carrier (Israel) |
| PH | Measure of the Acidity or Basicity of an Aqueous Solution |
| PMU | Performance Monitoring Unit |
| ppm | Parts Per Million |
| PPPY | Per Person Per Year |
| PS | Pumping Station |
| PSD | Public Security Department |
| RHDHV | Royal HaskoningDHV Group |
| RS | Reintroduced Scenario (WEAP) |
| RSCN | Royal Society for the Conservation of Nature |
| SWC | Saline Water Carrier (Israel) |
| SWM | Solid Waste Management |
| TDS | Total Dissolved Solids |
| Tell | Arabic word for Hill |
| UJR | Upper Jordan River |
| USD | United States Dollars |
| Wadi | Arabic Word for Valley |
| WAJ | Water Authority of Jordan |
| WEAP | Water Evaluation and Planning System |
| WEDO | Water and Environmental Development Organization |
| WSP | Wastewater Stabilization Pond |
| WUA | Water Users Association |
| WW | Wastewater |
| WWTP | Wastewater Treatment Plant |
| ZS | Zero Scenario (WEAP) |

## PHOTO CREDITS

Photograph mosaics in various themes of the Jordan River Valley are presented throughout the report.

Photographs of the Jordan River are taken by Samer Talozi and Banan Al Sheikh during 2009. Historical photographs of the Jordan River are provided by EcoPeace Middle East. Displayed themes are the historical Jordan River (pages 15 and 187) and the current Jordan River (pages 131 and 175).

Photographs from the Jordan River Valley are taken by Amelia Altz-Stamm, a Fulbright visiting scholar and researcher at the MASAR Center, during 2013 and 2014. The represented themes are: Landscapes (page 11), Water (page 36), Fruits & Vegetables (page 78), and People (page 119).



# 1 INTRODUCTION

## 1.1 This Master Plan

The Water and Environmental Development Organization (WEDO) / EcoPeace Middle East (EcoPeace) assigned Royal HaskoningDHV / DHV B.V. (RHDHV) on the 27th of August 2012 to develop a Master Plan for the Jordan River Valley (JRV). This Master Plan has been developed with full support from the Jordan Valley Authority (JVA). WEDO / EcoPeace will publish this final Master Plan and will use it as an advocacy tool with national stakeholders and the international community for the fully or partly adoption of the proposed interventions.

This Master Plan describes the current land and water related issues in the LJRV, and the projections in the basin for the years 2025 and 2050. It presents the major challenges in the basin towards creating sustainable development conditions, including environmental flows provided through its natural resources; a healthy eco-system; equitable sharing of water resources, and it presents a list of prioritized interventions that will restore the valley's environmental and ecological values within a realistic financial and economic framework.

An extensive baseline report of the trans-boundary Jordan River Valley has been prepared by the RHDHV in March 2014, which provides the base for this Master Plan.

## 1.2 The Consultants

RHDHV is the EcoPeace's main contractor for this study, and has established sub-contacts with MASAR Center from Jordan. RHDHV is one of the largest independent consultancy groups, employing currently around 6,300 employees world-wide. The firm is a merger between the DHV Group and the Royal Haskoning Group established on the 1st of July 2012. DHV was founded in 1917 and has gained a world-wide reputation from many projects in a wide range of sectors implemented in more than 70 countries, including river basin and water resources management. Royal HaskoningDHV is registered with the major Financial Institutions and International Agencies, and regularly carries out projects financed by them. See also www.royalhaskoningdhv.com.

MASAR has been established since 1994 as a regional non-government, not-for-profit organization focusing on youth activism issues. In 1999, MASAR together with Danish, Palestinian and Israeli colleagues launched Crossing Borders, a regional youth magazine, in English for young journalists. With the success launching of Crossing Borders, MASAR embarked on a number of projects in the fields of environment, democracy, education, peace and conflict resolution, human rights, gender, interfaith dialogue, youth employment and entrepreneurship. In addition, MASAR has also been engaged in providing consulting and expertise to local, regional and international beneficiaries on matters related to environment and education. Recently, MASAR was one of the pioneering Jordanian non-government organizations to respond to the psycho-social needs of the Syrian refugees by designing and implementing projects, in partnership with international NGOs. In 2013 and 2014, MASAR implemented two large-scale projects on Conflict Mitigation and Social Cohesion targeting Syrian refugees and host community in Jordan. More recently, MASAR is running the Transboundary Water Basin Management project, a Marie Curie Actions project under the European Seventh Framework Programme. See also www.masarcenter.org.

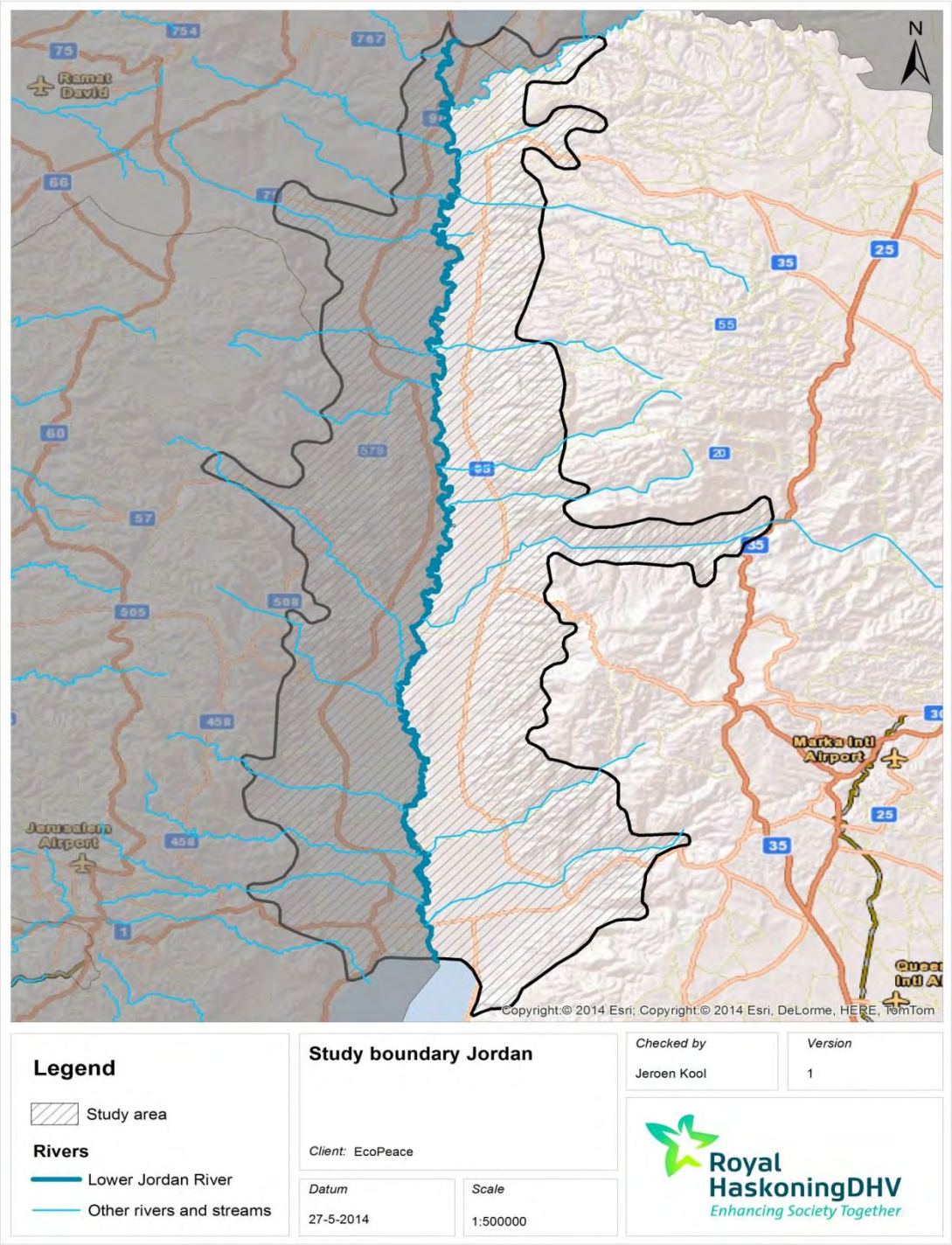



**Figure 1 – The Jordan River Valley**

## 1.3 The Project Team

This Master Plan has been prepared by an international team of renowned Jordanian and Dutch experts, who have dedicatedly worked together with the staff of EcoPeace to describe the baseline situation of the Jordan River Valley as presented in this report.

**Consultant's Team**

AL SHEIKH, Banan, environmental expert

BANYHANY, M.Sc. Lobna, agricultural and water expert

DE GROOT, Mark, pollution control expert

HARTVELD, Dr. Aard, sociologist

HUNTJENS, Dr. Patrick, governance expert

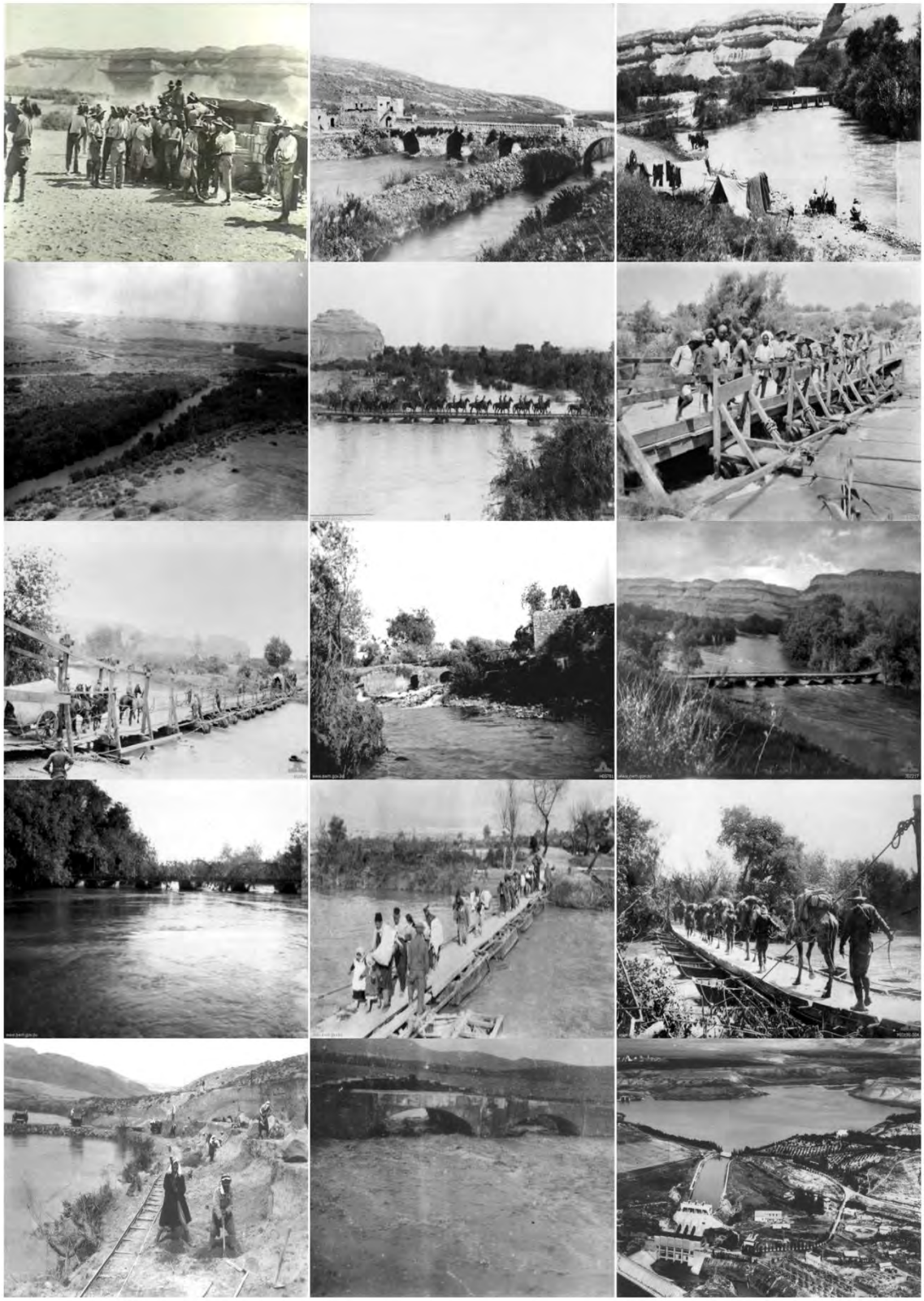
KOOL, Jeroen, project manager

KWAKKEL, Jeroen, information management support

TALOZI, Dr. Samer, water management expert and Jordanian team leader

**EcoPeace Staff**

| | | |
|---|---|---|
| Mr. Munqeth Mehyar | EcoPeace Amman | Director |
| Mrs. Yana Abu Taleb | EcoPeace Amman | Deputy Director |
| Mrs. Nancy Haddaden | EcoPeace Amman | Projects Manager |
| Mr. Eshak Alguza'a, | EcoPeace Amman | Assistant Projects Manager |



# 2 THE JORDAN RIVER VALLEY

## 2.1 Introduction

In March 2014, a Baseline Report has been prepared and published by EcoPeace Middle East on their website, describing the current situation in the Jordan River Valley (JRV), including the physical and environmental characteristics of the basin, the population living in the basin and their socio-economic status and the governance structures in the basin. This report concluded with the major challenges that the basin faces, both from national perspectives and in terms of trans-boundary challenges. This section here provides a summary of this baseline report.

## 2.2 The Jordan River Valley

The Jordan River Valley (JRV) forms part of the larger Jordan Rift Valley (Arabic: الغور Al Ghor). The internationally recognized World Heritage values of the valley are strongly related to its unique historic, religious, cultural, economic and environmental values, not at least due to its typical rift valley topography. The Lower Jordan River (LJR), the segment of the Jordan River (JR) that connects the Tiberias Lake with the Dead Sea, flows out of Tiberias Lake, intercepts with the Yarmouk River and next meanders for 200 km through the Jordan Valley down to the Dead Sea. About 247,000 registered Jordanians live on the eastern side of the river together with an estimated a quarter million foreign workers originating mainly from Egypt, Iraq and recently from Syria.

The rehabilitation of the river has been a central aim of EcoPeace work since its establishment in 1994. Through education and advocacy campaigns, major research and regional rehabilitation efforts, some real changes have already been made. For instance, new sewage treatment plants have been constructed or planned in Jordan, Israel and Palestine, which will enable treatment of polluted wastewater flowing currently into the river. Earlier research conducted for EcoPeace concludes that the Jordan River will require 400 - 600 MCM of fresh water per year to reach an acceptable rehabilitation level.

### 2.2.1 Land Use

The topographic nature of the area has the typical rift valley characteristic with drastic drop in elevations over short distances from the edges of the valley, and a more gently decline closer towards the Jordan River. Alongside the axe of the valley, the elevation drops from north to south. In the northern part of the JRV the drop is almost 375 m over a distance of 10 km. In the middle part of the valley this drop in elevation exceeds 500 m over a distance of 9 km. In the very south, this drop reduces to 100 m over a distance of 8 km. An overview of the topography of the JRV is provided in Figure 4 – Topography of the Jordan River Valley.

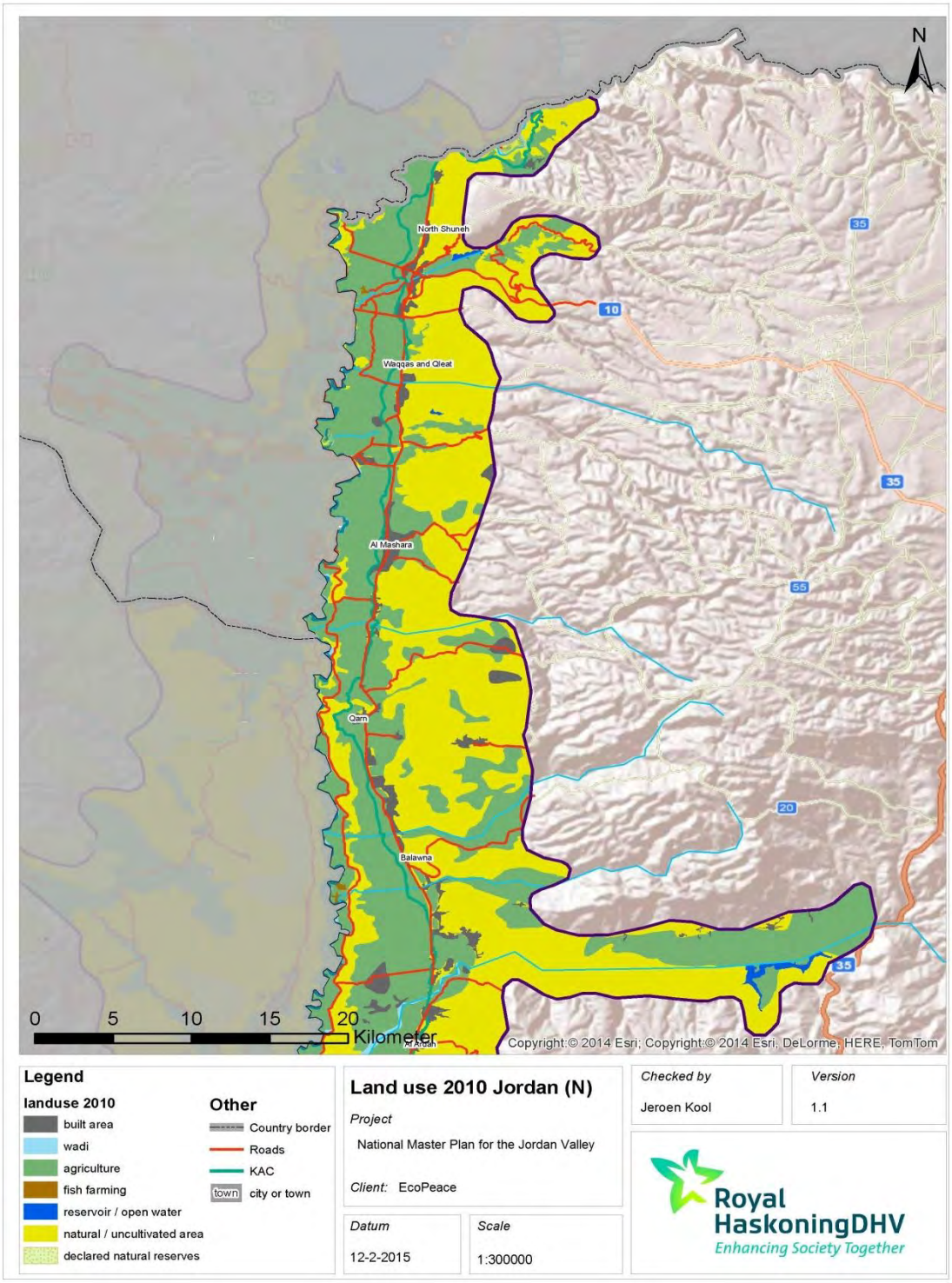



**Figure 2 – Land Use in the Jordan River Valley in 2010 – North Part**

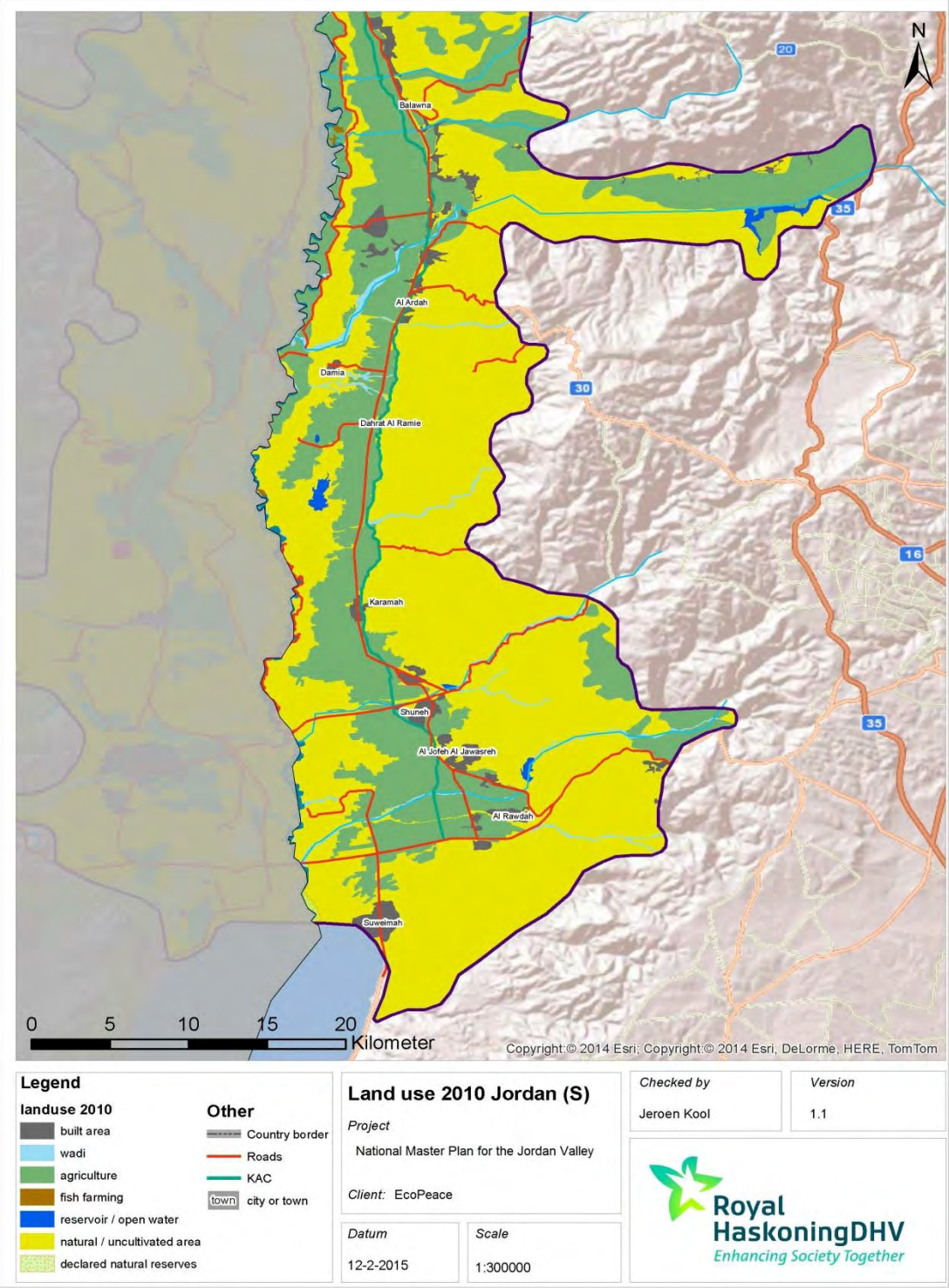



**Figure 3 – Land Use in the Jordan River Valley in 2010 – South Part**

The dominant soil types in the area are regosols, rendzinas and serozems, which are mainly tertiary deposits, and to a lesser extend lithosols, all of them are generally fertile. As a result, the majority of land in the area that can be provided with water is used for agriculture and horticulture.

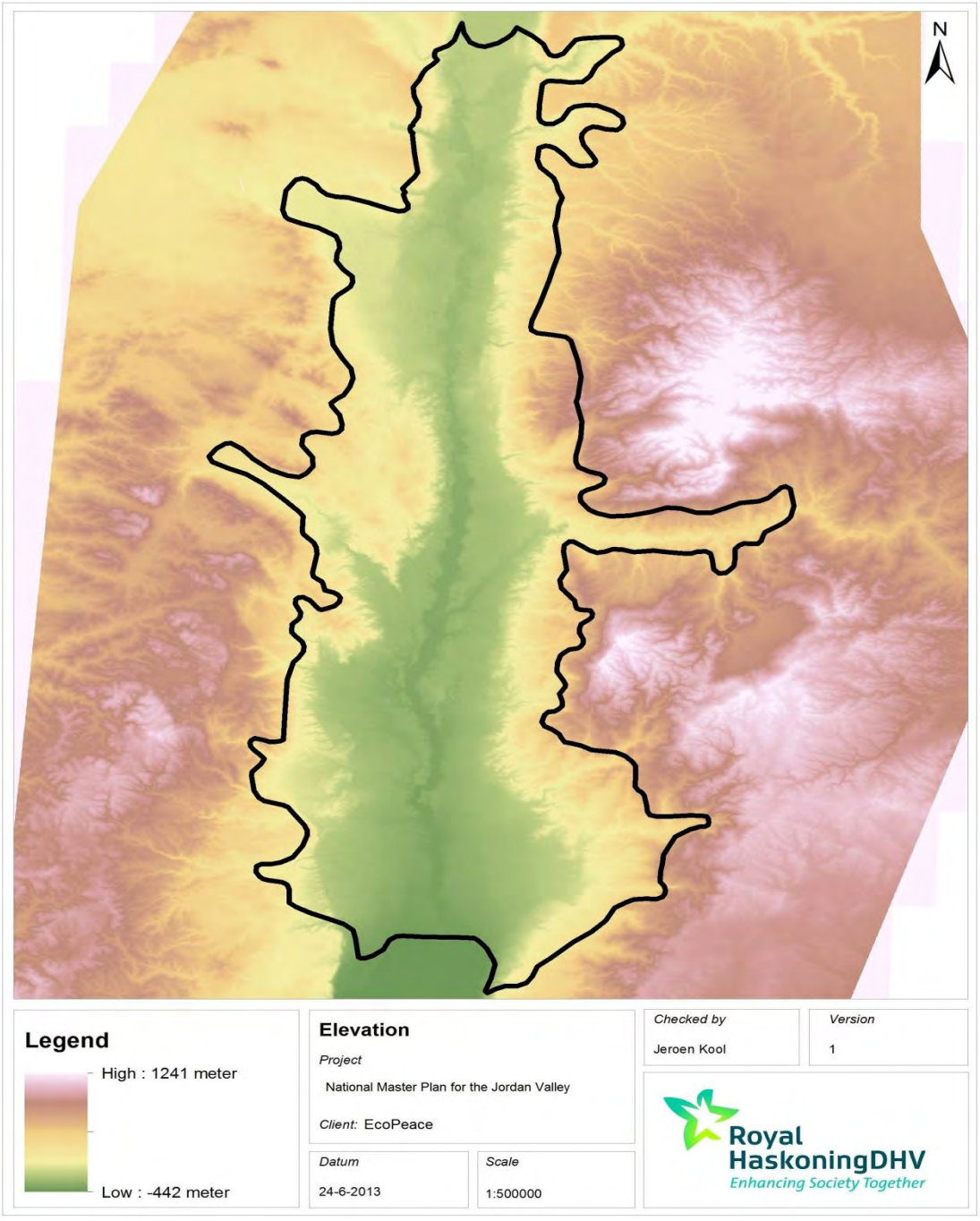



**Figure 4 – Topography of the Jordan River Valley**

The groundwater system in the Jordan River Valley consists of a shallow aquifer system from the Plio-Pleistocene ages, which overlays the upper sub-aquifer system of the Upper Cenomamian and Turonian ages and the deep confined aquifer of the Lower Cenomamian age. The groundwater in the JRV is subject to increasing salinity levels, particularly in the south. Earlier studies suggest that the salinity in the shallow aquifer is derived from adjacent aquifers and up coning of deep brines that flows through the Jordan Rift Fault system; and from contamination of agricultural return flows and sewage effluents. In addition, groundwater resources are particularly scarce and overexploited. An overview of the main groundwater aquifer systems in the region is given in the next figure.

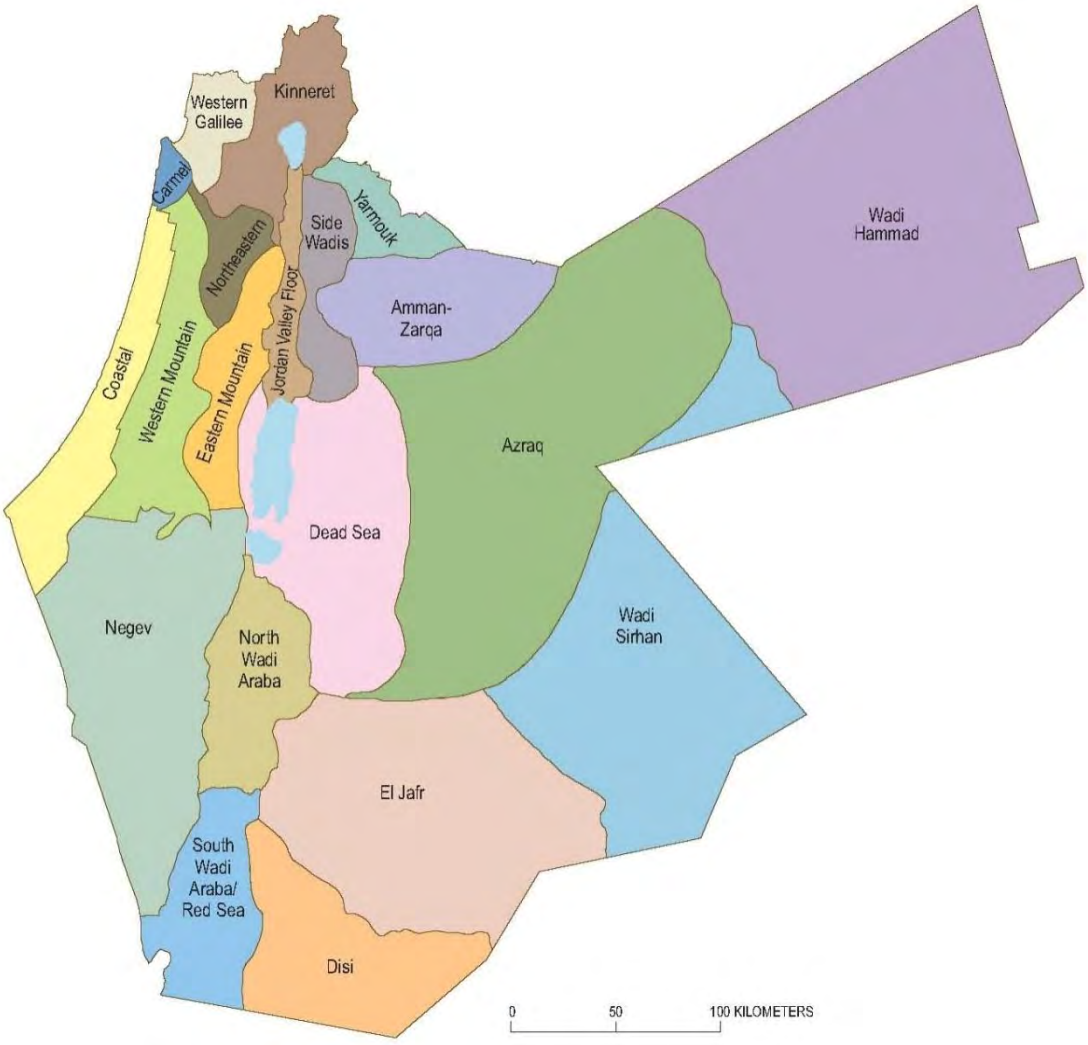



**Figure 5 – Groundwater Aquifer Systems in the Region [Ref: EXACT-ME]**

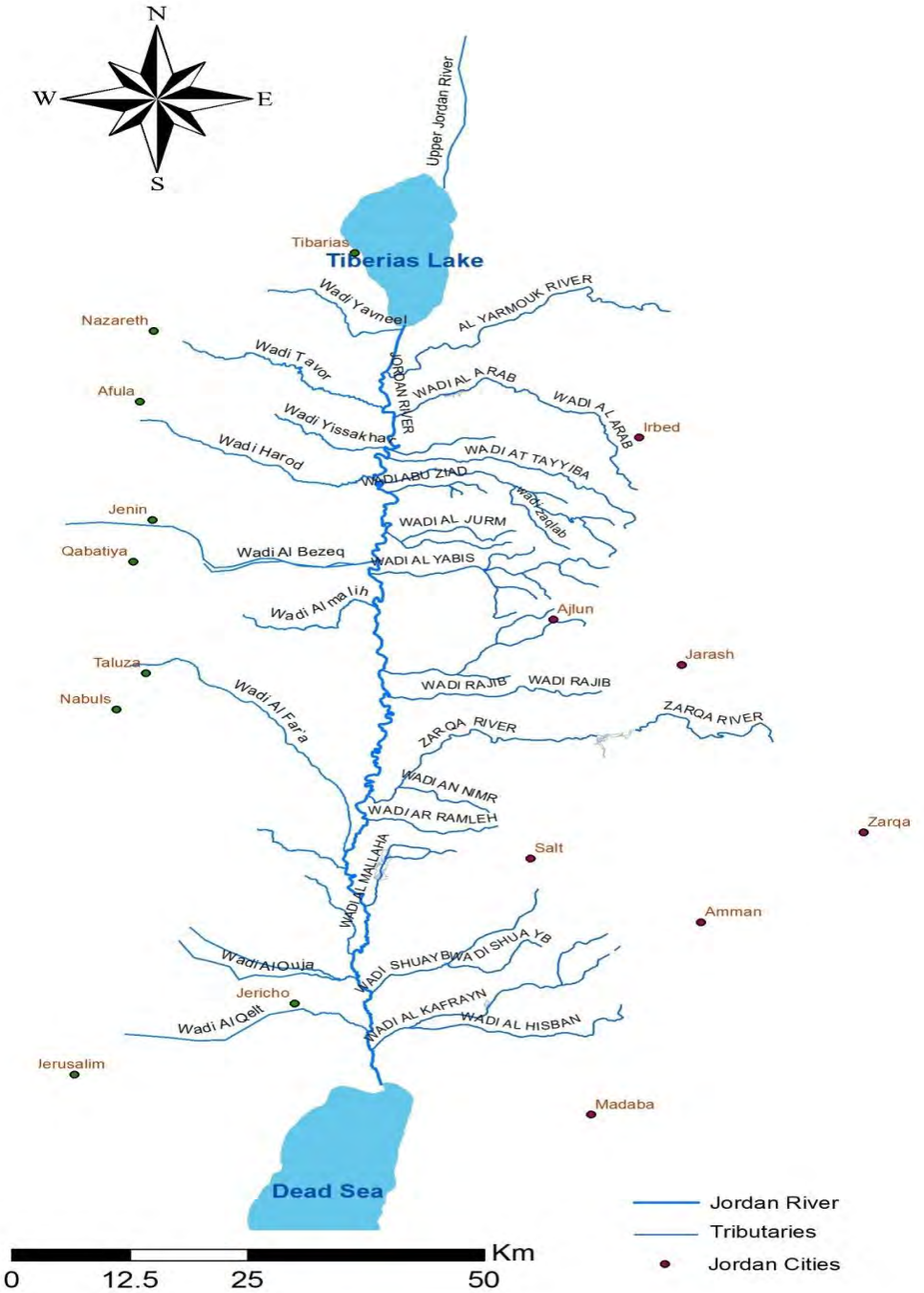



**Figure 6 – The Jordan River and its Tributaries**

The major water resources in the Jordan River Valley are the Jordan River, Lake of Tiberias and the Yarmouk River. The Lake of Tiberias is the largest fresh surface water reservoir in the region. The basin of the Upper Jordan River is the main water contributor to the Lower Jordan River. The basin of the Yarmouk is the second largest water contributor to the Lower Jordan River. It covers a total estimated area of 6,968

km$^2$ and is shared between Syria (77%), Jordan (22%) and Israel (1%). The catchment boundary is defined by the Jabal al Arab Mountains in the east and the Golan Heights in the west. Syria has built many dams in the Yarmouk River sub-basin, which is part of the wider Jordan River basin. The country historically uses about 450 MCM/yr of surface and groundwater resources in the basin, mainly for agricultural purposes. Israel is the largest user of water from the Jordan River basin, with an historical annual withdrawal of up to 640 MCM, of which 55 MCM goes to Jordan since 1995 as part of the Israeli Jordanian Peace Treaty. Jordan uses historically about 290 MCM/yr of water from the Jordan River basin, which together with 55MCM from Israel totals 347 MCM. Water diverted from the Yarmouk River to the King Abdullah Canal (KAC) is used for irrigating crops in the Jordan Valley and for domestic use in Amman. However, given the consecutive years of drought faced in the region and the impacts of climate change, the historical utilization rates of the past for all countries is a poor indication of present and future extraction rates.

South of the Yarmouk, the Jordan River Valley includes nine major Jordanian streams that enter the valley from the east. An overview of the estimated water inflow and outflow to the JRV is provided in the next tables. Notably, only an estimated 100 MCM flows annually from the Jordan River Basin into the Dead Sea area, either as surface water or as groundwater.

**Table 1 – Overview Water Resources[1] in the Jordan River Valley (2010)**

| **Jordan River Valley - Jordan** | **2010** (MCM/yr) |
|---|---|
| | |
| Tiberias Carrier Pipe | 49.00 |
| Purchased Water to Amman | 10.00 |
| Groundwater wells in JRV in Jordan | 26.74 |
| Yarmouk River | 17.23 |
| Mukheiba Well Field | 27.72 |
| Wadi Arab Dam | 13.60 |
| Wadi Ziglab Dam | 3.53 |
| Wadi Al Jurum | 2.40 |
| Wadi Abu Ziad | 0.35 |
| Wadi Yabis Diversion | 0.94 |
| Wadi Kufrinja | 2.53 |
| Wadi Rajib | 1.76 |
| Zarqa Carrier 1 / King Talal Dam | 52.95 |
| Zarqa Carrier 2 / King Talal Dam | 50.00 |
| Shouib Dam | 0.53 |
| Kafreen Dam | 8.50 |
| Wadi Hisban | 0.88 |
| **TOTAL (MCM / yr)** | **268.66** |

[1] This table does not include Wadis in Israel or Palestine.

### 2.2.2 Water

The Lower Jordan River itself plays nowadays a very modest role in the water circulation in the Jordan Valley. Most of the side Wadis do not discharge into the river anymore, and a substantial part of the water resources from the Upper Jordan River, including the Lake of Tiberias, has been diverted. Where the Jordan River had historically an annual flow of around 1,250 MCM, it contains today not more than 40 to 100 MCM per year, with its maximum base flow more of less at the confluence of Wadi Al Rayyan (Yabis).

**Figure 7 - The Jordan River**

The northern most section of the river is regulated in Israel by the Degania Dam at the exit of Tiberias Lake. South of the Yarmouk River, the river is fed by streams and channels, although most water resources of the Wadis in Jordan have been developed and diverted for agricultural or domestic purposes, and only undeveloped Wadis supplying winter flows and floods directly into the LJR. Seven dams were constructed since the 1960‘s with a total live storage capacity of 265 MCM, which diverts water mainly for agricultural purposes (Table 2). The average salinity, pH and total dissolved solid levels of the water flowing from these dams are presented (Table 3).

**Table 2 –Dams in the Jordan River Valley**

| Dam | Year of Construction | Wadi / River | Live Storage Capacity (MCM) | Purpose |
|---|---|---|---|---|
| Kafrein Dam | 1997 | Wadi Kafrein | 8.5 | Irrigation & Groundwater Recharge |
| Shueib Dam | 1969 | Wadi Shueib | 1.43 | Irrigation & Groundwater Recharge |
| Karamah Dam | 1997 | Wadi Malaha | 55 | Irrigation |
| King Talal Dam | 1977 / 1987 | Zarqa River | 75 | Irrigation & Hydropower |
| Ziglab Dam | 1967 | Wadi Ziglab | 3.9 | Irrigation |
| Arab Dam | 1986 | Wadi Arab | 16.8 | Irrigation, Drinking & Hydropower |
| Unity Dam | 2006 | Yarmouk River on border with Syria | 110.0 | Irrigation, Drinking & Hydropower |

**Table 3 – Water Quality Values of Relevant Dams in the Jordan River Valley**

| Name | EC ds/m | PH | TDS mg/L (ppm) |
|---|---|---|---|
| King Talal Dam | 2.07 | 8.41 | 1324.85 |
| Wadi Arab Exit | 1.07 | 8.34 | 686.18 |
| Shueib Dam Exit | 0.97 | 8.54 | 622.05 |
| Mukheibeh Exit | 1.39 | 8.13 | 888.29 |
| Kafrein Dam Exit | 0.97 | 8.92 | 621.1 |
| Unity Dam Exit | 2.13 | 7.98 | 1363.41 |
| Karama Dam Exit | 25.07 | 8.32 | 16044.06 |

Due to the dry climate and high evaporation rates in this lower part of the LJR basin, also effluents from agricultural and domestic water usage evaporates or infiltrates into the subsurface, before it reaches the LJR. Eventually, about 30 MCM of highly polluted water flows from the Lower Jordan River into the Dead Sea on an annual basis.

The current low flow levels and bad water quality of the Lower Jordan River have severe impacts on the area‘s unique ecosystem and to the approximate 500 million migratory birds that migrate through the Jordan basin twice a year. The Dead Sea, which relies on the Lower Jordan River as its primary water source, is reaching a critical point of irreversible damages.

**Figure 8 – The Arab Dam**

### 2.2.2.1 The King Abdullah Canal

The King Abdullah Canal (KAC), runs parallel to the Jordan River on the east side, was built in three phases between 1957 and 1966 and initially covered 70 km from the Yarmouk River to the Zarqa River. Following the completion of the King Talal Dam on the Zarqa River in 1977, the KAC was extended to a total length of 110 km to provide irrigation water to the southern parts of the Jordan Valley. The King Talal Dam was designed to store runoff from the Zarqa River. The dam was raised in 1987 to increase the annual storage capacity from 56 to 75 MCM and capture an estimated 50 MCM/yr from the Samra wastewater treatment plant (WWTP).

The KAC captures runoff from the Yarmouk River, the Mukheibeh wells and several side Wadis. These small Wadis are important for their floods, but have usually a low base flow. The Mukheibeh Wells, to the North of the valley, represent an annual flow of 25 MCM. This resource is of excellent quality, with a constant yield throughout the year. However, the production of these wells is decreasing, due to extensive depletion of surface water recharging the aquifer. In addition, the KAC receives discharge from the King Talal Dam, which is a mix of freshwater from the Zarqa River and effluent from the Samra WWTP which processes over 75% of Jordan‘s domestic wastewater. The capacity of KAC ranges between 20 $m^3$/sec at the intake, 630 MCM/yr, to 2.3 $m^3$/sec at its southern end.

The canal includes two main sections:

(1) **KAC North**, 65 km long is fed by, the Yarmouk River, the Mukheibeh Wells, the KAC conveyor (water supplied from Lake Tiberias under the Peace Treaty since June 1995), and the side Wadis whenever water is available, and provided that its quality is acceptable for domestic use. The KAC is controlled here by 37 cross regulators (check gates) consisting of radial gates with two weirs on each side.

(2) **KAC South**, 45 km long. KAC South is supplied by KAC North via a 12 $m^3$/s siphon connecting the two sections. KAC South provides water to farmers, as well as to the newly constructed Karama Dam which stores winter water. In the summer the King Talal Dam and the Karama Dam supply KAC South.

The canal plays a central role in Jordan's agricultural development as it supplies irrigation water via pumping stations to farmers in an area of 280,000 dunums. However, as domestic demand continues to rise, water from KAC is increasingly being pumped to the Greater Amman area over an elevation of 1,300 meters. Between 2002 and 2011, Amman received an average annual amount of 47 MCM from KAC. This transfer constitutes around one-third of water supplied to Amman and also corresponds to one third of the water diverted to KAC.

#### 2.2.2.2 Side Wadis

As outlined above, the hydrology of the Jordan River Valley is dominated by the side wadis, which historically flowed into the Lower Jordan River. This section provides some additional information.

Wadi Al Arab

Wadi Al Arab is located in the northern part of Jordan Valley about 10 km south of Lake Tiberias and 25 km west of the city of Irbid. The average annual rainfall in the Wadi Al Arab watershed is approximately 400 mm which occurs between October and April (60% of rainfall is confined to the period from December to February). The estimated precipitation per year is 7000 $m^3$ and the average discharge of the Wadi is around 28 MCM a year equally distributed between base and flood flows. The catchment area is agrarian and most population is concentrated in the city of Irbid. The months from June to September are considered dry and hot (31°C and 14°C are the mean monthly temperatures in the summer and winter respectively).

The Wadi Al Arab Dam reservoir was constructed in 1987, with a total capacity of 20 MCM. The principal features of the dam are summarized as follows: the reservoir catchment's area is 262 $km^2$ with gross, effective and dead storage capacity of 20.0, 16.9 and 3.1 MCM, respectively. Daily evaporation causes a decrease in the dam water level from 4.8 mm in January to 8.9 mm in July. Current sources of water in the dam are two; first, base and winter flow of the Wadi Al Arab; second, water pumped from the KAC. Due to the drilling of a number of wells by the Water Authority of Jordan (WAJ), summer base flow is reduced to a minimum or nil.

The Arab Dam is linked to the KAC by a dual system that allows water to flow in both directions. The KAC supplies the dam with water during the winter (this water originates from Lake Tiberias, Yarmouk River, and/or Mukheibeh Wells). In addition, winter and base flows from the Wadi Al Arab are stored in the Dam. This water stored in the dam in the winter is then returned back to the KAC during the summer. The reservoir water is used to irrigate about 12,500 dunums in the Northern Jordan Valley (namely around the area of North Shouneh and Al Baqura). It also serves as a drinking water source for the city of Amman in periods of water shortage through KAC.

Previously, treated waste water from the city of Irbid and surrounding communities was treated and stored in the Arab Dam. Currently, and because the dam is being used for drinking purposes, the treated waste water is diverted through a closed pipe into the Jordan River near the town of Hamamreh. The average daily flow rate of this treated waste water is estimated at 19,700 $m^3$/day (7500, 12000, and 2000 $m^3$/day from Foara, Dogara, and Shallala wastewater treatment plants respectively); a total of 7 MCM/year.

Wadi Taibeh and Wadi Abu Zeyad

These are two minor Wadis that are not dammed and are shown in the Google Earth map below. Rainfall on their watersheds ranges from 150 mm/year up to 550 mm/year, with potential evaporation rates ranging from 2100 mm/year to 2700 mm/year. The base flow of these valleys is used in irrigation along their courses and partly at the foothills of the Jordan Valley. Flood flows still reach the Lower Jordan River.

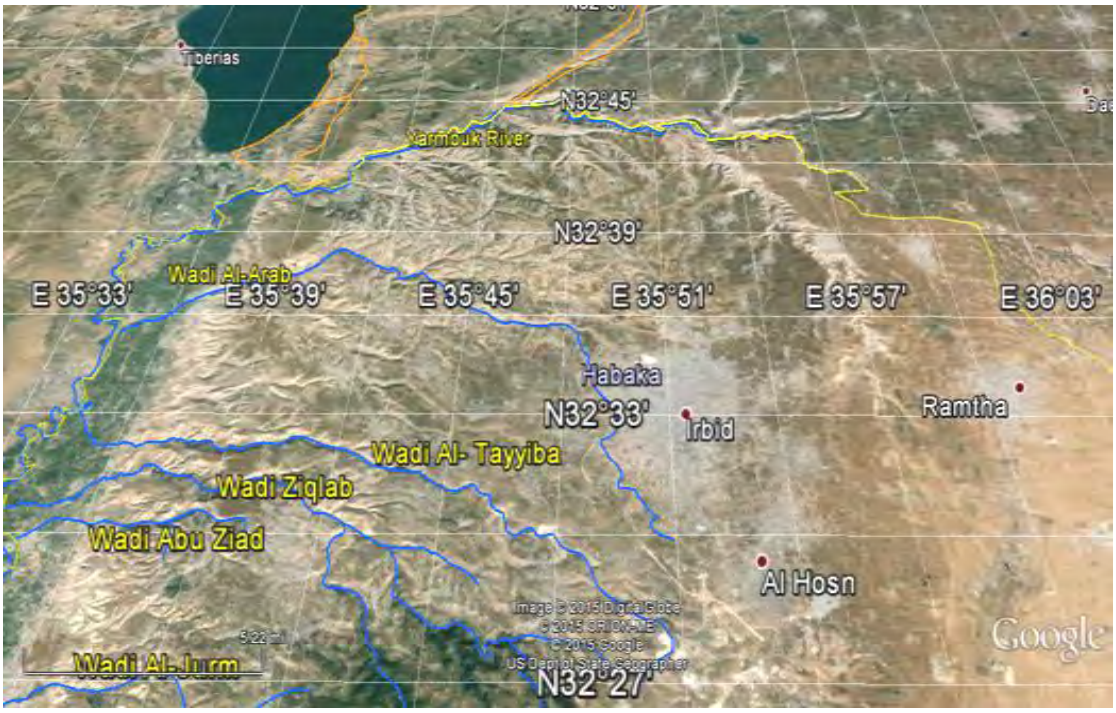



**Figure 9 - Several Wadis in the Northern Part of the Jordan River Valley**

Wadi Ziglab (also known as Sharhabeel)

The catchment area of Wadi Ziglab measures 106 km$^2$. Its eastern parts in the highlands receive an average amount of precipitation of 500 mm/year, whereas its western parts in the Jordan Valley receive only 300 mm/year. Various springs issue along Wadi Ziglab with a total producing the base flow of the valley. In addition Wadi Ziglab drains floodwater in the winter. A dam was constructed in Wadi Ziglab with a total capacity of 4.3 MCM in 1967, and it captures winter flow and floods. Currently, no water flows in the Wadi Ziglab during the summer. The Water Authority of Jordan (WAJ) drilled 7 new wells recently (2012-2013) which reduced springs summer flow drastically. Ziglab dam water is used for irrigation in the Northern Jordan valley area for units 33 – 39, 12,500 dunum. Ziglab dam also supplies water to KAC depending on availability.


**Figure 10 - Several Wadis in the Middle Part of the Jordan River Valley**

Wadi Jurm

Around 90% of the flow in this Wadi is used for drinking to the city of Irbid. The rest is diverted to KAC, but its contribution to the KAC is getting lower every year. Floods during winter still reach the Jordan River.

Wadi Rayyan (previously known as Wadi Yabis)

This Wadi is not dammed, the rainfall on its 124 $km^2$ watershed ranges from 150 mm/year up to 550 mm/year, with potential evaporation rates ranging from 2100 mm/year to 2700 mm/year. Base flow is used for irrigation on the sides. The Wadi is connected to KAC through a diversion weir. Currently, during the summer and because of irrigated agriculture on the sides, almost no flow reaches the Jordan Valley or Jordan River. In the winter, early season rains reach the Jordan River. This is allowed to clean the bed of the Wadi. After that, water is diverted to the KAC. Flood waters, however, reach the Jordan River.

Wadi Kufranja

Wadi Kufranja basin comprises an area of about 112 $km^2$. This basin is a typical rural and agricultural area. The topography and relief of this basin is rather complex. It changes rapidly from east to west towards the outlet of the basin. The mean annual rainfall ranges from about 600 mm to about 300 mm. Wadi Kufranja is not connected to KAC anymore (it used to be in the past) because its water now contains treated wastewater. It is used to irrigate areas 18, 19, 20, and 21.

Wadi Rajib

Wadi Rajib's total watershed area is 85 $km^2$. It receives its waters from a multitude of smaller tributaries and several natural springs, therefore the main Wadi never falls entirely dry, even though the discharge varies substantially between winter and summer. Wadi Rajib has reasonably good water quality for irrigation, but substantial pollution from household waste, livestock and agricultural production makes the water unsuitable for human consumption. There are also 13 major springs located within the watershed, most of them being used for either human or livestock water supply. Currently, during the summer and

because of irrigated agriculture on the sides of Wadi Rajib, almost no flow reaches the Jordan Valley or Jordan River. In the winter, early season rains reach the Jordan River. This is allowed to clean the bed of the Wadi. After that, water is diverted to the KAC.

Wadi Abu-Zeighan (the extension of Zarqa River downstream King Talal Dam)

The water that originates from the King Talal Dam (KTD) is used for irrigation in the Jordan Valley (82,000 dunums in the middle Jordan Valley). KTD water is a mixture of treated waste water and precipitation. It is transferred to the KAC, downstream of the point where fresh water in the KAC is pumped to Amman for drinking.

**Figure 11 - Mixing of KAC Water with KTD Water**

The reach of river downstream from KTD receives fresh (mainly in the winter) and saline water (throughout the year) from groundwater springs. At the village of Abu Zeighan, in the Jordan Valley, 350 m below sea level, ground water with a TDS content of 7000 is extracted from wells. At the Abu Zeighan Reverse Osmosis Plant 60,000 $m^3$/day of water is treated by oxidation, pre-filtration in pressurized sand filters and a two stage reverse osmosis plant with a recovery rate of 75 %. The treated water is conveyed to a storage tank from where it is pumped in several steps to Amman, about 800 m above sea level. The water is used as household drinking water and for irrigation.

Wadi Shueib

Wadi Shueib drains an area of approximately 180 $km^2$ lying to the west of Suweileh region at elevation of 1200 m down to below sea level. Precipitation over the catchment area partly falls in the form of snow in its eastern parts and ranges on averages from 500 mm/year in Suweileh and Salt Mountains to 150 mm/year in the Jordan Valley area. Wadi Shueib is located in the Salt Valley of Jordan, a tributary watershed of the Jordan River. The city of Salt sits at the headwaters, and during the summer months the municipal sewage of Salt makes up a large portion of the Shueib's flows.


**Figure 12 – Several wadis in the southern part of the Jordan River Valley**

In the catchment area different towns and villages, like Fuheis and Mahis, discharge their treated and untreated wastes along the wadi and its tributaries. A dam was constructed in Wadi Shueib in 1968 with a capacity of 2.3 MCM and with the aim of using its water for irrigation in the Jordan Valley. In addition to base and floods flows, this dam now receives irrigation return flows and the effluent of the city of Salt WWTP. Fresh spring water in Wadi Shueib has declined to comply with the increasing drinking water demand. The flow was replaced by the effluent of WWTPs, a process that changed the ecological balance over time. Shueib dam is not connected to KAC; it is used for local irrigation (2500 dunums) in its vicinity.

Wadi Kafrein

The watershed area for Wadi Kafrein is about 189 km$^2$. Kafrein Dam receives flood and base flow, irrigation return flows, treated and untreated wastewaters and groundwater discharged from artesian wells and springs. As the other Wadis, Wadi Kafrein does not show perennial flow evidence. Rainfall takes place only during the winter months. During and after the rainy events, floodwater drains down to the Jordan River. It is not connected to KAC; instead it used to irrigate the Hisban – Kafrein project area 31 & 32 (1,247 dunums).

Wadi Hisban

The catchment area of Wadi Hisban is about 81 km$^2$. The saline groundwater in the upper catchment of wadi Hisban is channeled to the Hisban-Kafrein irrigation area to prevent the salinization of the natural wadi path. Other approved extensions, such as the connection of the Hisban-Kafrein irrigation area to the KAC, a pilot plant producing 5 MCM/y of desalinated water was proposed in the Kafrein/ Hisban area, and recently studies were carried out to desalinate 30 MCM from Kafrein/Hisban for the urgent need in Amman. The Hisban project could be implemented by 2015. This project should deliver some 9–15 MCM/y.

### 2.2.2.3 Water Resources from a Historic Perspective

During the 1950s the Jordan River closely resembled its historic natural water balance, not yet much influenced by artificial human interception: about 605 million cubic meters (MCM) was discharged into the Jordan River through the Lake of Tiberias and 455 MCM originated from the Yarmouk River. Additional inflow came from the Yarmouk basin as well as from the Zarqa River basin, as well as from annual rain floods from the West Bank. The outflow of the Jordan River in 1950 into the Dead Sea was about 1285 MCM. This amount was about equal to the total evaporation from the surface of the Dead Sea, leading to an average a stable surface water table of the Dead Sea.

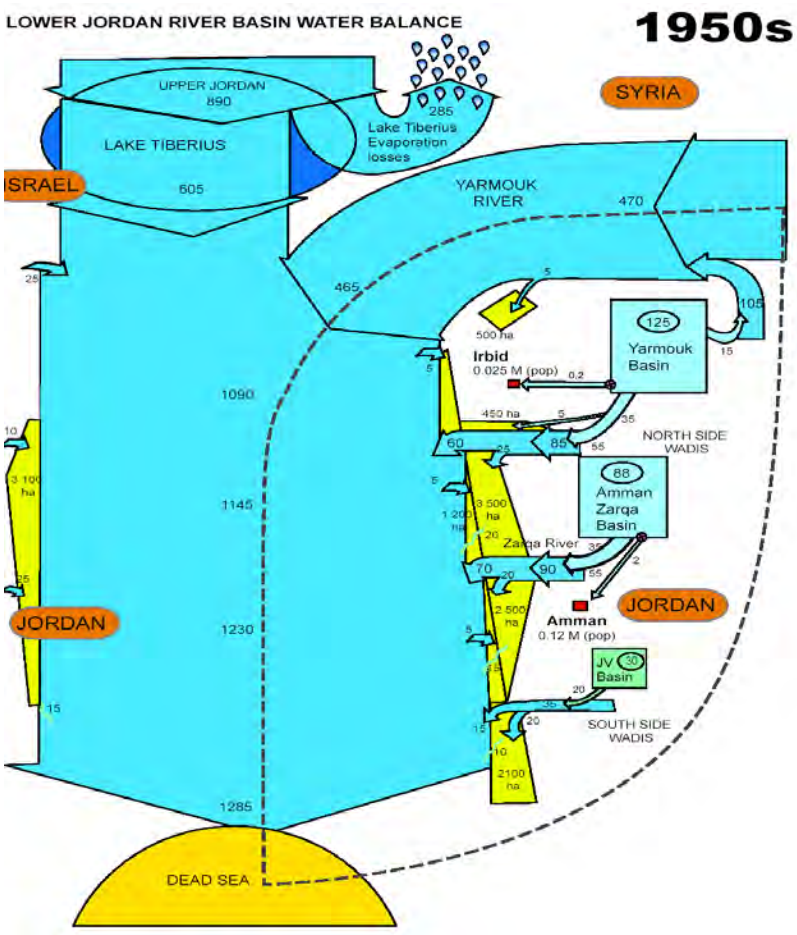



**Figure 13 – Approximate Water Flows in the Jordan River Valley in the 1950s**

By the year 2000 the water balance had changed drastically and substantial flows were meanwhile diverted by the riparian countries of the Jordan River Basin:

1. About 100 MCM per year was diverted by Israel from the Upper Jordan river system, which reduced the inflow into the Lake of Tiberias
2. About 440 MCM per year was diverted by Israel from the southern mouth of Lake Tiberias, at the Degania Dam, to feed to Israeli National Water Carrier (NWC)
3. About 155 MCM per year is withdrawn by Jordan from the Yarmouk River to feed the Amman, the Zarqa Region and for irrigation in the Jordan Valley.

4. Brackish water from springs north and west of Tiberias Lake was diverted through the Salt Water Carrier to the Alumot Dam, from which it flows into the Jordan River.

The Yarmouk River Basin is shared by Syria and Jordan, and it is heavily exploited on both sides of the border. The sharing of the waters of the Yarmouk River between the two countries is governed by the 1987 treaty that set up a Jordanian-Syrian Yarmouk River Basin Higher Committee, and included plans for the development of the Unity Dam, or Wihdeh Dam along the border. The construction of the dam was completed in 2006. According to the treaty, the downstream Syrian farmers are entitled to use 6 MCM per year from the Dam's reservoir, but the actual Syrian consumption is probably substantially higher.

By the year 2000, the Lower Jordan River had become a well defended international border between Jordan and Israel / West Bank, with very limited public accessibility, military zones and various mines fields along its shorelines. The reduction in the flow regime caused changes in the morphology of the river as well, since lower flows lead to reduction of meanders and thus shortening of the stream length and steeper gradient, as well as a dramatic decline of the Dead Sea.

The flow rates in the Lower Jordan River have decreased sharply in the last 50 years due to the construction of a series of infrastructure and diversion scheme established in the basin. For instance, the mean annual historic flow of the Yarmouk that was estimated at 450-500 MCM in the 1950s has today decreased to 83-99 MCM. The current annual discharge of the Lower Jordan River into the Dead Sea is estimated at 30 - 100 MCM compared to the historic 1,300 MCM.

The quality of water in the Lower Jordan River has severely deteriorated in recent decades. While the headwaters upstream of the Alumot Dam are unaffected, the lower sections of the river consist primarily of untreated sewage and agricultural return flows, groundwater seepage, as well as brackish water from springs diverted into the river away from Tiberias Lake.

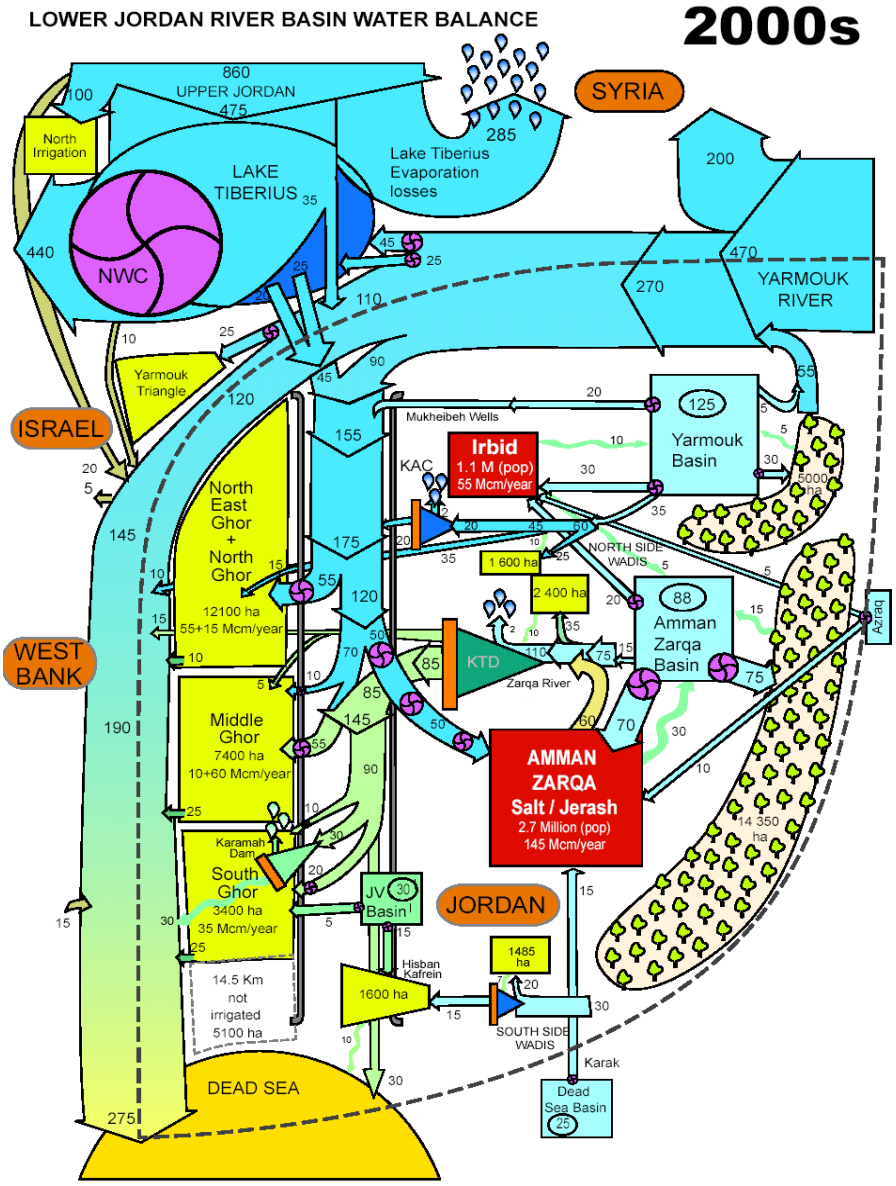



**Figure 14 – Approximate Water Flows in the Jordan River Valley in the 2000s**

### 2.2.3 Climate Change

Climatically, the Jordan River Valley is characterized by hot dry summers and mild wet winters, becoming progressively drier moving southward through the valley towards the Dead Sea. Climate change impacts are likely to intensify the water supply related problems in the JRV. Analysis of the impacts of climate change has been made for the wider Middle East Region by GLOWA (2008). According to their study, the climate in Jordan in the JRV was classified for the period 1901-1915 as type 11 for the northern part and type 8 for the southern part. Analysis for the period from 1989-2003 showed that the entire JRV has shifted from climate types 8 and 11 to type 9. The climatic characteristic for each of these classification types is shown below.

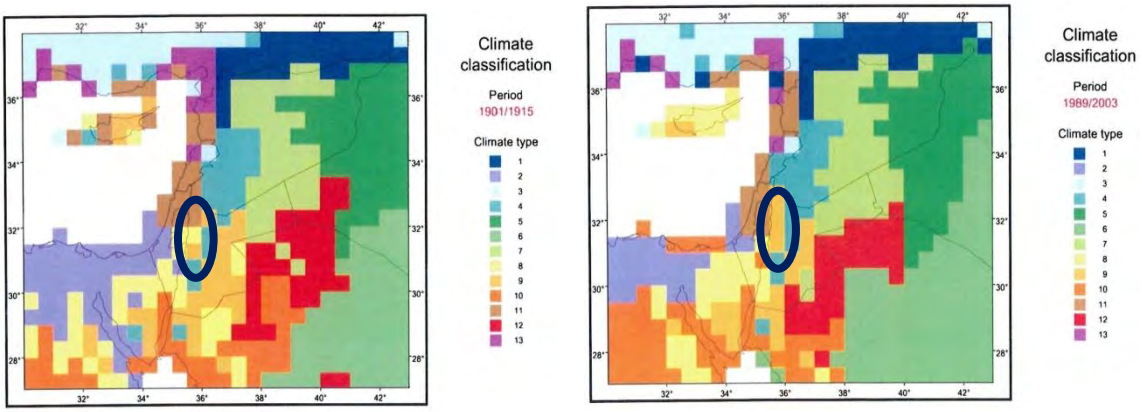



**Figure 15 – GLOWA Classification Clusters of Climate Change; Left for the period 1901-1915 and Right for the period 1989-2003.**

**Table 4 – Climate Characteristics Relevant for the Jordan River Valley**

| GLOWA Climatic Classification | Type 11 | Type 9 | Type 8 |
|---|---|---|---|
| **Corresponding Area of JRV within Jordan** | **North JRV 1901-1915** | **Entire JRV 1989-2003** | **South JRV 1901-1915** |
| | **Climatic Characteristics** | | |
| Annual Precipitation | > 600 mm | 70 - 100 mm | < 70 mm |
| Summer Precipitation | < 10 mm | 10-30 mm | < 10 mm |
| Winter Precipitation | > 300 mm | < 30 mm | < 30 mm |

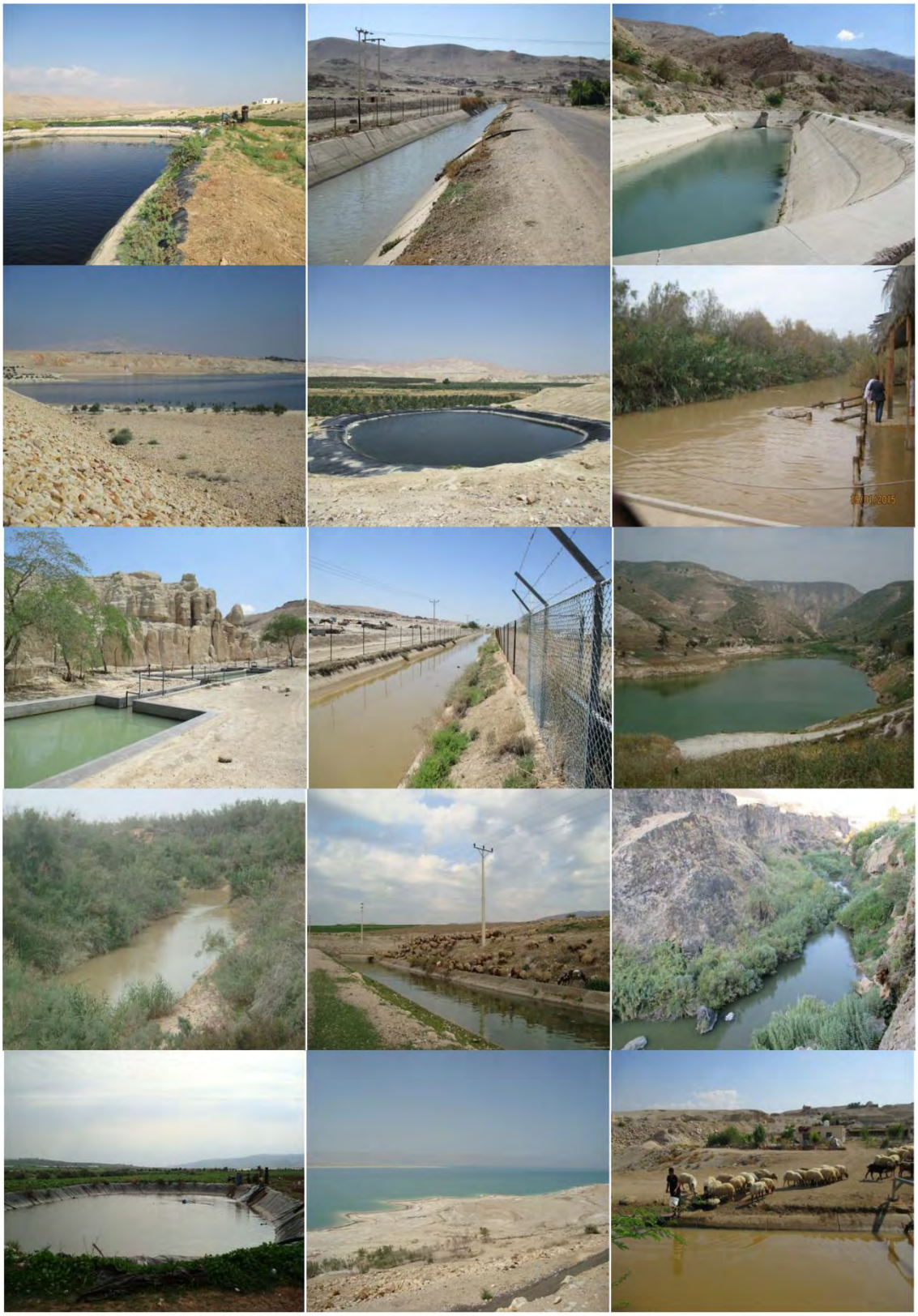
*Source: GLOWA, 2008.*

The northern part of the JRV in Jordan will be impacted most negatively by climate change, with a foreseen substantial reduction of annual and winter rainfall, although the summer rainfall will increase slightly. The southern part of the JRV in Jordan will see a slight improvement of rainfall conditions, both annually and during the summer. Overall, these impacts include a foreseen reduction in local annual water resources with a maximum of 20% by 2050 and increasing temperatures and related surface water evaporation rates. A summary of the related impacts is provided below.

**Table 5 – Climate Change related Impacts to the Jordan River Valley**

| LJRV Regions | Annual Precipitation | Summer Precipitation | Winter Precipitation |
|---|---|---|---|
| LJRV (North) | Substantial reduction of annual rainfall in the coming decades from historically more than 600 mm to less than 100 mm | Slight increase of summer rainfall from less than 10 mm historically to maximum 30 mm | Substantial reduction of winter rainfall in the coming decades from historically more than 300 mm to about less than 30 mm |
| LJRV (South) | Slightly increase of annual rainfall from historically less than 70 mm to about 70 – 100 mm | Slightly increase of summer rainfall from less than 10 mm historically to maximum 30 mm | No change in winter rainfall, which remains to be less than 30-70 mm |

*Source: GLOWA, 2008.*



## 2.2.4 Ecosystems

### 2.2.4.1 Flora

The Jordan River and its tributaries flowing east west on its east bank are considered biologically very important. As in the case of the Dead Sea, many endemic forms have evolved over the millennium to create many special habitats and communities. In dry and arid areas, wetlands become important ecosystems for the survival of species thus creating the chance for diversity of species and habitat.

The Jordan River Valley extends from the Yarmouk River in the north to the northern shore of the Dead Sea. This area is divided from north to the south into three bio-geographical zones with extensive plant diversity. These are:

1. *Mediterranean non forest vegetation zone.* This biozone extends from Jordan – Yarmouk River until Sheikh Hussein bridge (Deir Alla area). The most common species are Pistacia atlantica, Rhamnus palaestinus, Ceratonia siliqua, Ziziphus lotus, Teucrium polium, Ononis natrix, Ballota undulate, Capparis spinosa, Varthemia iphionoides, Asphodelus eastivus, Urginea maritime, Asparagus aphylla, Eryngium glomeratum, Echinops sp., Dactylis glomerata, Hordium bulbosum and Poa bulbosa. This area has scattered trees of Pistacia atlantica, Phoenix dactylifera and shrubs.

2. *Irano- Turanean Vegetation zone.* It extends from Sheikh Hussein bridge (Deir Alla area) to Damya bridge in the south along the Jordan River and along the descending slopes as the transition after the Mediterranean regions at the higher altitudes. These slopes (hills) are dry and the soil is highly poor and degraded, due to erosion and grazing. The dominant plant species are mostly bushy types such as Zygophyllum dumosum, Anabasis articulate, Astragalus spinosus and Noaea mucromata. In the shallow wadi systems and run off places small shrubs of the rare plant Rhus tripartite will be observed in addition to Ochradenus baccatus. The area includes Al Karamah Dam. The common features of this vegetation are the presence of shrubs and dwarf shrubs without trees. The dominated species are Retama raetam, Ziziphus lotus, Ziziphus spina-christi and Ferula communis. It has to be mentioned that there is lots of Acacia arabica and Prosopis juliflora on both sides of the main street.

3. *Tropical vegetation or Sudanian Afro Subtropical Zone.* This extends from Damya bridge to Aqaba in the south through the Dead Sea and Wadi Araba. It includes stations of Al Kafrain Dam and Sweimeh (close to the Dead Sea). It is characterized by warm winter and very hot summer. The leading species are: Ziziphus spina-christi, Calatropis procera, Balanites aegyptiaca**,** Acacia sp., Tamarix sp., Ochradenus baccatus, Forsskaolea tenacissima and others.

**Figure 16 – Vegetation in the Jordan River Valley**

A study on the flora of the JRV was published in 2010 by EcoPeace, which covered five stations along the Lower Jordan River from Al Majamea` bridge in the north to the King Abdullah Bridge in the south. These five stations are considered aquatic habitat. The study covered an additional four stations from North Shouneh to Wadi Arab Dam in the north until the area of Sweimah close to the Dead Sea in the south.

The figure below shows the Normalized Difference Vegetation Index (NDVI) for the Lower Jordan River Valley. This index was calculated, for the purposes of this study, on the basis of satellite images, wherein the green(er) parts represent high(er) vegetation densities, or higher concentrations of natural photosynthesis processes.

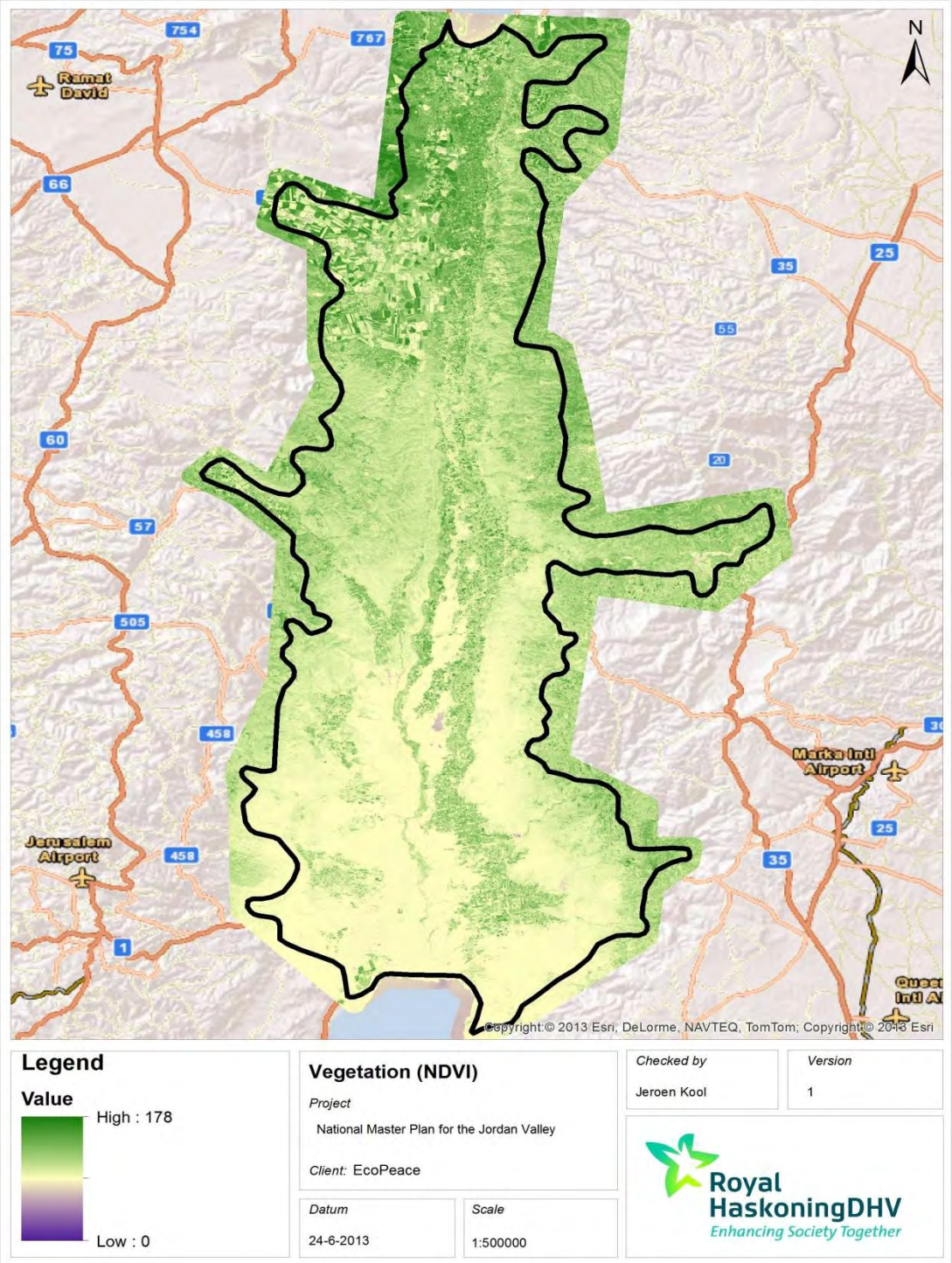



**Figure 17 – The Calculated NDVI Vegetation Index for the Jordan River Valley**

#### 2.2.4.2 Fauna

In terms of fauna, the Jordan River Valley is dominated by the presence of agriculture. Despite these agricultural activities there are small depression and wadis that have the potential to act as safe corridors for fauna and wildlife. About 29 bats species were recorded in the Lower Jordan River and Dead Sea basins and its surrounding areas. In addition, 40-50 aquatic invertebrates, 24 mammals, 3 amphibian, 150 birds, 21 reptile and 3 fish species have been recorded in the same area. Former Israeli military bunkers in the Jordan Valley have been reconstructed into bat roosts to support their habitat. Many vertebrates inhabit the eastern lower Jordan River basin as well, such as the hyenas, rock hyrax, and the jungle cat, Egyptian mongoose, caracal and other globally and regionally endangered species.

In terms of birds, the valley is important for both resident birds species and for the safe stop-over of huge numbers of birds which fly annually along the rift valley between Africa & Northeast Europe. The LJR lies on a globally important migratory route for birds. It is estimated that about 1/2 billion birds migrate annually through this narrow corridor, thus making the basin an important migratory route of global avifauna, such as the black and white stork, Dalmatian and common pelican, kingfisher, herons, shovlers, sandpipers, shanks, francolin and other globally threatened water fowl.

**Figure 18 - European Beater: Common Migrant to the Jordan River Valley**

A rich variety of breeding birds of unusual mixed bio-geographical origin pass by the valley. At least nine raptors breed here, including Circaetus gallicus, Buteo rufinus, Hieraaetus fasciatus and Falco pelegrinoides, and other proven or probable breeding species include Alectoris chukar, Charadrius alexandrinus, Vanellus spinosus, Apus affinis, Halcyon smyrnensis, Coracias garrulus, Melanocorypha calandra, Cercomela melanura, Oenanthe lugens, Corvus rhipidurus, Petronia petronia, Rhodopechys obsoleta, R. githaginea and Emberiza striolata. There is a strong raptor migration in April, especially of Accipiter brevipes, Buteo buteo, Falco tinnunculus and Emberiza caesia occurs on passage and Lullula arborea is a winter visitor in small numbers. Ciconia ciconia and Ciconia negra is said to favor the Rift valley for resting while on autumn passage. Due to the richness of surface water in the valley and its location, the area is on one of the globe's most significant migratory flyways. However, not all the wadis host high levels of avifauna as a result of excessive farming, hunting and constant disturbance to wildlife.

The key bird areas along the eastern side of the Jordan River Valley are the Yarmouk River and the Jordan River. The Yarmouk water body, with its dense concentration of vegetation, such as Salix sp., Phragmitis australis, Typha angusta and other hydro-phitic plants, attracts many local and migrant water fowl to breed and roost in the area. The main importance of the Yarmouk Basin is the recorded existence of the Brown Fish Owl (Ketupa zeylonesis), a globally threatened species and the vulture Gyps fulvus. Many other important waterfowl inhabit the Yarmouk Basin all year round. The Jordan River and its attributes are also important to Jordanian birdlife due the richness of the river in aquatic life.

The Yarmouk and Jordan Rivers are also important for hosting many mammals in the vicinities of their river banks. Many carnivores and other mammalian species have managed to survive because access to the area has been limited due to military restrictions. However, the presence and status a number of species in the Jordan River is unclear and needs further research. It is possible, after thorough research, that some of the species could be reintroduced if conditions are appropriate.

The availability of suitable water bodies in the LJRB represents also the main limiting factor of amphibian distribution. The distribution of some amphibian species, namely Pelobates syriacus and Triturus vittatus is limited only to this region and the current occurrence of these species is questionable. P.syriacus has not been reported since 1973 and the occurrence of T. vittatus needs confirmation as well. Remaining three amphibian species are representatives of three amphibian families (Table below).

**Table 6 - Main Amphibians in the Jordan River Valley**

| Status | Common Name | Scientific Name of Species |
|---|---|---|
| Common | Green or Chageable toad | *Bufo viridis* |
| Endangered | Savigny's Tree Frog | *Hyla savignyi* |
| Endangered | Levantine Frog | *Rana bedriagae* |

A total of 12-13 native freshwater fish species belonging to ten Families were recorded in the Lower Jordan River. The fish fauna distribution of Cyprinidae has the highest diversity with 8 species. Locally extinct species that were successfully reintroduced to Jordan are Anguillidae, Blennidae, Clariidae, Mugilidae, Cichlidae, Balitoridae and Cyprinodontidae and finally Acanthuridae, which is represented by two species.

### 2.2.4.3 Fresh Water Ecosystems

Jordan lies on the major migrating route of north Palearctic waterfowl. Although in the past few years the majority of migrating waterfowl has shifted from Azraq area to the Jordan Valley, due to the dryness of Azraq oasis caused by over extraction of groundwater, migrating waterfowl nowadays disperse to different water bodies all over the Jordan Valley which gives it a crucial importance.

The hydrofaunal diversity of the above mentioned wetland areas are not thoroughly surveyed yet, certain floral and faunal key species are known up-to-date. Floral species such as *Phragmites australis*., *Juncus maritimus*. and *Nerium oleandor*, and faunal wetland species such as *Rana Bedriagae*, *Hyla savignyi*, *lutra lutra. Tilapia spp.*, *Natrix tessellata*, *Barbus spp*., *Aphanius spp.*, *Gara rufa*, *Claris lazera* and many reptiles are known to inhabit these areas.

Jordan's River wetlands vary from salt marshes to fresh water ecotypes to estuaries and permanent small water bodies to man-made water reservoirs and sewage treatment plants. Any water body in such a semi-

arid area is of significant importance for the survival of migrating waterfowl. However, all water bodies in Jordan are looked upon as a source of exploitation for urban, agricultural or industrial use. Many water bodies are affected by increasing salinity, pollution and eutrophication due to intensive agricultural practices. Many aquatic species are at the edge of extinction if not already so.

The typical aquatic flora in the study are is Populus euphratica, Salix sp, Typha domengenensis, Phragmitis australis, Pluchea dioscoridis , Tamarix sp. and Ranunculus sp.

#### 2.2.4.4 Natural Reserves and Important Biodiversity Areas

The following nature sites have been allocated as ecological protection sites by the Jordanian authorities (Figure 19). As shown, none of these sites are located in the JRV.

The part of the Yarmouk River valley, where it borders with Israel, has been left largely undisturbed due to its strategic political location. As a result of this it supports a wide variety of plant and animal communities typical of intact and unpolluted river systems. It is proposed to allocate this area as a dedicated protection site (around 30 $Km^2$), because the area includes important woodlands of deciduous oak trees, the largest of the oak tree species found in Jordan, Salix sp. and a Ranunculus water sp. It also supports many rare animals, including the locally endangered and globally near-threatened river Eurasian otter *Lutra lutra*, the globally threatened mountain gazelle *Gazella gazella* and one species of fish found only in the Yarmouk / Jordan catchment. The area is also very important for birds, especially birds of prey like Griffon vultures *Gyps fulvus*.

The main threats are water extraction, sewage pollution, uncontrolled agriculture, grazing and increasing visitor pressure. In the flat and open plain of the Yarmouk basin that borders the Jordan River, tamarisk thickets and reed beds can be found along the river. Scattered poplar and eucalyptus trees attract several species of Herons. Other birds of this site include the breeding Marbled Teal (max. 5 pairs), Black Francolin, Pied Kingfisher and Clamorous Reed Warbler. Cattle Egret, Masked Shrike and Indian Silver bill (Introduced) are usually present in neighboring farms. Pygmy Cormorant and Egyptian Vulture are non-breeding residents, while Corncrake, Bittern, White and Black Storks, Honey Buzzard, Levant Sparrow hawk, Great Snipe and Syrian Serin have been recorded here as migrants or winter visitors.

The second proposed site is located in the southern part of the LJRV, including Wadi Al-Kharar (Baptism site), next to the northern shores of the Dead Sea (c. 390 m below sea-level). This area show silt plains adjacent to the river, which are subject to occasional flooding. The water level of the river has become very low in recent years due to over pumping for agriculture and the water itself has become rather saline. Tamarix thickets, reeds and other subtropical vegetation dominate the area along the river, both in side wadis and on the northern edge of the Dead Sea. Breeding birds include Sand Partridge, Black Francolin, Little Bittern, Cream-coloured Cursor, Blue-checked Bee-eater, Smyrna Kingfisher, Arabian Babbler, Spanish and Dead Sea Sparrows. Other non-breeding residents or visitors include Marsh Harrier, Egyptian Vulture and Cattle Egret, while the White Stork and Corncrake have been recorded as spring migrants.

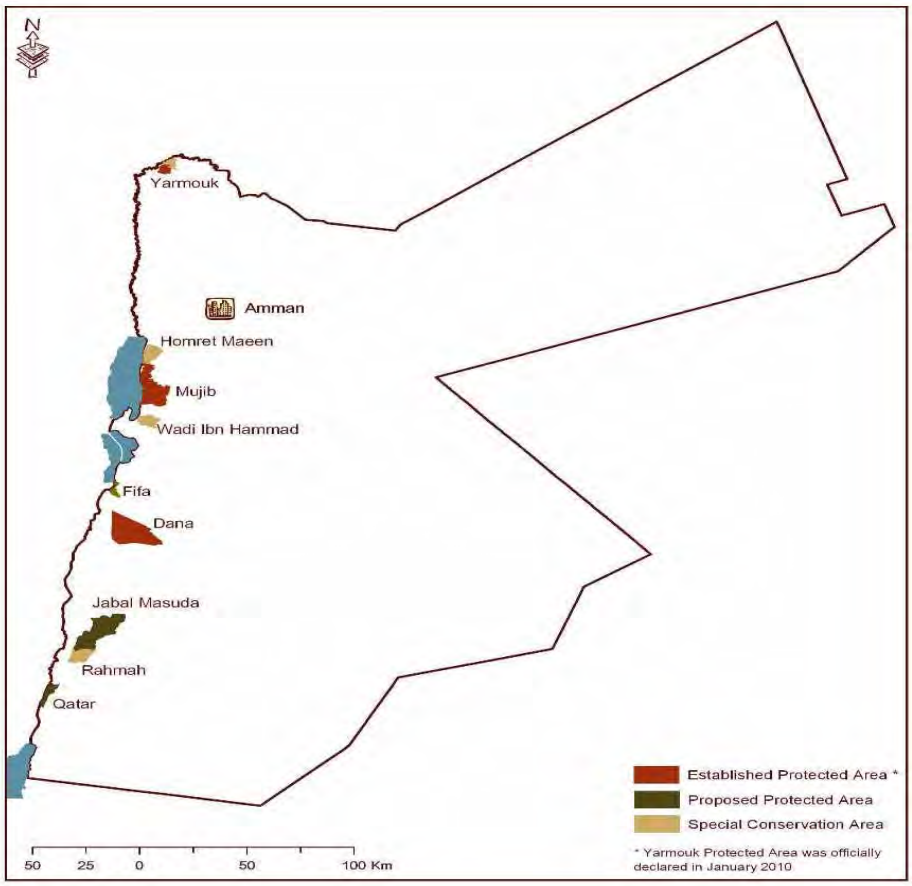



**Figure 19 - Protected Areas and Proposed Protection Sites in Jordan**

**Figure 20 - Water Snake in the Jordan River**

### 2.2.4.5 Ecological Challenges

The main ecological threats and their causes that have been identified in Jordan are presented in the next table.

**Table 7 - Current threats to ecosystems of the Lower Jordan River and their causes**

| No | Threat | Root Cause |
|---|---|---|
| 1 | Fragmentation of habitats | • Agricultural encroachment<br>• No applied land use strategies<br>• No guideline policies on conservation with development agencies<br>• Unregulated urban and infrastructure expansion<br>• No clearly mandated management agency |
| 2 | Inappropriate agricultural development | • Lack of comprehensive land use strategy<br>• No conservation-orientated policies or extension services<br>• Weak coordination between farmers and government agencies and local NGOs<br>• High water demanding crops |
| 3 | Water pollution | • Excessive agrochemical use<br>• Inadequate guidelines on use of agrochemicals<br>• Minimal sewage treatment<br>• Inadequate controls on industrial effluent |
| 4 | Air pollution | • Inadequate controls on industrial emissions |
| 5 | Solid waste | • Lack of treatment infrastructure |
| 6 | Excessive hunting pressure | • Inadequate enforcement of laws<br>• Declining bird populations |
| 7 | Excessive grazing Pressure | • Inadequate enforcement of regulations<br>• Lack of grazing land<br>• Limited alternative livelihoods |
| 8 | Tree cutting | • Inadequate enforcement of regulations<br>• Limited fuel supplies for subsistence communities<br>• Lack of alternative livelihoods |
| 9 | Unregulated tourism Development | • Inadequate planning and enforcement of regulations |
| 10 | Over-extraction of water | • Lack of coordinated strategy between government and users<br>• Weak enforcement of regulations (EIAs)<br>• Lack of water conservation technologies<br>• High water demanding crops<br>• No coordination between supply and demand |

The challenges to ecosystems and biodiversity protection in the LJRV are particularly to create a stronger legal, management and information framework that enables adequate allocation, management and enforcement of nature protection. In particular this challenge will be to:

- Reduce deficiency in relevant laws and regulatory guidelines
- Strengthen enforcement through increasing financial and technical capacities
- Strengthen responsibilities related to laws and regulations
- Release the national biodiversity policy
- Increase communication, education and public awareness
- Increase financial resources
- Increase technical capacities at the institutional level
- Increase civil local community participation
- Address climate change in conservation of biodiversity

Freshwater is the major environmental and socio-economic resource in the LJRV, directly supporting all human activity, vegetation, and wildlife habitats and their associated productivity, with considerable inter-country variability. Freshwater sources are also the natural resource component most at risk since there is no economic substitute for the basin‘s watercourses and associated aquifers, which are also the final repository of human waste.

Despite past impacts, the Jordan River still provides important wildlife and fish habitat. This lowland riparian habitat has been identified by many national and international environmental agencies as the single most important habitat type in Jordan for avian species.

The significance and rarity of these riparian habitats to breeding birds makes the Jordan River corridor important habitat. Its location at the heart of the Rift valley flyway magnifies this value to migrants. For migrant species, extensive degradation and loss of wetland habitats formerly seen in the valley enhances the importance of remaining habitat along the Jordan River.

The LJRV has significant political challenges that need to be overcome before a comprehensive basin management plan can be developed. Water and water resources management is an area of work where there one can find examples of genuine efforts by all riparian nations to cooperate and divide scarce water equitably amongst nations. Faced with the rising demand for water and water resources, as well as the impacts of climate change, it is increasingly important to create economic incentives for the protection and restoration of water systems in the region, and to present a compelling argument for a plan to share the resource among the riparian countries, based on a clear understanding of ecological service benefits and values in the region.

Scholars writing about individual basins have also emphasized the use of financial incentives for ecosystem services in water management. That would make the case for a transition to an ecosystem approach in the Jordan basin by investing in services that are critical to livelihoods and communities. They elaborate on this new form of water resources management in which the first transition is to move beyond the conventional ‗blue‘ water bias to one in which water resources management adopts a whole-systems approach to include ecosystems services.

There is a strong case to include ecosystem approaches to revitalize and inject resources into complex and under-resourced IWRM processes. There is an opportunity for the use of ecosystem services valuation and implementation as a means to affect much needed change in the dynamics of transboundary water resources management. This change will shift the focus away from traditional upstream downstream dynamics to a more holistic, whole-basin approach where there are multiple beneficiaries and providers of

ES. This movement can happen in a variety of ways—no doubt a combination of a bottom-up and a top-down approach is most sustainable

#### 2.2.4.6 Environmental Flows

The major flow reduction in the LJR since it has become regulated has resulted in dramatic changes of the river habitat structure. An analysis of the environmental flow requirements indicates that the physical characteristics of the flow are the most important ecological factor for enabling macro-invertebrates. Less water in the LJR caused changes to the stream channel, resulting in a narrower and more canalized river ecosystem. Less water has also resulted in much slower velocities, reducing the habitats depending of flows, such as falls, cascades and rapids. Less water in the river also means less dilution with inflowing polluted water, such as brackish (ground) water or wastewater. This leads to higher pollution concentrations in the river stream. As a result, the ecology of the river is now reduced to pockets of high resistant and medium to slow velocity habitats.

Reduction in water flows, but also dams in the river and its tributaries, resulted also in smaller river's sediment loads. Slower velocities carry far less sediment with smaller grain sizes. The formation of streamside water bodies, such as deserted meanders, has stopped, and related habitats have disappeared from the river's ecosystem, resulting in the loss of unique community compositions of both plant and animal species specifically adapted to these habitats.

If healthy freshwater ecosystems are to be restored, it is important to address the natural flows around which flora and fauna can develop. Critical parameters in this respect are: the quality of the water; the magnitude of the flow; the seasonable fluctuation of the flow; the frequency, duration and variability of floods and droughts. The Environmental Flow Report presents four alternatives strategies for restoration of viable environmental flows in the Lower Jordan River and related ecological values of the river system:

(1) Full Ecological Restoration;
(2) Partial Restoration;
(3) River Rehabilitation;
(4) Flow Enhancement. A summary is provided hereafter:

**"Full Restoration" Strategy**

Under this strategy the pollution sources into the LJR are to be removed, including treatment of all wastewater generated in the basin and saline water from the Saline Water Carrier. The salinity of the water in the Lower Jordan River shall not exceed 250 ppm in the winter and 350 ppm in summer and in the southern section it should not exceed 750 ppm. The saline water of Tiberias Lake salty springs shall be diverted away from the Jordan River, for instance through desalinization and removal of its brine from the Jordan River basin.

Full restoration would also mean that the original pre- 1950 flows are to be restored to 1200 – 1400 MCM per year. This very ambitious objective implies that for instance 500 – 600 MCM is to be released extra from Tiberias Lake into the LJR, and approximately 500 - 600 MCM per year from the Yarmouk River. This Full ecological restoration strategy also requires at least 3 minor floods (c.a. 20-50 $m^3$/sec) per year, to be achieved for instance by fully opening the dams for 24 hours, three times every winter and 1 major flood (c.a. 200 $m^3$/sec) every 3 years. In order to bring back the original habitats of the river, also the shape and flow path of the river is to be restored, including reconstruction of meanders, cascades and waterfalls. Clearly this very ambitious strategy would require high investments, a revolutionary change in the water

regimes of particularly Israel and Jordan, and would be globally the first full river restoration in its kind. This strategy will lead to recovery of a healthy water related eco system comparable to the historic situation of the area.

**"Partial Restoration" Strategy**

Partial restoration of the river is defined here as removal of the pollution sources into the LJR, including treatment of all wastewater generated in the basin, and dilution of the saline water in the LJR from the Saline Water Carrier with fresh water, so that the water in the LJR shall not exceed 500 ppm in the winter and 750 ppm in summer and in the southern section it should not exceed 1,500 ppm. For this purpose the saline water of Tiberias Lake salty springs could for instance be mixed with fresh water originating from the Tiberias Lake and the Yarmouk River.

**Figure 21 – The Jordan River**

Partial restoration is also defined here as generating flows of 600 – 800 MCM per year. This highly ambitious objective implies that for instance 250 – 300 MCM is to be released extra from Tiberias Lake into the LJR, and approximately 250 - 300 MCM per year from the Yarmouk River. This ecological restoration strategy also requires at least one minor flood (c.a. 20-50 $m^3$/sec) per year, to be achieved for instance by fully opening the dams for 24 hours every winter. In order to bring back the original habitats of the river, also the flow bed of the river is to be widened to 50-70 m in the north and 25 – 40 m in the south, with flood plains on both sides. New meanders, cascades and waterfalls are to be constructed to some extent. This strategy would require considerable investments and a substantial change in the water regimes and national water policies of particularly Israel and Jordan. This strategy will lead to recovery of healthy water related ecosystems.

**"River Rehabilitation" Strategy**

The river rehabilitation strategy is less ambitious than the two strategies described above. It is defined here as full treatment of all wastewater generated in the basin, including originating from the fish ponds, and allowing discharge of treated wastewater into the LJR to maximum 25% of the river's base flow. It includes dilution of the saline water in the LJR from the Saline Water Carrier with fresh water, so that the water in the LJR shall not exceed 1000 ppm in the winter and 1500 ppm in summer and in the southern section it should not exceed 4000 ppm. For this purpose the saline water of Tiberias Lake salty springs could for instance be mixed with fresh water originating from Tiberias Lake and the Yarmouk River.

River Rehabilitation is also defined here as generating flows of 300 – 400 MCM per year. This ambitious objective implies that for instance 100 - 150 MCM is to be released extra from Tiberias Lake into the LJR, and approximately 100 - 150 MCM per year from the Yarmouk River. This ecological restoration strategy requires again at least one minor flood (c.a. 20-50 $m^3$/sec) per two years, to be achieved for instance by fully opening the dams for 24 hours every other winter. In order to bring back the original habitats of the river, also the flow bed of the river is to be widened to 50-70 m in the north and 15 - 30 m in the south, with flood plains on both sides. New meanders, cascades and waterfalls are to be constructed to some extent. This strategy would require investments and a substantial change in the water regimes of particularly Israel and Jordan. This strategy will lead to some recovery of the water related eco systems.

**"Flow Enhancement" Strategy**

The Flow Enhancement strategy is defined here as enhancing the base flow of the LJR only the basis of treating all domestic and fishpond related wastewater, and discharging the treated effluent into the LJR, without depending on additional release from Tiberias Lake or the Yarmouk River. Under this strategy the saline water carrier would continue to flow into the LJR, leaving the salinity levels at 3000 ppm in the winter and 4000 ppm in summer. In the southern section is should not exceed 10,000 ppm, which is 1% salt content.

The Flow enhancement is also defined here as generating flows of 300 – 400 MCM per year, to be generated all from treated wastewater. This implies that all generated wastewater shall be treated and discharged into the river, without being reused for agricultural or other purposes. On the other hand, this also implies that no additional water is required from the Tiberias Lake or the Yarmouk River. This ecological restoration strategy requires again at least one minor flood (c.a. 20-50 $m^3$/sec) per two years, to be achieved for instance by fully opening the dams for 24 hours every other winter. In order to bring back the original habitats of the river, also the flow bed of the river is to be widened to 50-70 m in the north and 15 - 30 m in the south, with flood plains on both sides. New meanders and cascades are to be constructed to some extent, but no waterfalls. This strategy would require a substantial change in specifically the agricultural water regimes in the LJR basin. This strategy will lead to limited recovery of the water related eco systems.

It should be noted that within the Flow Enhancement Strategy various sub-variants can be considered as well, such as:

1. Desalination of the water in the Saline Water Carrier, and using this water to compensate the agricultural sector for –closing" reuse of treated wastewater
2. Adding some additional 20 – 50 MCM of water from Tiberias Lake to the LJR Basin system, triggered by the large scale desalination projects along the Mediterranean in Israel
3. Adding some 20 – 50 MCM of water from the Yarmouk on the basis of introduction of higher value, lower water consuming cash crops in the Jordan Valley

4. Recycling water within the LJR system, for instance through the Jordan Valley Floor Aquifer, to create segments of highly rehabilitated ecosystems
5. Creating economically and ecologically sound projects along the LJR to compensate the agricultural sector in the LJR for –closing" reuse of treated wastewater
6. Create constriction and expanded channel sections, to diversify the flow speeds and related ecosystems
7. Expanding the networks of roads, trails and camp grounds to support economically and ecologically sounds developments along the river
8. Connecting ecological projects along the river with archeologically important spots
9. Designating parts of the LJR stream as tri-national protected nature parks, possibly to be connected to other existing nature parks in the LJR basin

Out of the four alternatives strategies for restoration the Lower Jordan River and related ecological values presented in the Environmental Flow Report, EcoPeace decided to adopt a mixed option between river rehabilitation strategy and partial restoration which requires water flow of 400 to 600 MCM annually, including one minor flood per year and a reduction of salinity levels to no more than 750 ppm.

### 2.2.5 Pollution Sources

The major sources of pollution in the Jordan River Valley include untreated wastewater, solid waste dumping and pollution from agriculture, and husbandry.

#### 2.2.5.1 Wastewater

According to earlier studies of the WAJ, the people living in the valley live too far apart to make investments in a sewerage network economically feasible. As a consequence, no investments in networks were made and cesspits are the dominant method for collection of wastewater. Most houses have their own cesspit, or share a cesspit among a cluster of houses. The wastewater percolates into the groundwater, often overflows into the streets and too often when the cesspits are full, the waste is dumped into a nearby wadi. The JVA however, recently provided a letter to EcoPeace supporting that a master sanitation plan be prepared for the valley, to replace the current use of cesspits.

*Wastewater quantity and collection*

Officially, the LJRV has a registered population of 247,000 according to the Jordanian Bureau of Statistics (DOS, 2010). This excludes non-registered people in the basin, such as foreign temporary agricultural laborers. Estimates vary from 20,000 to 40,000 agricultural laborers. Totally, Jordan inhabits a population of 6,300,000 (2013), with a growth rate of 2,2 % per year.

The inhabitants of the LJRV live mainly in villages along the main road in the following districts:

Northern Jordan Valley (Agwhar Shamaliyah), with a population of 108,943
Deir Alla, with a population of 67,925
South Shouneh, with a population of 61,424

The largest Jordanian municipalities in the Jordan River Valley are (from North to South):

- Muath Bin Jabal municipality
- Tabkat Fahal municipality
- Sharhabeel Bin Hassneh municipality
- Deir Allah municipality
- South Shouneh municipality

The people in the Governorate of Irbid consume on average 95 liter/capita/day. In the Governorate of Balqa, people consume 158 liter/capita/day (DOS). This excludes industrial water demands. In the LJRV, it is estimated that the per capita domestic and industrial water demands together are about 246 l/cap/day, while the actual supply reaches 184 l/cap/day , or about 75% of the demands. Approximately, 80 % of the water consumption returns in the form of waste water into the LJRV system. With a population of 247,000 inhabitants in the Jordan Valley, a total annual WW flow of approximately 36 MCM per year may be expected in the JRV.

The Governorate of Irbid as whole has a 36% sewerage coverage and Balqa has a 60% coverage. Usage of permeable and impermeable cesspits (partly open, partly closed sides) is the dominant wastewater collection method. Cesspits are dug-out holes that store untreated wastewater. In the LJRV, most houses have their own cesspit, though occasionally small clusters of houses share cesspits. Unlike septic tanks, which use anaerobic bacteria to partially decompose waste, cesspits simply store wastewater, and they must be emptied regularly. Generally, tanker trucks collect the sewage from the cesspits, and bring it to treatment facilities inside or outside the basin, or they discharge the wastewater in nearby wadis.

Most cesspits are lined with concrete along the side walls, but lack bottom lining (percentages up to 95 % are mentioned by WAJ). Some households use cesspits without any concrete lining at all, or use holes cut into concrete home floors to allow wastewater simply to flow into the sub surface. This reduces the need and related costs to emptying the cesspits, but it causes untreated wastewater to seep into the soils around the tank, polluting ground and surface water.

Many cesspits are covered with loosely fitting plastic or corrugated iron plates, which allows insects to enter the cesspits, and generates emission of bad odors. It also causes cesspits to overflow when it rains: during heavy rains wastewater can be noticed to overflow the streets, posing serious public health hazards.

Closed and well functioning cesspits require the use of a tanker a few times per month. In reality, many households with leaking or open cesspits never make use of tanker trucks, because all wastewater seeps away to the underground. This eventually reaches the shallow groundwater system, and may negatively influence drinking water quality for communities who depend on groundwater resources.

The Lower Jordan River is the natural drainage system of the valley. This means that the polluted groundwater, if not pumped up, eventually reaches the river system, influencing negatively the environment and river quality. It is estimated that only 5 or 6 % of the total WW produced in the LJRV is actually treated in treatment plants, meaning that about 95%, of about 36 MCM per year of untreated wastewater is discharged in the LJRV.

Without a sewage network or other public services for WW management, households voluntarily pay to get their cesspits emptied by tanker truck. Most of them are operated by the local municipalities. A small municipal tanker trucks (6 $m^3$) charges usually 15 JD per tanker for transportation. Larger municipal tanker trucks cost 20 JD, while the use of private tankers (as the capacity of municipal tankers is limited) may cost

up to 30 JD. Some of the trucks transport their content to the Al Akaider WWTP, which is over 50 Km away and around 850 higher in altitude than the Jordan Valley. Due to its long distance, the costs per trip may be as high as 50 JD. These high costs create a situation where most people prefer a leaking cesspit over expensive truck services. If required, some people empty their cesspit themselves with a pump, and discharge the wastewater in the direct vicinity to limit the costs. Due to the long drive to the Al Akaider WWTP, some drivers illegally empty their tanks somewhere along the road, like in Wadi el Arab and other Wadis, to save fuel costs.

In the short run, it is important that lining and covers of most cesspits are improved, that tanker truck removal costs are reduced by creating sufficient wastewater treatment capacities within the LJRV itself. This may create a more affordable wastewater collection system, which can be properly enforced by the authorities. Only then will it be possible to substantially increase the percentage of wastewater collected and limit the impact of untreated wastewater on the environment. In the longer run the objective should be to shift to the realization of adequate sewage network coverage with related treatment facilities throughout the valley.

*Wastewater treatment*

There are currently 27 WWTPs in Jordan with a maximum capacity of approximately 150 million $m^3$/year and 122 million $m^3$ wastewater actually treated. Many of them are old and need to be upgraded. The effluent quality is often low. There is only one plant including tertiary treatment in Jordan, the Aqaba WWTP. The others have only secondary or primary treatment facilities.

Within the Jordan Valley, there are now two WWTPs in operation: the Tal Al Mantah WWTP located to the west of Deir Alla, which started operations in 2005. This WWTP receives the waste water from the Deir Alla and South Shouneh regions. Its maximum capacity is 400 $m^3$/day and it received in 2013 about 320 $m^3$/day (365 $m^3$/day in 2012). It is an activated sludge facility, and its effluent is discharged into evaporation ponds, but WAJ is trying to introduce reuse locally. The facility is in urgent need of rehabilitation.

In North Shouneh, a new WWTP was recently completed, with a capacity of 1,200 $m^3$/day. This WWTP started operation in late 2013. WAJ expects that its capacity is large enough to serve the North Shouneh region for at least the next 25 years, based on current collection rates. This doesn‘t take into account a potential increase of the waste water collection, for instance if sewage systems would be introduced.

Now that the new North Shouneh WWTP is under operation, the total treatment capacity in the Lower Jordan Valley is 1,600 $m^3$/day (equivalent to 584,000 $m^3$/year). This is only a few percent of the total estimated WW production in the LJRV, and can only be used to treat the WW that is collected by tanker trucks. There are currently no actual plans for expanding the treatment capacities in the Jordan Valley.

**Table 8 – Wastewater treatment plants in Jordan (2012)**

| No | WWTP | Year of Operation | Type of plant | Average Design Flow $m^3$/day | Actual Flow in 2012 $m^3$/day |
|---|---|---|---|---|---|
| 1 | AQABA NATURAL | 1987 | WSP | 9000 | 7220.1 |
| 2 | AQABA –Mech. | 2005 | Extended aeration | 12000 | 8511.2 |
| 3 | AL BAQA | 1987 | Trickling filter | 14900 | 11713.3 |
| 4 | FUHEIS | 1997 | Activated sludge | 2400 | 2304.7 |
| 5 | IRBID (CENTRAL) | 1987 | Trick.&act. Sludge | 11023 | 8635.1 |
| 6 | JARASH (EAST) | 1983 | Oxidation ditch | 3250 | 3333.3 |
| 7 | AL KARAK | 1988 | Trickling filter | 785 | 1753.4 |
| 8 | KUFRANJA | 1989 | Trickling filter | 1900 | 2763.0 |
| 9 | MADABA | 1989 | Act. Sludge | 7600 | 5259.6 |
| 10 | MAFRAQ W.S.P | 1988 | WSP | 1800 | 1618.2 |
| 11 | MA'AN | 1989 | Extended aeration | 5772 | 2357.8 |
| 12 | ABU NUSEIR | 1986 | Act. Sludge R,B,C | 4000 | 2400.6 |
| 13 | RAMTHA | 1987 | Act. Sludge | 7400 | 4049.9 |
| 14 | AS SALT | 1981 | Extended aeration | 7700 | 6529.2 |
| 15 | TAFILA | 1988 | Trickling filter | 1600 | 1575.4 |
| 16 | WADI AL ARAB | 1999 | Extended aeration | 21000 | 10681.4 |
| 17 | WADI HASSAN | 2001 | Oxidation ditch | 1600 | 1237.6 |
| 18 | WADI MOUSA | 2000 | Extended aeration | 3400 | 2536.4 |
| 19 | WADI AS SEEIER | 1997 | Aeration lagoon | 4000 | 4052.8 |
| 20 | AL EKEDER tankers | 2005 | WSP | 4000 | 3232.4 |
| 21 | AL LIJOON tankers | 2005 | WSP | 1000 | 734.7 |
| 22 | TALL AL MANTAH tankers | 2005 | Trick.&act. Sludge | 400 | 365 |
| 23 | AL JIZA | 2008 | Act. Sludge | 4000 | 623.9 |
| 24 | SAMRA | 1984 | Act. Sludge | 267000 | 240925.5 |
| 25 | AL MERAD | 2010 | Act. Sludge | 9000 | 2297.1 |
| 26 | SHOOBAK tankers | 2010 | WSP | 350 | 67.2 |
| 27 | AL MANSORAH tankers | 2010 | WSP | 50 | 12.5 |

*Industrial wastewater*

In Jordan, the larger industries are obliged to have their own WWTPs. Industries generally reuse a lot of water internally. Industrial wastewater effluents in the major cities is tested by WAJ on BOD, COD and other parameters to check if it is allowed to discharge the effluent on sewerage networks operated by WAJ for further treatment. Most of the industry in Jordan is located to the east of Amman and in the Aqaba Special Economic Zone. However, their wastewater flows do not influence for the Lower Jordan Valley. In the Lower Jordan River Valley, there is no large industry.

Small scale industries in the valley include:

- Agriculture related industry such as tomato and pickle processing
- One fertilizer factory
- Small stone cutting (more than 10)

- Stone baking, carpeting and metal work shops
- Number of gasoline stations (more than 10)
- Small scale poultry slaughter (almost 30 mainly in Deir Alla)
- Small car workshops (more than 30)

Wastewater from stone cutting workshops contains fine cutting remains. Mostly, holes are dug in the ground and the waste water flows freely into the holes and the sub surface. The white fine cuttings remain behind in the hole and are removed occasionally. This sludge is usually dumped at random somewhere in the hills. In some cases the wastewater is pumped and discharged in the Wadis as well.

Car Wash sites use generally large cesspits, generally emptied by tanker trucks, and sometimes reused on the site or dumped directly to the surroundings. The total (small) industrial wastewater production on the Jordanian side of the LJR basin is estimated to be 34,000 $m^3$/year. A total of 17,300 $m^3$ is produced by Car Wash facilities and 16,200 $m^3$ by slaughter (mainly chicken) houses.

**Figure 22 : Stone cutting workshop and car workshop near Muath Bin Jabal**

*Reuse of treated waste water and water quality of Jordan River subsidiaries*

On a national scale, over 50% of wastewater generated in Jordan is treated and reused in the Jordan Valley for irrigation purposes through the KTD and the KAC. This percentage is expected to increase during the coming several years with the additional treated wastewater from the northern governorates. In total about 100 MCM/year of TWW is reused for irrigation in Jordan. This is 94 % of total amount of wastewater treated in Jordan. Jordanian wastewater reuse licenses and standards strictly regulate the reuse of wastewater. For instance, a —Standard A-license" is required by WAJ to reuse wastewater for agriculture purposes: only trees are allowed to get irrigated: no crops that get in direct contact with the treated wastewater. WAJ furthermore takes regular soil samples to investigate the influence of the waste water reuse. However, not all farmers obey to this standard. Sometimes treated waste water is mixed with fresh water to improve its quality, and is next used for direct crops irrigation.

In the Northern part of the Lower Jordan Valley, fresh water is transported through the KAC, which is used for irrigation. Along the way to the south water from various dams is added to the canal. However, dams

containing treated wastewater are no longer connected to the north section of KAC. In the North, water from the WWTP of Irbid and Dogara, which used to flow into the Wadi Arab Dam, is now diverted away in a pipe that reaches the Jordan River as explained earlier in this report.

More to the South, water from the KTD is brought to the canal through 3 water carriers (the Zarqa carriers 1, 2 and 3). The water in the KTD is a mixture of fresh water from the hills and springs, water from the Zarqa River and treated wastewater from Amman and Zarqa. The treated waste water in the dam is mainly coming from the As-Samra WWTP, which treated in 2012 approximately 87 MCM per year (almost 75 % of the total treated waste water quantity in Jordan). The Zarqa River is severely polluted by industry, municipal wastewater and several other pollutions sources. This has a negative influence on the water quality in the KTD.

The lower 14.5 km section of the irrigation network of the KAC has never been taken into use. Farms there just use local water resources that contain high salt concentrations. This causes a lot of salinity problems in the agricultural area in this lower part of the Lower Jordan Valley including soil siltation related problems. In addition, farmers tend to combine large amounts of fertilizers with the use of local wastewater, which adds to the soil deterioration problems.

Apart from the water from the KAC, other sources of treated wastewater will become available for irrigation in the next few years:

- A new WWTP near Irbid with a capacity of 13,000 $m^3$/day will soon start its operation, in addition to the existing Shlalha WWTP. Near the Wadi Arab Dam the treated wastewater will be mixed in a mixing station and then supplied to farmers to be used mainly for irrigating citrus trees.
- Treated wastewater from Salt and Fuheis flows into the Wadi Shueib Dam, and is then reused directly in the Lower Jordan Valley, near South Shouneh, for irrigation.
- The same is the case for water from the Wadi Sir WWTP. Its effluent goes to the Kafrein Dam and is then reused directly in the Kafrein and Sweimeh area for irrigation.

**Figure 23 - King Abdullah Canal**

### 2.2.5.2. Solid Waste collection, treatment and management

*Waste quantity and collection*

The official Jordanian population within the Lower Jordan River Valley in 2012 is estimated to be 247,000 inhabitants. The Jordan Department of Statistics shows a wide range of waste production figures over the last few years, varying between 370 to 1,000 kg of waste production per capita per year. This wide range may be caused by incomplete data or by adding industrial waste to the figures. In general for a country like Jordan a domestic waste production figure of around 400 kg/capita/year seems more logical. With a population of 247,000 inhabitants in the Lower Jordan Valley, a domestic solid waste production of about 99,000 tons per year is expected.

Waste collection, transportation and disposal in Jordan are handled by local municipalities. Sometimes, smaller municipalities combine forces into a Common Services Council. In the Lower Jordan Valley, the municipalities in the north co-operate within the Northern Joint Services Council.

Waste is collected daily. In large communities, like Deir Alla, collection takes place twice a day. In smaller villages this is 3 to 5 times a week. Most household uses small bins, baskets, sacks or bags to collect waste. Next, the waste is emptied in metal community waste containers which are located on various locations along the streets. Small industries use the same waste containers as households. In Deir Alla, households pay 1.50 JD per month to the municipality waste collection and treatment.

In some areas waste collection frequencies seem to be too low, leading of overflow of containers and waste littering around the waste bins. Another source of littering is waste thrown from cars, which accumulates along the road sides.

*Waste disposal and treatment*

There are approximately 20 landfill sites in Jordan that have been recognized by the Ministry of Municipal Affairs. With exception of the Ghabawi landfill in Amman, none of the landfill sites in Jordan have a bottom lining. Few landfills are well managed, and some are located on sensitive locations, such as on top of aquifers used for abstracting drinking water.

Currently, there are no fully engineered sanitary landfills in the Lower Jordan Valley. Two controlled dumpsites are located in North Shouneh and in Deir Alla. These dump sites have no lining system and no leachate percolation collection and treatment system. As a consequence, rainwater leaching through the dump sites becomes polluted and will seep into the groundwater.

The landfill in North Shouneh (Manshea dumpsite) apparently has been closed recently and is no longer in operation. Previously the waste from the North Shouneh (100 tons/day) was brought to this dumpsite. Now this location is only used for some small scale recycling activities and for transfer of waste from smaller to larger waste trucks. The waste is then transported further to the Al Akaider landfill to the east of Irbid.

At Al Akaider landfill near Irbid the waste is pressed in bales before being land filled. Waste from the region in between Irbid and the Jordan Valley was brought to the now closed Manshea dumpsite. This dumpsite is located east of the main road near the Muath Bin Jabal municipality just within the Lower Jordan Valley. This dumpsite seems not to have been covered with a top lining. This means it will continue to be a threat for the environment in terms of rainwater percolation and groundwater pollution. It is therefore advisable to put a final waterproof cover on the landfill.

The waste coming from the southern part of the Lower Jordan Valley (Deir Alla and South Shuneh) is brought to the Deir Alla dumpsite. This dumpsite is located 1 km from the Jordan River to the west of Deir Alla. The dumpsite is badly sited, because the location is close to a community and a groundwater reservoir which is used for drinking water. The dumpsite doesn‘t have any facilities like lining or percolate collection. Percolation water goes directly to groundwater and the Jordan River. Regularly the waste is covered with soil. Some places have a final covering of soil, but no waterproof lining system. The municipality wants to replant part of the completed dump site and use it to grow vegetation using treated wastewater.

The surface area of the Deir Alla landfill is 364 dunum and has a rectangular shape. The landfill currently receives 250 tons of waste per day.

**Figure 24 - Deir Alla landfill**

On the Deir Alla dumpsite waste scavengers collect plastic by hand and sell it to plastic recycling companies with permission of the Ministry of Environment. Also some cardboard is collected from the dumpsite, cut into pieces and then sold to the Lafarge cement industry, which use it as fuel because of the high caloric value of the material.

**Figure 25 - Plastic Waste Pickers**

The municipality of Deir Alla is planning to set up mechanical sorting equipment on the landfill to recycle plastics and organics on a larger scale. The separated organic material can be processed into compost to be used in agriculture. The plastics can be recycled. In this manner future landfill space will be saved, and the quality of the percolation water will be increased. EcoPeace is currently preparing a Term of Reference for this recycling project.

The total capacity of the two landfills described above (100 and 250 tons/day respectively) is more than enough to handle the domestic waste generated in the Lower Jordan Valley, calculated on basis of the population numbers and average waste production per capita.

Located directly next to the Deir Alla dumpsite is a composting facility for processing agricultural waste and manure. There is no information available about older and closed dumpsites in the Lower Jordan Valley from the documents analyzed or from people spoken to in the area. No other types of composting or recycling facilities exist in the Lower Jordan Valley.

*Industrial waste*

As mentioned earlier there is no heavy industry in the Lower Jordan Valley. Waste oil from car workshops were previously discharged into Wadis. Today it is collected in tanks. Companies from Amman buy the oil for reuse purposes. Sometimes it is reused as oil for heavy machinery, sometimes it is used as fuel for industries located outside the Lower Jordan Valley. Using waste oil as fuel for industry will have large air quality implications. Waste metal cans and waste plastic from industry are generally sold for reuse purposes.

The total industrial waste production in the Lower Jordan Valley is estimated to be about 750 tons/year. About 715 tons/year are produced by slaughter (mainly chicken) houses.

Another solid waste related problem in the Lower Jordan Valley is the uncontrolled dumping of debris from house building and demolition activities. This waste is not brought to dumpsites, but is just disposed of on piles everywhere in the valley. With heavy rains, fine particles will migrate to wider areas in the valley, or will eventually flow into the Jordan River. Sometimes even the larger pieces of debris and demolition waste can be seen in the river. The fine remains of stone cutting activities are often dumped in Wadis. This fine waste will also be spread into the environment after heavy rains.

Plastic are extensively used in green house farming and agriculture in general. Alongside roads and green houses these waste plastics are accumulated in long strings.

**Figure 26 - Plastic Litter**

### 2.2.5.3 Agricultural Pollution

*Plant Tissue Waste from Agriculture*

In agriculture a lot of plant tissue waste remains in the fields or greenhouses after the crops have been harvested. In the Jordan Valley about 4,300 ha of the arable land is in use for the production of field crops like wheat and barley. Almost 75 % of this area is located in North Shouneh. In most cases the plant tissue is left on the fields for sheep and goats to eat. The remaining material is ploughed under into the soil, which is considered as good agricultural practice. Alternatively, this waste could be composted and turned again into a soil improver.

Vegetables are produced in two cropping periods, varying from tomatoes and cucumbers to melon, cauliflower, okra and cabbage. In the early season about 9,000 ha is planted and 7.100 ha is planted in the late season.

**Figure 27 - Crop remains in greenhouses**

On average 1 kg of plant tissue per $m^2$ remains in the field after harvesting depending on the type of crops. This would result in an amount of 160.000 tons of organic material each year. In general, however, plant tissue left in the open field is ploughed under or farmers allow sheep and goat herds to enter their fields after harvesting to eat the remains. In greenhouses part of the plant tissue is removed as waste is partly fed to sheep and goats after the plastic covers of the green houses have been removed. The surface area of the green houses is estimated on 3,500 ha (75 % of which is located in Deir Alla). This results in approximately 35,000 tons of plant tissue per year. Near the Deir Alla landfill a composting facility is located, which composts agricultural waste together with manure. Not all the generated plant tissue is brought there. The capacity of this composting facility is not known.

Fruit trees (mainly citrus, banana and dates) are cultivated on a total surface area of about 9,700 ha. Citrus is mainly grown in North Shouneh (> 80 %), Bananas in South Shouneh (almost 80 %) and date palms mainly in South Shouneh and Deir Alla (> 50 % and almost 35 % respectively). The remaining plant tissue after pruning consists of leaves and branches. The leaves are ploughed under the soil. The branches (estimated to be one ton of branches for each ha of production area, resulting in a total of 9,700 tons of branches) are general sold directly as fuel, or for the production of wood coal. Smaller branches are generally burned at the spot, causing nuisance in terms of smoke and odor. It would be better if these small branches would be brought to a composting facility.

### *Feedstock Waste (manure and animal tissue)*

There are about 164,000 sheep being reared in the Jordan Valley, mainly in North Shouneh, Deir Alla and South Shouneh). The production on average 3.5 kg of manure/day results in a total manure production of 210,000 tons of manure in a year. The manure is generally left in the fields, particularly from sheep and goat herds eating plant tissue remains from agricultural areas. This does not cause particular environmental problems. Carcasses of dead animals on the other hand are sometimes left where they died, causing direct environmental and public health risks. Stronger enforcement on getting these carcasses removed and incinerated seems to be required.

**Figure 28 - Sheep herd**

There are 470 horses (mainly in North Shouneh) and 250 camels (mainly in South Shouneh) living in the Jordan Valley. Horses and camels on average produce 10 kg of manure/day. This results in a total manure production of 2,600 tons of manure in a year. There are furthermore 5,000 cows living in the Jordan Valley on 128 farms (almost 60 % in North Shouneh and 30 % in Deir Alla). Cows on average produce 40 kg of manure/day. This results in a total manure production of 73,000 tons of manure in a year. The major part of this manure will be produced on the farms and is not collected. Is concentrated on small areas, extensive disposal of manure may lead to infiltration of organics into the groundwater, leading to high concentrations of particularly nitrate.

About 26 chicken farms and small owners have a total of 400,000 chickens (and other poultry) in the Jordan Valley, of which more than 80 % in South Shouneh. Poultry on average produce 0.1 kg of manure/day. This results in a total manure production of 15,000 tons of manure in a year. The major part of this manure will be produced on the farms and is not collected. Chicken manure waste not composted is a major cause for house fly infestation in the valley, a major health concern and impediment for tourism development in the valley. The mortality rate of poultry before being slaughtered is about 10 % a year. This leads to 60 tons/year of poultry tissues.

### *Plastic Wastes*

Plastic waste in agriculture is generated from plastic covers of greenhouses, plastic mulch covers used for solar protection and plastic pipes used in the fields and the greenhouses for irrigation. Most of the plastic is collected and sold to plastic recycling factories, located mainly outside the Jordan Valley.

Polyethylene plastic covers of greenhouses are used on average for a period of 3 years. Assuming a thickness of approximately 150 micro meter, their weight is about 1 kg per 7 $m^2$ surface. With a total surface area of about 3,500 ha of greenhouses a total of 16,000 $m^2$ of foil is required, resulting in about 2,700 tons of waste foil. Most of this material is recycled.

**Figure 29 - Greenhouses and Plastic Waste**

Plastic mulch foil is applied on 60 % of the arable land (33,000 ha) in the Jordan Valley to prevent growth of weeds in between the crops and to limit the amount of evaporation from the soil. This is mainly used in open fields, but also sometimes in greenhouses. Plastic foils have generally a thickness of 150 micro meter and a typical weight of 1 kg for each 25 $m^2$ used. When applied on about 20,000 ha of agricultural land, this leads to an annual production of about 8,000 tons. Often the mulch is destroyed by sheep and goats in the fields. Remaining fractions are generally collected by the end of the season and burned, which has a negative influence on the air quality. Old plastic pipes on the other hand are generally sold and recycled after a life cycle of about 3 to 5 years.

### *Agrochemical wastes*

Agrochemical wastes are mainly related to over date remains of fertilizers, pesticides and herbicides chemicals used for sheep dipping. Little information is available regarding the destination of remnant pesticides and herbicides from the Ministry of Agriculture. It is expected that most farmers burry these remnants in holes on their land, causing potential sources of pollution for soil and groundwater.

In Jordan no information is available on the practice of sheep dipping. Sheep dipping in general is done to control of sheep scab, lice, ticks and blowfly. Proper control of these parasites is essential and leads to

reduced deaths and economic farm losses. Probably still some harmful chemicals are used for sheep dipping, which nowadays can be replaced by more environmental friendly chemicals.

### Fish Ponds

The 2012 Annual Report of the Department of Fish Breeding states that fish production started in the Jordan Valley in 1965, and that 20 fisheries have a total fish production of around 700 tons/year. In addition, fish is produced in the KAC (approximately 20 tons/year) and in a number of dams (approximately 30 tons/year). The major fish farms are:

- The Jordan Valley Fish Farm or Taloubia
- The Arab Fish Farm in the North
- Al Natoor Fisheries
- Al Taba'a Fisheries.

The Jordan Valley —aloubi" Fish Farm was mentioned to have been the largest fish farm in Jordan and the most successful aquaculture operation. The farm was established on 274 dunums in 1996, and was located 5 km from the Baptism site. However, it was closed down recently.

Almost all fisheries receive their fresh water from groundwater. With regard to management of the effluent the information from different sources is inconsistent. Most likely most fish farms discharged their wastewater directly into to the Jordan River without treatment, while some farms apply basic filtering and re-use its water for irrigation purposes due to the high nutrient content of this water.

### Land Mines

The Hashemite Kingdom of Jordan ratified the Mine Ban Treaty in 1999. In accordance with its obligations under this international legal standard, Jordan has destroyed its stockpile of antipersonnel mines and has made steady progress to complete demining for its side of the entire Lower Jordan Valley.

## 2.2.6 Cultural Heritage

The national authorities in the valley are protecting and promoting a number of cultural heritage (religious and archaeological) sites within the Jordan Valley, including Umm Qais (just outside the JVA mandate boundary), Pella, the Baptism site, the Dead Sea Panorama, Zara, and Lot's Cave. Near Lot's Cave the Lowest Museum on Earth is being constructed. These sites are well located for tourism linkages from north to south in the JV, and they also link to sites outside the JV from west to east.

One of the most common types of ancient sites in the Jordan Valley is the Tell (Arabic word for Hill), which is a mound formed by successive layers of settlements being built on top of the ruins of previous ones. The most common building material used such sites was the sun-dried mud bricks, or adobe, made from the clay soils found throughout the Lower Jordan River Valley.

The following main archeological sites in Jordan have been identified:

*Al Maghtas - Baptism Site*

The Baptism Site, Bethany Beyond the Jordan (Al-Maghtas) Protected Area, is located in the Southern Jordan Valley on the east side of the Jordan River around 9 km north of the Dead Sea and is part of the

District of South Shouneh in the Governorate of Al-Balqaa. The site is located a few kilometers to the east of the oasis and ancient site of Jericho and 50 km west of Amman, the capital of Jordan. The site covers an area of 533,7 hectares where five archaeological sites dating back to the Roman and Byzantine periods have been discovered. The precise limits of the archaeological remains are undetermined, although all identifiable cultural traces are included in the protected area. Several modern villages are located in the vicinity of the property. These include Al-Kufrein, Al-Ramah, Al-Jofah, Al-Rawdah, Sweimeh, New Shouneh, Al-Karamah, Al-Nahdah, Al-Jawasreh, Nimrin Al-Gharbi and Nimrin Al-Sharqi.

**Figure 30 – The Baptism Site**

*Beth-Haram Livias at Tell er-Rama*

Located at Rama in North Shunah, 3 km to the south of Tell Al- Kafrein, 500 meter to the south of Wadi Al-Rama, and 40 meter from the western edge of the main road connected between junction of Rama and the junction of Jufa. This site is mentioned by several researchers and has just been excavated at the end of northern summit of the Tell. The site is an Artificial Tell with a high wide area separated by the modern houses from the main road and had been used as a modern cemetery by the locals. Archeological activities in the site resulted in a large number of pottery shards, some of these shard was a result of illegal digging made by the tomb rubbers, at the same time many Byzantine tombs detected in deferent locations with a stone pavement covered with plaster with stone foundations of many walls in the site.

*Al Rawda Dolmens*

Al Rawda Dolmens is located in al Rawda region in the South Shouneh district, at the north east edge of the main road connecting between South Shouneh and Amman opposite of resent Al-Rawda town and to

the south and east south of Tell Al-Hammam site. The site stretched over a hundreds of acers parallel with the main road. The land of this field contains mountains and hells separated by valleys. The dolmans tombs spread almost everywhere in the area, tenths of them lies directly at the edge of the road or few meters away from its edge. At the southern side of the site many modern roads has been cut to serve the housing projects. Because of the uniqueness of the site and distinctiveness it needs more attentions through serous surveys and studies of the tombs, at the same time a rescue projects to the Dolmens might be affected by the new constrictions projects.

*Khirbet Al Hammeh*

The site is located at Deir Alla district, 2200 meters away from the east side of the main road of Jordan Valley and 2500 meters to the south east of Tell Deir Alla overlooking the north bank of Zarqa River. The site is mentioned by Nelson Gluck and Muller and is recorded during the archeological survey in 1975-1976. The site is a medium height Tell (hill) and not very large in area. The walls appear almost everywhere at the service with a huge number of pottery shards. Some caves cut into the rock can be seen with what seems to be a bridge foundations used to link the two banks of the Wadi. A joint project between the department of antiquities at Yarmouk University and a Danish Expedition team worked in the site. The north parts of the site are destroyed by agricultural and building activities

*Khirbit Al Izziyeh*

The location lies to the south east of Wadi Al Taibeh. Architectural building stones are starched all over the place; some of these stones are reused of building. The new walls as well as thousands of pottery shards related to a different periods, many mosaic flours which are exposed by agricultural activity‘s are found in the site; some of them are destroyed. Additionally, a part of more than 2 meters tall stone column has been discovered at the site. It is highly recommended to conduct a more thorough excavation at the site and to concentrate on restoration of the mosaic flours with the other archeological features.

*Tabaqat Fahl (Pella)*

Ancient Pella at Tabaqat Fahl is one of the most important archaeological sites in the Jordan Valley. Its central location in the land of biblical ‗Gilead‘ on the most strategic east-west trade route to the Mediterranean coast was the key to its prosperity. The city is referred to almost a hundred times in various historical texts including the Old Testament which names this city ‗Penuel‘ and records that it was here that Jacob wrestled with God who was in the form of an Angel (Genesis 32: 22-30). The famous Amarna letters from ancient Egypt names Mut-Baalu as the ruler of Pella in the 14th century BC. During the Bronze and Iron Ages Pella had the largest known migdol type temple in the entire region. The base of this massive multi-storied structure measures 32 x 24 meters with two fortification towers and was dedicated to the Canaanite God Baal. In the fourth century BC, Pella was established as a Hellenistic city and was later included in the Roman Decapolis league. Some of the first Christian converts were known to have taken refuge from Roman persecution here in around 70 AD. The city thrived during the Byzantine period having three basilica churches. A thirteenth to fifteenth century mosque was built on the same site as the Bronze Age Migdol temple of Baal.

**Figure 31 – Tell Deir Alla**

*Tell Deir Alla*

Strategically located at the mouth of the Zarqa River, Deir Alla is the Old Testament site of Succoth (Genesis 33: 17; Joshua 13: 27; 1 Kings 7: 46; 2 Chronicles 4: 17; Psalms 60: 6; and 108: 7) which was purported to have been fortified by Jeroboam and visited by Gideon as he pursued the eastward retreating Midnights (1 Kings 12: 25; Judges 8: 5-17). Succoth means ‗small structures' which may have derived from the ancient town's function as a central market place for the Gilead region during the Late Bronze and Iron Ages. To this day, Deir Alla remains a trading centre for the Jordan Valley. Archaeological excavations have also revealed an important sanctuary here where many items bought in the town may have been donated as offerings. By this practice the town may have acquired its present name of Deir Alla, ―the house, or place, of God". The rare discovery of an Aramaic inscription proclaiming ―Balaam the son of Boor, the visionary of the gods", attests to the use of the site as an ancient holy place dating back to the ninth century BC. Balsam is also referred to in the Old Testament (Numbers 22-24).

*Tell Damia*

Located about 2 km to the west of the main Jordan Valley road at Al Zore area, and to the east of Al Thahir Pepars bridge, the Tell is a high artificial place with a big area surrounded by agricultural plains from the all sides, the surface of the site covered by thousands of pottery shards from different periods.

*Tuleilat Al Ghassul*

Tuleilat el-Ghassul is one of the largest Chalcolithic sites to be found in the entire region. It shows uniform architectural units consisting of large rectangular rooms. The rooms are built of stone with a mud-brick superstructure. Notable are several wall paintings that were well executed in various colors; beside naturalistic and geometric designs there are signs and cult processions that represent the religious practices of this region. At the end of the Chalcolithic period, the area witnessed a new phase designated by archeologists as Late Chalcolithic, Proto-Urban or Early Bronze I. This is a transitional period that led to the beginning of the urbanization of the entire region during the Early Bronze Age.

*Tell Abu Hamid*

Located at 960 meters to the west of the main Jordan Valley road surrounded by two valleys from the north and south, it is mentioned for the first time in 1975 during the comprehensive Jordan Valley archeological survey. In 1986, the field work started at the site through a joint project between The Yarmouk University and the French Institute for Scientific Researches, which proved that settling in the sit started in 5200-4800 BC. Visitors of the site can easily notice thousands of pottery shards and flint stones spreading all over the place and many foundations of walls with different sizes, some of which were discovered during archeological missions.

*Tell Abu Kharaz*

This archeological site is a 40 meter high large Tell. The site is mentioned for the first time by Nelson Gluck in 1942. In 1975, an intensive archeological survey officially recorded this site, which is. located to the east of main Jordan Valley road. Huge numbers of pottery shards can be noticed everywhere at the site with many wall foundations situated in different locations. Some of these walls were discovered by the ongoing Swedish expedition which started in 1989.

*Tell Dhahab Gharbi*

Located in Deir Alla, 7 km to the east of Tell Deir Alla at the edge of the Zarqa River, it was first mentioned in 1930. Yarmouk University started archeological excavations and studies at the site in 1980, which showed that human settled at the site during the early Iron Age, Hellenistic and early Roman age periods. The site is a very high mountain with a wide area, many antique walls found at the top and around it. The service of the site covered by thousands of pottery shards related mostly to the mentioned periods. Few years ago, Dortmund University from Germany started a long term archeological project which is still ongoing. This mission lead to the discovery of many large buildings at the top of the Tell concentrated at the north edge. A narrow farm road leading to the top of the Tell and a building at the northern end of the site were constructed by the Jordan Valley Authority

**Figure 32 – Tell Dhahab Gharbi**

*Tell Al Hammam*

Tell Al Hammam is located approximately 8 km north of the Dead Sea, 12 km east of the Jordan River, 8 km south of the modern village of South Shouneh (the location of Tell Nimrin), and 1 km south west of the Kafrein Dam. This area of the southern Jordan Valley, particularly the eastern half of what many now call —the Jordan Disk" (the circular alluvial area north of the Dead Sea, approximately 25 km in diameter), lies on the crossroads of the region's ancient north-south and east-west trade routes. Several significant sites, all seemingly occupied during the high points of Levantine Bronze Age civilization, hug the eastern edge of the Jordan Disk just beyond the spread of the ancient flood plain, bounded on the north by the throat of the Jordan Valley, and on the south by the rocky terrain of the Dead Sea area. Tell Nimrin, Tell Bleibel, Tell Mustah, and several smaller sites are in close proximity. Tell Iktanu is approximately 2 km to the south, and numerous small sites are in close array. Also nearby are hundreds of dolmens and cemetery sites that, for the most part, remain unexcavated. Architecturally, the major contributors to the enormity of the site of Tell el-Hammam, spreading approximately one square kilometer, are the cities of the Early Bronze Age (3600-2350 BCE), Intermediate Bronze Age (2350-2000 BCE), and Middle Bronze Age (2000-1550 BCE). The massive 6-meter-thick Early Bronze Age city wall rings the lower and upper Tells to an elliptical diameter of 500 x 750 meters. The same fortifications were refurbished and re-used during the Intermediate Bronze Age, and were later swallowed up by the construction of massive Middle Bronze Age fortifications up to 50 meters thick, including the city wall and outer rampart/glacis with multiple interior stone stabilizer walls.

*Tell es-Sa'idiyeh at Zarethan*

One of the best examples of Tell sites in the Jordan River Valley is Tell es-Sa idiyeh, which is located west of the mouth of Wadi Kufranja close to the point where it flows into the Jordan River. This impressive double mound is the largest Bronze and Iron Age site in the central Jordan Valley. Due to the abundant and well-made bronze finds at the site, it has been related to the Old Testament Zarethan' (1 Kings 4: 122; Chronicles 4: 17), a region where the bronze fittings for Solomon's temple in Jerusalem were cast (1 Kings 7: 23-46). Tell es-Sa idiyeh has also been associated with the accounts of Joshua and Gideon in the Old Testament (Joshua 3: 16; Judges 7)

*Tell Es-Sakhneh*

Cemetery has been discovered in the year of 2001. Thousands of artifacts found in those tombs related to the Chalcolithic and Early Bronze Age. The tombs were carved in the soft lime stone, the main forms of the tombs are: one chamber tomb; merged double chamber tomb; double chambers; and the artifacts.

*Tell Kreimah*

The site is a medium size Tell, located 140 meter to the west of the main Jordan Valley Road. Thousands of pottery shards related to many periods easily can be noticed at the site. Agricultural and housing activities by the locals, remains of a modern house at the top and many holes made by the tomb robbers can all be noticed.

*Tell Shouneh North*

Located in the middle of the New Shouneh city. Excavations started in 1985. The historical period at the Tell started in the Early Bronze Age. Many architectural features have been revealed. Recent developments have affected the site: more than 80% of the site has demolished during the construction of the new city center.

*Tell Tahuneh*

This site is located in the area of Al Kafrein Dam, directly on the northern edge of the main road leading to Amman from South Shouneh and offset from the South of Tell Hammam archeological site. The site looks

like a natural hill, part of the mountain range overlooking the Jordan valley. The top of the hill is made up of natural rock.

*Tell Umm Hammad (east )*

The site is located in the area of Deir Alla, just to the west of the road and the Jordan Valley, on the edge of Zarqa River. The site is an artificial hill, with pottery shards scattered on the surface of the site. The first survey of the site was done by the archaeologist Nelson Glock Milart in 1942 and next in 1953. Next, an overall archaeological survey team worked in the site in 1975-1976, followed by the British Institute of Archaeology, who conducted two seasons of explorations in the years 1982 – 1984. The site is currently used as Muslim cemetery.

*The Tomb of Abu Ubaydah (North of Deir Alla)*

Abu Ubaydah Amr ibn Algarah was a relative and one of the ‗Blessed Ten' companions of the Prophet Mohammed who were assured a place in heaven. Abu Ubaydah led the Northern Army of Muslims after the Prophet's death, and also contributed to the writing of the Holy Qua‗ran. He died during a plague in the central Jordan Valley where he is buried. An impressive modern mosque complex has now been built over Abu Ubaydah's tomb which serves as the principle Islamic centre in the Jordan Valley.

**Figure 33 - The Mosque hosting the tomb of Abu Ubaydah Amr ibn Algarah**

*Umm Hadhar*

Umm Hadhar stands out as a small outpost among a number of larger fortresses in the southeastern region of the Jordan Valley. Because of its strategic location Umm Hadhar controlled traffic on the road along Wadi Al Kafrein, and stopped access up from Jordan Valley to Wadi Al Sir, or vice versa, or possibly both. The main function of the fortress in Umm Hadhar was to control the caravans (Frangie and Salles 2009: 137-152). Umm Hadhar 1 (Hellenistic Period) is the main site on top of a hill. The remains of a

structure approximately 40.7 x 30.8 m, had foundation walls of small and medium stones, while a large cistern located in the center of the site possibly collected the runoff water from the roof during the winter season. Umm Hadhar 2 has remains of a small Hellenistic rectangular structure (16.5 x 13m). The pottery is late Hellenistic – Early Roman (Waheeb 1997: 463-468). Umm Hadhar 10 is Hellenistic and Byzantine in date.

*The Hydroelectric power station at Bakoura*

In 1927, Pinchas Rutenberg, a Russian immigrant and founder of the Palestine Electric Company (PEC), reached a unique agreement with HM King Abdullah I of Jordan to build the company's main hydroelectric power station. To this aim, canals and dams were built, creating a manmade island that harnessed the flow of the Jordan and Yarmouk Rivers to produce electricity. By 1932, the hydroelectric power plant began supplying electricity on both sides of the river and continued to do so until it ceased operations as a result of the Israeli Arab hostilities of 1948. In 1994, with the signing of the Peace Treaty by Jordan and Israel, the island was returned to Jordan but was leased with special usage and visitation status to Israeli and international tourists. Today a tour is offered from the Israeli entrance at Al Bakoura, where one can cross to the island, catch a glimpse of the river beneath and see the remnants of the power station. Military personnel schedule and coordinate opening of the fences on both sides, allowing tens of thousands of visitors per year to enter the island without the need for a visa. The Municipalities at both sides, supported by EcoPeace, intend to expand this area into a trans-boundary park, the Jordan River Peace Park, reaching 2 to 3 kilometers down the meandering river to the Jeser Al Majama.

*The castle of Karak*

The castle of Karak, close to the Jordan Valley, was only in Crusader hands for 46 years. It had been threatened by Saladin's armies several times but finally, surrendered in 1188, after a siege that lasted more than a year. Saladin's younger brother, Al Adil was governor of the district until becoming ruler of Egypt and Syria in 1199. The castle played an important role as a place of exile and a power base several times during the Mamluk Sultanate. Its significance lay in its control over the caravan route between Damascus and Egypt and the pilgrimage route between Damascus and Mecca. In the thirteenth century the Mamluk ruler Baibars used it as a stepping stone on his climb to power.

**Figure 34 – The Castle of Karak**

### 2.2.7 Infrastructure

*Main bridges over the Jordan River*

The Jordan Valley is connecting Israel with Jordan though the Sheikh Hussein Bridge in the north, and Palestine with Jordan through the King Hussein (Allenby) Bridge. The King Hussein Bride is located just outside Jericho city and is the only connection between the Palestinian West Bank and Jordan. The West Bank side of the King Hussein / Allenby Bridge is considered a border entry point by the Israeli Authorities. The Jordanian authorities recognize the bridge as an international border entry point, but in contrast to other border crossings with Israel, do not grant entry visas to foreign passport holders at this crossing. Palestinians traveling abroad must use this bridge to exit the West Bank into Jordan and then use the Queen Alia International Airport in Amman to fly abroad, because they are not permitted to use Ben Gurion Airport near Tel Aviv. Travel permits from both Israeli and Jordanian authorities are required, with varied stringency depending on the political situation. Israeli citizens are not permitted to use the terminal. Tourists who wish to travel to Jordan must be in possession of a visa from Jordan in advance. Those who leave Jordan via the King Hussein Bridge may return by showing the exit visa. Tourists and inhabitants of East Jerusalem may travel directly to an Israeli terminal, although Palestinians from the West Bank have to start the departure procedure at the special Palestinian border terminal in Jericho city.

*Road Network in Jordan*

The Dead Sea Highway (Route 65) is the major regional highway in Jordan that crosses the LJRV from north to south along the western Jordanian border and Dead Sea shoreline. All other roads leading to and leaving from the LJR Basin connect to this road. The road passes through some heavily populated urban areas where it is widened to four-lane divided with shops and buildings on both sides of the road.

This road is heavily used for local traffic as well as regional transportation. The traffic along Route 65 is dense, consisting of slow moving trucks carrying agricultural produce, farm vehicles, and local traffic. The road is heavily intersected by minor roads used by farmers. Most intersections with major roads are signalized. The Dead Sea Highway along the LJR Basin is poorly serviced for major sections, and there is a need for maintenance and improvements, particularly pavement, marking and signage. There are plans for upgrade the road into four divided lanes, or to construct a new highway parallel to the existing one.

*Traffic Safety*

Although no detailed information is available on traffic accidents in the Jordan Valley, the number of traffic deaths in Jordan as a whole is relatively high with 12 to 14 deaths per 100,000 inhabitants (ref. Jordan Traffic Institute, 2011). In 2010, Jordan had a total of about 1 million registered vehicles; including 770,000 4-wheeled light vehicles and 100,000 buses. Extrapolating the traffic accident percentages to the current population in the Jordan Valley would imply 25 – 30 traffic deaths on average in the Lower Jordan Valley. Statistics show that 63% of these casualties are among drivers and passengers of 4- wheeled cars and light vehicles, 33% among pedestrians and 4% among buses and heavy trucks. Improving road safety conditions along Route 65, including street lighting and separate protected pedestrian lanes and cross-overs will likely reduce the annual number of deathly traffic accidents considerably.

The government is considering to either upgrade the Route 65, or to construct a new parallel highway though the LJRV. The argument for constructing a new highway is currently stronger than that of upgrading the existing road, as upgrading entails demolition of existing village buildings and farms. In addition, increased traffic will increase noise, pollution and accidents in urban areas. Also the large number of intersections makes the existing highway unsuitable for international (through) traffic.

The Amman - Naur - Dead Sea (Route 40) is the main entrance in Jordan to the LJR Basin. It is a well engineered four-lane divided expressway, but there are steep inclines that slow down heavy trucks. The last segment of this road from Al Rama intersection to Al Quds intersection with Route 65 has been upgraded to a four-lane divided highway.

The Al Ardah – Al Salt Road (Route 24) connects with Route 65 approximately 32 km north of South Shouneh. This road is a rural two-lane two-way road of approximately 8 m wide carriageway that climbs along the wadi up to Al Salt for approximately 23 km. The intersection with Route 65 (Muthallath Al Arada) is a signalized —"T Intersection. The road at the intersection is widened to four-lanes, with shops and buildings on both sides. The road has some very sharp reverse and broken back curves and steep grades. The surface of the road needs some rehabilitation work to repair pavement cracks and pot holes. In addition, some protection from falling rocks and drainage works are needed.
Continuing north (approximately 15 km) along Route 65 from Muthallath (T - Crossing) Al Arada intersection is the intersection of the Kufranja – Ajloun Road. This is a two-lane, two-way undivided rural road that runs for about 24 km to Kufranja and Ajloun. This road has approximately 6 m of paved width. The road climbs up the hills and mountains towards Ajloun.

The Qalat (Castle) Al Rabad – Ajloun Road climbs along Wadi Al Yabis passing Qalat ar Rabad on to Ajloun (approximately 40 km). The road intersects Route 65 approximately 12 km north of Kufranja
– Ajloun Road. This two-lane road features approximately a 7 m wide paved carriage way. Further north (approximately 16 km) along Route 65 is the intersection with Abu Saeed – Irbid Road. This two-lane two-way road climbs about 34 km up to Irbid city. The Shouneh (North) – Irbid (Route 16) two-lane two-way road has been upgraded to a four-lane divided rural highway with shoulders.

The main public transport in the Jordan Valley in Jordan is by minibus. These buses travel generally frequently, but generally without fixed schedules, depending on the number of passengers being picked up. Minibuses generally stop anywhere at request. For many destinations in the Jordan Valley, the minibus is the only other public transport option. Some large air-conditioned bus companies are operating in Jordan as well, although mainly along the main routes such as from Amman to Aqaba or Amman to Petra. There is no information that the bus routes pass through the Jordan Valley. The system of shared taxis is also applied in Jordan, Like the minibuses, they pick up passengers and generally depart to specific destinations when full.

The Jordanian national interconnected grid transmits electricity from the power stations to the distribution substations and transformer substations in the Jordan Valley via 400-kV and 132-kV power lines. The grid has a clearly identifiable north-south axis. The national 400-kV power line runs outside the Jordan Valley from Aqaba via Amman and up to the Syrian border. In the north, the power grid is connected to the Syrian grid by means of a 230-kV and a 400-kV power line. In the south, there is a 400-kV connection to the Egyptian grid. The interconnected grid feeds the local distribution systems via which almost the entire population of Jordan, including in the Jordan Valley receives its electricity.

## 2.3 People

### 2.3.1 Population

The Jordan River Valley (JRV) houses a total population of about 500,000 people. The information with regard to the population numbers in the LJRV have been obtained through the Jordanian Department of Statistics (DOS) and consultations with the Jordan Valley Authority (JVA).

The population growth rate is estimated at respectively 2.2 %. The growth rate, during the period 1994-2004, was calculated at 2.6% and decreased to 2.2% during the period 2004-2010. A slightly further decline of the birth rate in Jordan is expected, however the communities in the Jordan Valley follows the national trends with some years delay and therefore the birth rate for the period 2011 to 2020 is estimated at 2.2%.

Separate from the registered Jordanian population, the LJRV houses large numbers of informal foreign workers originating mainly from Egypt and Iraq, and lately including some refugees from Syria. It is estimated that a total of about 250,000 informal people live in the LJRV today, many of them employed as temporary workers in the agricultural sector.

In addition, the United Nations had registered 619,000 official refugees from Syria in Jordan in August 2014, with over 80,000 registered in the refugee camp Za'atri, located close to the Syrian border, just outside the study area. However, the impact of these refugees on the population in the LJRV is limited, due to strict travel restrictions for Syrian refugees, enforced through checkpoints on the roads towards the Jordan Valley.

The table below provides an overview of the population figures.

**Table 9 - Estimated population in the study area (2010)**

| Population in the Jordan River Valley by District | Population 2010 |
|---|---|
| Northern Jordan Valley | 108.943 |
| Deir Alla | 67.925 |
| South Shouneh | 70.294 |
| *Informal population (according to JVA)* | *247.000* |
| Total formal population | 247.162 |
| **TOTAL, incl informal population** | **494.162** |

### 2.3.2 Socio-economic Situation

The native inhabitants of the Jordan Valley in the early 19th century are known as Al Ghawarna or Ghorani (meaning people of Al Ghor), who were involved in mixed farms that covered crop and livestock production systems. Semi-nomadic Bedouins also lived in the Lower Jordan River Valley and used the lands as grazing ground for their sheep and goats during the winter months because of its warm climate and

available fodder for their animals. However they moved their flocks up into the hills during the summer to avoid the intense heat.

The World Bank classified Jordan as an "upper middle income country." The GDP per capita rose by 351% in the 1970s, declined 30% in the 1980s, and rose 36% in the 1990s The GDP per capita for 2009 is estimated at USD 4,916. Since 2005 the economy has grown at an average rate of 4.3% per annum. For 2011 the estimation was made that the agricultural sector contributed 4.4%, the industrial sector 30.3% and the services sector 65.2% to the GDP (Source: gfmag.com/gdp-data-jordan). The life expectancy of the Jordanian people has risen during the previous decades. By 2011, the infant mortality rate (per 1000 people) was 14.9 and the life expectancy at birth for women was 75 years.

The Jordanian economy strongly depends on non-industrial sectors because of the limited natural resources and a weak industrial base. Low erratic rainfall and limited irrigation water resources constrain agricultural development in Jordan. Jordan is strong on industrial production of minerals but limited resources (natural and human resources) restrict other industrial developments. A modest natural gas field was discovered during the 1980s and presently it produces nearly 10% of the Jordan's electric needs. Large reserves of crude oil have been found that cannot yet commercial be exploited under present energy prices. These limited industrial development potentials have made public and private services into the main source of employment in Jordan.

The economic development in Jordan is severe hampered by political unrest in the region. Jordan itself enjoys a stable and enabling policy environment for economic development. It used to attract foreign investments and guest laborers from neighboring and Asian countries. However the political and military unrest in the region negatively affected socio-economic developments and resulted in an inflow of Palestinian, Iraqi and most recently Syrian refugees, also into the Lower Jordan Valley. These inflows have caused pressure in the local economy in particular on Jordan‘s heavily subsidized basic services like education, health and drinking water supply.

The GoJ made a major effort to promote agricultural development through public investment in irrigation development and the transformation of peasants into farmers. The Jordan Valley is one of the few areas with irrigation development potentials in Jordan: both water and suitable soil resources are available. To encourage peasants to invest in commercial production of high-value crops, a land reform program was implemented in the command areas of the irrigation systems and an enabling environment established. Many peasant households with customary land entitlements were selected as beneficiaries of the land reform on their expected capacities to acquire the technical and commercial capacities for managing farms on a commercial basis. A network of public and private agricultural service providers established that supported these peasants to develop their family farms into commercial enterprises producing irrigated high-value crops for the local and export markets.

The Jordan agricultural sector has to deal with political and socio-economic challenges in the region that negatively affected its economic performance. Export markets developed carefully over decades have been erased in very short periods due to social and military conflicts in neighboring countries. The sector is also confronted with increased competition from farmers in the region and the increasingly stringent environmental regulations connected with the chemical inputs applied and the reuse of treated and untreated wastewater. These developments demanded a dynamic agricultural sector that could quickly react on these external developments. But the Jordan economy faced problems in handling these constraints that have caused declining rates of economic growth and growing unemployment levels. The unemployment rate was estimated at 13% in 2012, however some analysts consider the rate to be much higher and their estimates reach up to 25% of the working age population. These political and technical

developments put the Jordanian authorities under growing pressure for the planning and implementation of lasting socio-economic reforms that will deliver greater economic prosperity and social justice to the Jordanian people, especially in the densely populated and economically prosperous regions, of which the Lower Jordan River Basin is one.

Within the Jordan Valley the development of irrigated agriculture during the last 40 years increased the population substantially from 70,000 in the early 1970's to about the registered 247,000 inhabitants today.. The GoJ policy was to promote the irrigated cultivation of high-value crops - fruits and vegetables- which are inputs and labor intensive. Due to the land tenure conditions the GoJ decide to implement a land reform in the command areas of the irrigation schemes and developed a family farm model of 3.5 ha. About 6.800 farm units were established in the Lower Jordan Valley and allocated to farming families who were considered to have the management capacities to engage in irrigated fruit trees and vegetables production. The settlement of these families and the development of their farms increased the labor demands sharply. Not only in the farming enterprises, also in construction, irrigation and agricultural support services draw workers and their families to the LJRB, this resulted in increased demands for public services, like education and health services. All these interrelated socio-economic processes contributed to a sharp increase of the population in the LJRB from the early 1960s onwards.

In the northern and middle zone the indigenous Ghorani and Bedouin farmer communities were the main beneficiaries of the land allocation but in the southern zone investors and absentee landlords obtained an increasing proportion of the farm holdings. The Ghorani families were of Arab and Palestinian decendency and were selected as beneficiaries because of their farming expertise and land entitlement inside the schemes. There are three influential clans among the indigenous farming communities living in the East Bank: the El Wakid and Ghezawi clans among the Ghorani communities and the Al Adwan clan in the Bedouin communities. The leaders of these patrilineal clans are the local opinion leaders who are influential in political and economic developments at local level. They have been very effective in convincing their clan members to invest in modern irrigation and crop production technologies.

The investors mainly live in Amman, Irbid and Balqa also benefitted from the land reform in the Middle and Southern Ghor. The GoJ was interested to attract the agricultural entrepreneurs to the Valley and to have them invest in capital-intensive irrigated agriculture. These entrepreneurs had experiences in irrigated agriculture and the export of high-value crops. Some have specialized in the production and marketing of specific crops, like strawberries of Hungarian pepper, for which they signed production and supply contracts with supermarket chains in the region and western countries. For other beneficiaries with an urban background farming is a secondary occupation and owning a farm provides them with social prestige and rent seeking opportunities. They either employ an experienced farm manager, who runs the farms for them, or they rent the farm to a tenant through a lease or a share-cropping arrangement[1].
The investors and family farms engaged in irrigated fruit and vegetable production need farm laborers for the labor intensive farm operations. In the Jordan part of the Lower Jordan Valley there are beside an official registered population of 258,000 inhabitants also 18,082 non-permanent agricultural laborers. The majority are non-Jordanians, who work as permanent, casual and seasonal laborers. Although it is becoming a GoJ policy to discourage guest workers and refugees from moving and settling in the Jordan

[1] A lease contract provides tenure security for the investor to earn back the initial investment in land development and on-farm water management system to attract investors. In a share-cropping arrangement the landowner and the tenant share the investment costs for crop cultivation and the harvested produce. For example, the landowner provides the land and external farm inputs (chemical fertilizer, pesticides and herbicides) and the tenant the labour, management and internal farm inputs (manure and seeds/planting materials), and they agree to share the resulting produce in a 40-60 or 50-50 proportion.

Valley, the intensive farms provide them with labor and shelter opportunities. Laborers were complaining that the influx of poor Syrian refugees has put the wage level for harvest workers under pressure.

Today, agriculture still dominates the socio-economic landscape of the LJRV. The World Bank classified Jordan as an "upper middle income country" however with significant economic inequalities: in the Jordan Valley there a small group of wealthy agricultural entrepreneurs, next to a large group of laborers who close to the poverty line of JD 32.6 per person per month. The importance of agriculture is expected to decrease in the LJRV. A shift from agriculture to service sector started during the 1990s and continues until today.

The table below provides an overview of some socio-economic parameters in the study area. These figures have been obtained from literature, from the Jordanian Department of Statistics (DOS) and supported by data from indexmundi.com These data reflect the status in the wider LJRB. This study did not include specific field data surveys in the LJRV itself and the data below should therefore be considered indicatively.

**Table 10 - Socio-economic parameters in Jordan, 2011**

| Socio-economic Statistics (2011)<br>Parameter | Amount | Unit |
|---|---|---|
| Average Household size | 6 | persons |
| Average Monthly Household Expenditures | 701 | JD |
| Average Monthly Per Capita Expenditures | 117 | JD |
| Average Monthly Income per household | 704 | JD |
| Illiteracy rate for persons aged >15 years | | |
| *Males* | *5* | *%* |
| *Females* | *12,6* | *%* |
| Gender Ratio (= males / females in %) | 106,4 | % |
| Labor Force Participation >15 years | | |
| *Males* | *63,4* | *%* |
| *Females* | *17,8* | *%* |
| Poverty rates | 12.5 | % |
| Unemployment > 15 years | | |
| *Males* | *11* | *%* |
| *Females* | *21,2* | *%* |
| Employment per sector (%) | | |
| *Agriculture, fishing, forestry* | *20* | *%* |
| *Mining, quarrying and manufacturing* | *9,5* | *%* |
| *Construction* | *15* | *%* |
| *Commerce, restaurants, hotels* | *20* | *%* |
| *Transportation* | *6,5* | *%* |
| *Services, others* | *29* | *%* |
| Basic Education (%) | | |
| *Males* | *51,3* | *%* |
| *Females* | *48,7* | *%* |
| Population Growth | *2.2* | *%* |

Within the study area, the size of households in Jordan is about 6 persons per household, which is comparable to the wider Middle East region. The differences in expenditures show slightly different pattern. Household and per capita expenditures in Jordan are resp. 701 JD and 117 JD (€ 728 and € 121). The Consumer Price Index for Jordan is about 65.55. Unemployment rates (percentages of the labor force without a job) are relatively high. Among the male population, unemployment rate 11%. Under the female population, unemployment rate is 21.2%.

There are considerable income disparities between the upper and lower strata of the society. A substantial proportion of the households (21.5) are living below the poverty line. The Gini Coefficient of Jordan confirms that large income disparities exist between the top 20% and the bottom 20% of the income earners.

Employment rates per economic sector show that Jordan has an estimated 20% of people working in the agricultural sector. Although detailed information on agricultural employment rates in the Lower Jordan Valley are not available, it may be expected that agriculture is more important here than at national levels. A different pattern can be seen in the construction sector, with 15% for Jordan. Finally the Service sector, including research and government, employs 39.8% in Jordan.

The gender ratio in the Jordan River Valley (number of males compared to number of females) is 106.4%. Illiteracy rates is relatively low (below 5%), but in females the average illiteracy ratio is 12.6%. Labor force participation for the male population is 63.4% in Jordan. Differences are larger for the female population: 17.8% of women participate in the labor market in Jordan.

The gender issue in Jordan is influenced both by national socio-economic conditions as well as by tribal traditions. In some rural areas, local Shari‘a courts have some jurisdiction over matters related to marriage, divorce and inheritance. The Jordanian National Commission for Women (JNCW) has established a network called Sham a (~~c~~andle”), which aims to combat violence against women by coordinating the efforts of both governmental and non-governmental organizations. In 2009, the JNCW established a Women‘s Complaints Office to receive complaints of discrimination and violence against women in private and public life and to raise awareness of these issues and provide legal aid, among other services. This work is carried out in collaboration with governmental and non-governmental organizations. There are also several NGOs that provide services to women, and a national register on violence against women has been established. In 2007, the Ministry of Social Development created the ~~F~~amily Reconciliation Centre” for victims of domestic violence.

### 2.3.3 Agriculture

Agricultural activities in Jordan are concentrated in the Jordan Valley and the Highlands. Besides some rain-fed agriculture in the Highlands, commercial agriculture is irrigated, both in the Highlands and in the Jordan Valley.

The communities that farmed in the LJRV had a reputation for the export of agricultural product to regional urban centers. The Jordanian and Palestinian communities, who are locally known as Al Ghawarna, were initially engaged in subsistence activities like herding, gathering and later cultivating cereals. Later they involved in the cultivation of wheat, barley, maize and vegetables, eventually irrigating these crops from water they obtained from rivers, streams, springs and wells inside the Jordan Valley and its side-wadis. In ancient documents the Al Ghawarna communities were praised for their irrigation practices and their capacities to export agricultural produce to urban centers in the region. Bedouins traditionally used the valley during winter months to forage their sheep and goats and then moved them to the fresher Highlands during the summer months.

In the 1950s, Jordan developed a strong interest in irrigation development to expand the agricultural output of the JRV. The Government of Jordan started the construction of the East Ghor Canal in the late 1950s, which later got known as the King Abdullah Canal. This main canal takes its water from the Yarmouk River and the streams flowing from the side-wadis of the river. The King Abdullah Canal supplies irrigation water to a series of irrigation schemes in the JRV and to drinking water processing plants of urban centers in the Highlands.

The development of a hydraulic revolution during the 1960s and 1970s has caused what El Musa (1994) called a —Sper Green Revolution" in the JRV. The expansion of the irrigated area and the successful application of Green Revolution technologies cause a boom to the production of high value crops like fruits and vegetables, which proved to be commercially highly profitable when exported to the regional and European markets.

The Government of Jordan enacted a number of policy and organizational concepts for the development and management of irrigated agriculture in the JRV. The Jordan Valley Authority (JVA) was established with the mandate to develop and manage the public owned irrigation systems and to carry out a land reform inside the command areas of the irrigation schemes. The JVA established a family farm model of 3.5 ha for the production of irrigated fruits and vegetables. The semi-public JVA organization allocated about 6,800 farm units inside the JRV study area to families of the indigenous Al Ghawarna and Bedouin farming communities and to investors from outside the valley, who were considered capable of developing and managing these resources intensive farms. A network of public and private sector irrigation and agricultural support service providers was established to assist these farming families to develop and manage on-farm irrigation systems, and to produce high value fruits and vegetables crops using the Green Revolution packages.

Over the last 60 years, irrigated areas in the Jordan Valley have steadily expanded from 9,300 ha in 1950 to over 23,000 ha in 2006 as part of public irrigation schemes. In 2009, the Ministry of Water and Irrigation in Jordan stated that there were 33,000 ha of irrigated land in the Jordan Valley. Cultivated crops in the Jordan Valley include vegetables, citrus fruits, bananas, field crops and trees among others.

Data from 2010 on water use in the Jordan Valley shows that agriculture is the main user with 172 MCM/yr. Water for domestic use (99 MCM/yr) probably includes water pumped from the Jordan Valley to Amman. While the total water use for irrigation in Jordan has remained constant over the last two decades,

the use of ground- and surface water for irrigation has decreased as irrigated agriculture in the Jordan Valley increasingly uses treated wastewater.

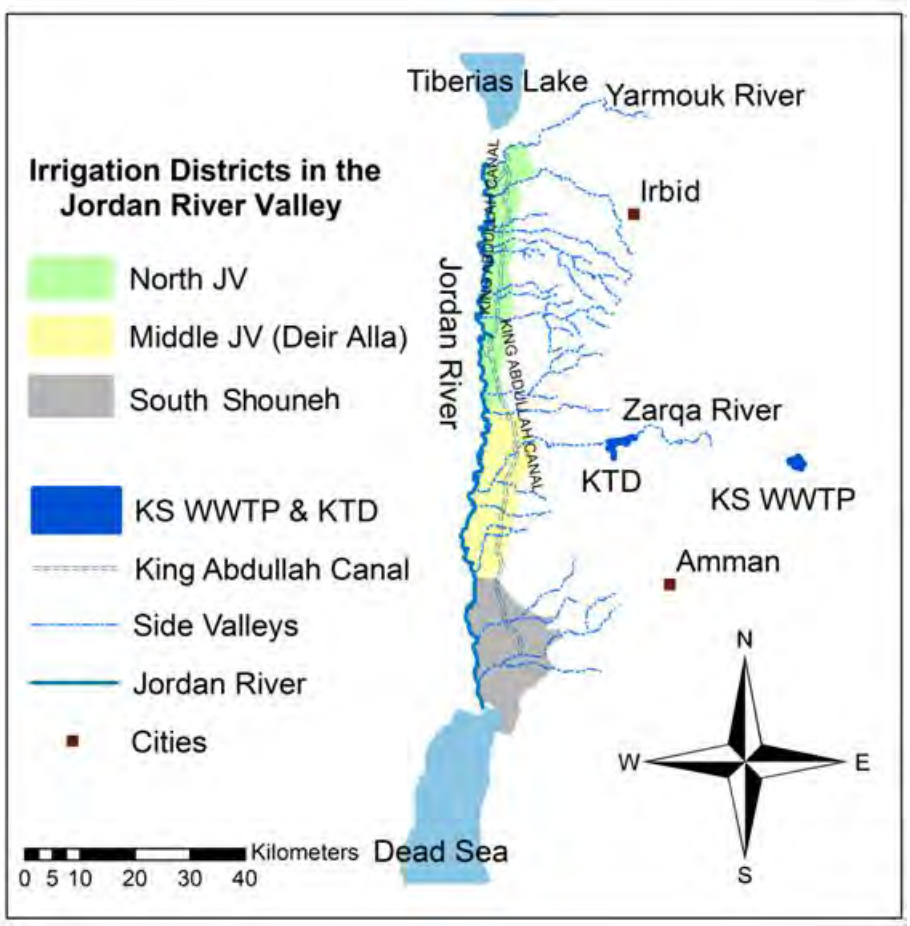



**Figure 35 – Irrigation districts in the Jordan River Valley**

The JVA planned, constructed and manages the public-owned irrigation systems and supplied irrigation water to the farm units, for which the owners developed and manage the on-farm water management systems. The JVA manages the KAC and the supplementary irrigation systems for supplying irrigation water to around 6,800 farms. The JVA has its regional headquarters in Deir Alla, which is responsible for the overall management of the system and the supervision of the three Irrigation Districts that are responsible for the operation and maintenance of the irrigation schemes in the various reaches of the KAC. The operation of the secondary irrigation schemes required intensive coordination with the agricultural water users to match water supply with demand[2].

[2] Along the KAC the JVA developed a series of irrigation systems that had their intake or Turn Out point in the KAC and their irrigation command areas varied from 100 to 1000 ha. These irrigation systems were public owned and supplied water on a volumetric basis through hydrants or FTA (Farm Turn-out Assembly) to the individual farm units. These family farms varied in size between 3 and 6 hectares and were lease to farming families who were selected on their land

The public funded agricultural research and extension services supported the individual farmers with enhancing their technical and managerial capacities for managing the on-farm irrigation systems and producing high value fruits and vegetables (e.g. greenhouses, drip irrigation, plastic mulch, fertilizer, new varieties, etc.). It has been a deliberate policy of the GoJ to encourage private agribusiness to involve in supporting the family farms to develop technical, managerial and commercial capacities for managing their farms and irrigation systems on a commercial basis.

During the late 1970s and 1980s, the JVA had to adjust its strategies to the increased competition for water resources between agricultural and residential users. With the expansion of the irrigation systems also competition for irrigation water between farmers in the head and tail reach of the systems became prominent. In addition, the domestic water supply expanded drastically which resulted in completion between agricultural and domestic water uses. The GoJ gave a higher priority to residential water uses and therefore agricultural water users had to enhance irrigation efficiency. The JVA changed from open to pressurized irrigation systems at scheme level and put pressure on farmers to use the water more efficiently.

To cope with water shortages at farm level JVA encouraged the farmers to apply on-farm water-saving irrigation technologies, to involve in demand management, and to blend treated wastewater with fresh water. JVA introduced crop specific water quotas and thereby restricted farmers in the head reach to expand the area planted with water demanding fruit trees. Farmers were encouraged to replace surface by drip irrigation systems. Initially these systems were directly connected to the Farm Turnout Assemblies or hydrants but later farmers were encouraged to have their own water reservoirs and pressure pumps at farm level that made them independent from the operation hours of the JVA pumping stations. Farmers were also encouraged to match the water demands of the crops they planted with the water quantities that JVA guaranteed them to supply. In the tail ends of KAC main canal and the irrigation schemes JVA encouraged the farmers to blend treated wastewater with fresh water as a strategy to cope with water shortages. Finally, JVA encouraged the private sector organizations to collaborate with the public sector and provide irrigation and agricultural support services (drip irrigation and green houses) to individual farmers. The innovations in on-farm water management required high investments for which the investors could obtain the capital from it commercial partners but the family farmers needed support of the public sector banks.

The table below provides an overview of the agricultural statistical data in the Jordan Valley (2011) as presented by NCARE (National Centre for Agricultural Research and Extension).

entitlements and management capacities to develop and managed the privately owned on-farm water management systems (personal communication JVA official).

**Table 11: Agricultural Statistics in the Jordan River Valley in 2011**

| 3ITEM | Total | North JV | Deir Alla | South Shouneh |
|---|---|---|---|---|
| Population | 237000 | 110000 | 65000 | 62000 |
| Total area / dunum | 725553 | 183763 | 242600 | 299190 |
| Arable land / dunum | 330932 | 135647 | 85285 | 110000 |
| Number of farms | 10800 | 3830 | 5000 | 2570 |
| Planted Area (dunums) | | | | |
| Non irrigated Area | 65647 | 35647 | === | 30000 |
| Irrigated Area | 263520 | 100000 | 83520 | 80000 |
| Number of springs | 17 | 9 | 3 | 5 |
| Number of dams | 6 | 2 | 1 | 3 |
| Storage capacity (MCM) | 161.25 | 26 | | 60.25 |
| Number of groundwater wells | 355 | 2 | 3 | 350 |
| Fruit trees Area (dunums) | | | | |
| Citrus | 60849 | 51216 | 7435 | 2198 |
| Palm | 12326 | 1586 | 4136 | 6604 |
| Bananas | 15420 | 3349 | 71 | 12000 |
| Other trees | 8017 | 3679 | 2660 | 1678 |
| Vegetable and field crops area (dunums) | | | | |
| Fall planting | 89805 | 25299 | 34506 | 30000 |
| Spring planting | 71460 | 18430 | 32415 | 20615 |
| Wheat area | 26950 | 17650 | 900 | 300 |
| Barley area | 16100 | 14000 | 1400 | 700 |
| Forest land | | | | |
| Natural forests areas | 86050 | 3050 | 63000 | 20000 |
| Synthetic forest areas | 55692 | 3000 | 35000 | 17692 |
| Number of agricultural units | 7255 | 3040 | 2580 | 1635 |
| Nurseries | | | | |
| Ornamental plants | 15 | 4 | 6 | 5 |
| Fruit tree | 35 | 12 | 10 | 13 |
| Vegetables | 48 | 8 | 23 | 17 |
| Agricultural installations and other utilities | | | | |
| Agricultural materials shop | 89 | 24 | 53 | 12 |
| Number of Plastic houses | 63650 | 7850 | 47600 | 8200 |
| Tomato paste Factory | 1 | === | 1 | === |
| Fertilizer Factory | 2 | === | 2 | === |
| Plastics Factory | 2 | === | 1 | 1 |
| Bolster Factory | 4 | 1 | 2 | 1 |
| Livestock | | | | |

| | | | | |
|---|---|---|---|---|
| Number of sheep | 163967 | 61064 | 52950 | 49953 |
| Number of goats | 77987 | 23000 | 27000 | 27987 |
| Number of cows | 128/ 5153 | 62/ 2952 | 51/1516 | 15 / 685 |
| Number of poultry farms (meet) | 26 Capacity )396600( | 2 Capacity )51000( | 2 Capacity )15600( | 22 Capacity )330000( |
| Fish farms | 12 | 4 | 5 | 3 |
| Number of hives | 10343 | 4893 | 3450 | 2000 |
| Number of horses | 470 | 300 | 60 | 110 |
| Number of camels | 250 | 30 | 45 | 175 |
| Fixed clinics Veterinary | 13 | 5 | 4 | 4 |
| Mobile veterinary clinics | 1 | 0 | 1 | 0 |
| Agricultural machine | 43 | 16 | 21 | 6 |
| Small tractor | 161 | 55 | 70 | 36 |
| Large tractor | 403 | 127 | 141 | 135 |

**Table 12: Irrigated area (ha) with winter vegetables in the Jordan River Valley in 2011**

| Irrigation Districts | Irrigated winter vegetables | Open field surface | Open field drip | Plastic tunnels drip | Plastic houses drip | Irrigated summer vegetables |
|---|---|---|---|---|---|---|
| North JV | 2185.7 | 74.8 | 1363.2 | 59.9 | 688.5 | 1551.0 |
| Deir Alla | 5052.4 | 34.4 | 2773.7 | 178.3 | 2066 | 728.7 |
| South Shouneh | 3196.3 | 35.3 | 2785.4 | 100 | 276.1 | 821.8 |
| Ghor Safi (*or South JV*) | 3974.7 | | 3919.7 | 5.1 | 49.9 | 851.4 |
| **Total** | **14409.1** | **144.5** | **10842.0** | **343.3** | **3081.5** | **3952.9** |

Source: DOS 2011: Table 5.1.9/10

Coping with water shortages and the growing competition on the export markets affected the profitability of irrigated agriculture on the Jordan Valley during the 1990s. Neighboring countries (e.g. Turkey, Lebanon and Syria) also invested in irrigated agriculture and produced similar fruits and vegetables that put the prices increasingly under pressure. In addition, political and economic upheavals in the region (e.g. Gulf and Syrian Wars) had detrimental effects on export markets of agricultural commodities. Another development was that the costs of irrigation increased drastically due to investments in on-farm water saving irrigation technology and wastewater treatment. Finally the customers of vegetables started to question the quality of vegetables and fruits grown with reused wastewater. The increased competition of the commodity markets, the increased irrigation costs and the growing public concern on product quality contributed to a decline of the agricultural sector‘s contribution to Jordan‘s Gross Domestic Product from 8.1% in 1991 to 3.6% in 2005 (Venot et al. 2003).

JVA has been successful in its effort to promote water saving on-farm irrigation systems. In 2011, farmers practiced drip irrigation on 99% of area cultivated with winter vegetables in the Lower Jordan River Basin. The main winter vegetables planted in the Jordan Valley are tomatoes, eggplants, cucumbers, peppers and squash. In 2011 farmers planted summer vegetables on 27.4% of the land that potentially can be

irrigated due to water shortages. Besides tomatoes, eggplants, peppers and cucumbers the main summer crops are melons, mallow, okra and green beans.

The table below shows the main fruit trees cultivated in the various districts. Citrus and olives become less prominent moving from the northern to the southern zone of the Jordan Valley. Bananas are prominently grown on farms in the Southern Ghor. Dates and grapes become more prominent moving southwards from Deir Alla to South Shouneh.

**Table 13: Productive tree crop areas per Jordan Valley district in 2011 in ha**

| District | Citrus | Bananas | Dates | Olives | Others | Total |
|---|---|---|---|---|---|---|
| North JV | 5662.3 | 212.6 | 137.3 | 327.8 | 358.2 | 6698.2 |
| Deir Alla | 835.8 | 1.9 | 480.6 | 74.6 | 199.2 | 1592.3 |
| South Shouneh | 151.7 | 1423.2 | 403.4 | 86.7 | 70.4 | 2135.4 |
| Ghor Safi | 6.1 | 324.0 | 49.3 | 18.1 | 81.6 | 479.1 |
| TOTAL | 6655.9 | 1961.7 | 1079.6 | 507.2 | 709.4 | 10905.0 |

Source: DOS Agricultural Statistics 2011:Table 5.1.52/53/54/55/56

Three systems of irrigation water supply to farms have developed in the Jordan Valley over the recent years. Firstly, a water-quota system was introduced for citrus farmers in the northern part of the Jordan Valley and JVA gradually decreased the quota to force the farmers to invest in water-saving technology. Secondly, blending of fresh and treated wastewater was promoted below the point in the KAC where fresh water is taken for drinking water supply in Amman. The remaining fresh water in KAC beyond that point was mixed with treated residential and industrial wastewater from the King Talal Dam in the Zarqa Valley. Thirdly, JVA allows farmers in the tail ends of KAC and the irrigation schemes to pumps ground and drainage water into their farm reservoirs and mix it with the blended water that JVA supplied. In the southern part of the valley many farmers have private wells, which yield salty water, and therefore blend it with water obtained from other sources. Some commercial farmers in the bananas belt have invested in desalinization plants to improve the water quality before they use it for irrigation (Venot et al 2007:23).

A growing numbers of commercial farmers are shifting to water and fertilizer saving water management techniques on their farms. Entrepreneurial farmers have invested in drip irrigation and fertilizer application systems, where fertilizers are added to the irrigation water. Some of them have fully computerized systems in their green houses for precision irrigation, which has led to high investments. These entrepreneurs have secured export markets for their produce through supply contracts, and therefore can afford to make these investments for which commercial banks are offering them loans. However, family farmers consider these investments high and risky in the absence of secured supply contracts. Considering the public interest in maintaining the export position and saving on water and fertilizers, the Jordanian Government provides these commercial farmers with loans that carry low interest rates to make for them investments in modern green houses with precision irrigation systems more attractive.

Livestock production systems do not get much attention of the agricultural technicians and surveyors. Crops production systems are dominant in the farming system of the Jordan Valley. However, annually trefoil clover is grown on 330 ha as fodder crop for dairy cattle and many flocks of goats and sheep can be observed feeding on the natural vegetation in the valley and on crop residuals. Peasants and shepherds living in the vicinity of the irrigation schemes have involved in mixed farming and extensive livestock production systems. The livestock production systems are of crucial importance for the Low External Input

Sustainable Agriculture (LEISA) mixed farming systems and the semi-nomadic groups, which justifies that statistical data is collected on livestock production in the Jordan Valley through agricultural surveys.

Between 2001 and 2008, JVA facilitated that agricultural water users organized themselves into voluntary Water Users Associations (WUA) per irrigation scheme. The WUAs were organized per pumping station that supplies water to an irrigation scheme. Till 2008, farmers formed 26 WUAs for irrigation schemes, which cover 74% of the KAC command area. Of these WUAs, 60% have signed Participative Irrigation Management (PIM) agreements with JVA. Through these agreements JVA involves the WUA in monitoring the water distribution, detecting and repairing water leakages and dealing with illegal water use by farmers. The WUA leaders receive funding from the JVA and their members and yearly review the progress jointly with JVA and their members. The leaders of some WUAs demand from JVA a further transfer of operation and maintenance responsibilities to them of the pressurized irrigation systems. However, JVA is reluctant to do so because it is concerned that the WUA leaders do not yet have acquired the technical and managerial capacities to manage the irrigation systems in a professional and sustainable manner.

**Table 14: Progress in WUA formation in the Jordan River Valley**

| Districts | Command area (dunums) | WUAs | WUAs served areas |
|---|---|---|---|
| Northern Irrigation District | 9431.1 | 10 | 6357.9 |
| Middle Irrigation District | 7229.8 | 4 | 4482.5 |
| Karamah Irrigation District | 5953.9 | 6 | 5953.9 |
| Total | 22615.0 | 20 | 16794.3 |

Source: JVA 2008 and GIZ 2011

Venot et al. 2007 distinguished 4 farming systems to deal with diversity in socio-economic conditions in irrigated agriculture in the Jordan Valley. The farming systems are: 1) Family farmers, who either own or rent the land and grow vegetables in open fields; 2) Entrepreneurial farmers, who adopt capital- and labor-intensive techniques such as greenhouses, and earn high returns on investments; 3) Family farmers or absentee-investors owning and managing citrus orchards in the north of the Jordan Valley, who are interested in respectively the economic value and social prestige of citrus farming; and 4) Mixed farms managed by low-income smallholders managing extensive vegetable cultivation and small orchards.

In the Jordan Valley, a distinction can be made between High External Inputs Agriculture (HEIA) entrepreneurs, HEIA family farms and the Low External Inputs Sustainable Agriculture (LEISA) family farms however it is difficult to quantify. The distinction HEIA and LEISA farming styles is quite new for the Jordan Valley and therefore the Department of Statistics is not yet collecting data that could help to understand the diversity and levels of external inputs used in the various farm units using different farming styles.

The HEIA farming style applies the Green Revolution technologies, like chemical fertilizers, chemical control of weeds and pests, and genetically modified seeds. These inputs are produced externally to the farms by agro-chemical industries. The HEIA entrepreneurs are investing beside HEIA also in the expansion of their enterprise by buying additional farm units that are offered for sale on markets.

The LEISA farming style covers a series of practices that serve to reinforce ecological principles that are in

line with local ecosystems[3]. The Low External Inputs Sustainable Agriculture (LEISA) farming styles apply inputs that preferably are prepared internally of their farms or partners' farms like manure and seeds and planting materials. The farmers use biological rather than chemical pest control techniques and mechanical weed control rather than herbicides. The family farms are involved in a continuous struggle for resilience of their combined farm-household systems and some consider that the HEIA farming style gives them the best opportunity to survive. A growing minority trusts more in the LEISA farming style to prevent what they consider the subordination of the farms to the major actors on the resources and product markets.

For this socio-economic baseline, a classification matrix is applied that uses a farming style and a farm organization dimension. For farming styles the distinction between HEIA and LEISA technology is applies and for the farm organization the distinction is made between entrepreneurial, cooperative and family farms.

In Jordan, industrial farming is being developed by entrepreneurs and large groups of family farms specifically in the Middle Section of the LJRV. Other farmers face the problem that their farm units are fragmented and their turn over is generally too limited to effort and apply extensive technologies.

The entrepreneurial farm is private property of the shareholders and its purpose is profit-making usually only in on-farm activities[4]. Therefore these farms are engaged in commodity production on the basis of commercial principles. The cooperative farm is communal property of its members and its purpose is income generation for its members through on-farm and non-farm activities. The family farm is private property usually of the family members in which social, economic, cultural and financial functions are combined. The purpose of the family farms is secured subsistence/income for the family members and therefore they can be engaged both in subsistence and commodity production[5] through on-farm and non-farm activities. Professional farm managers are in charge of the entrepreneurial and cooperative farms and they recruit laborers for the farm operations respectively through labor markets, and from the cooperative's members. They have to or try to pay market conform wages. However, the family farms recruit their labor from its members, who do not receive wages but subsistence security on the basis of solidarity within the family network.

[3] Low External Input Sustainable Agriculture (LEISA) is receiving increased attention of scientists and policy makers, both as a sustainable alternative to Green Revolution-technologies that make intensive use of internally produced inputs, and as a strategy of sustainable agriculture in resource-poor environments where no or very few external inputs are used. In areas with a high production potential, LEISA is considered to simultaneously improve ecological sustainability, food quality and farmers' socioeconomic conditions by minimal application of chemical inputs to reduce pollution of soil and water resources, chemical residuals in food, and financial incentives to increase labor production and ignore non-commercial functions of the agricultural sector. LEISA cover different set of agricultural practices that have different names (organic, ecological, bio-dynamic, and conservation agriculture (http://www.odi.org.uk/sites/odi.org.uk/files/odi-assets/publications-opinion-files/3143.pdf).

[4] Profitability is considered an achievement or success criteria for the managed enterprise.

[5] Subsistence production deals with the production of use values, which are consumed by the producers themselves, while commodity production deals with the production of exchange values or products that are exchanged through market forces.

**Table 15 - Classification matrix of farm organizations and farming styles in the Jordan Valley**

| Farming style Farm organization | High External Input Agriculture (HEIA) | Low External Input Sustainable Agriculture (LEISA) |
|---|---|---|
| Entrepreneurial farm | Capital intensive farms controlling moderate to large holdings where specialized crop and livestock production systems are practiced using hiring specialized farm managers and wage laborers | No information available yet |
| Cooperative farm | Capital intensive farms controlling large holdings specialized in intensive crop and livestock production systems using the management and labor capacities of the cooperative‘s members | No information available yet |
| Family farm | Widespread in family farms practicing specialized irrigated crop productions for which they depend on external upstream and downstream flow of commodities. These farmers had to take loans and engaged in production and marketing contracts to minimize risks are commonly called ‚farmer‘. | Widespread in family farms practicing mixed and subsistence farming and who want to control the internal resource base and to avoid risks of commercial loans. The farmers that focus on subsistence food production are commonly called ‚peasants‘. |

The HEIA and LEISA farming styles have beside distinct capital intensity level also different socio-technical-commercial networks that serve them. The farms applying HEIA farming style have made high investments in intensive irrigated crops or livestock production systems. The HEIA farms get their technical and commercial support from upstream and downstream mainly private service providers and they often have production and marketing contracts for integrated service packages with agro-business companies or supermarket chains. The farmers applying the LEISA farming style use internally produced inputs and therefore are weakly connected with the external input suppliers: the agri-businesses and bio-technology companies. The peasants miss connections with the product markets, however the commercial family farms are connected to processors and market for environmentally and animal friendly produced food. In many countries public sector has established regulations and organizations, to supervise the trade and application of chemical inputs, which focus on the HEIA farming style. Usually LEISA farmers voluntarily abandon the use of chemical inputs and have consultation platforms with consumers/environmental organizations and knowledge partners where the stakeholders decide jointly on guidelines and standards and supervision and labeling procedures of LEISA farming products.

**Export of Agricultural products**

The JRV is the major agricultural production region for Jordan. On a national scale Jordan‘s agricultural export accounts for about 550 Million JD (2014), mainly to the United Kingdom, The Netherlands, Canada, Germany and France, and to a lesser extend to Saudi Arabia and the Gulf States. The export increased by 12% compared to 2013, and includes 888,000 tons of fruits and vegetables. About 85% of the export

relates to vegetables, particularly tomatoes. In addition, Jordan exported 613,000 heads of cattle in 2014, mainly to the Gulf Region.

The Jordan Valley is divided into three distinct agricultural zones, because of different agro-climatic and ecological conditions. The northern zones receive more rainfall; have lower temperature and better soils. These conditions enabled the farming communities to cultivate field crops and tree crops under rain fed conditions. The middle and southern zones receive marginal rainfall; have poorer soils and higher temperatures and therefore higher evaporations. These zones are unsuitable for rain fed agriculture and Bedouin nomadic communities used to rear their goats and sheep flocks there. The altitude, climate, soil types, and water resources are different and unique for each of the agricultural zones.

**Agricultural Zones in the Jordan Valley**

The Jordan Valley consists of four agricultural zones; three of them are included in this study as was shown earlier. Cropping pattern, water sources and soil quality vary from one zone to another. Soil types in the Jordan Valley can be classified into class A, B, C and D. In Class-A soil is deep and level and has good permeability, low salinity, and no clay (Marl). This type of soil is suitable for all types of crop. Class-B soil is similar to Class A but is shallower, less permeable, and slightly more saline. Class-C and class D soils are shallow and have high salinity and low permeability, as a result of the impediment offered by its clay layers. Following is a description of the cropping pattern in each zone.

**Agricultural Zone 1 (North Shouneh;** *also known as North Ghor***)**

Zone 1 has a semi-arid climate. The soil classes A and B constitute about 84% of the total area in this zone. Fruit trees in zone 1 constitute about 56% of the total area, and about 44% of the total fruit area of the Jordan Valley in the years 2005 and 2013 (See tables below).

**Table 16 - Land suitability, soil type and cropping pattern (2005 & 2013) in the Jordan Valley**

| Characteristics - 2010 | Zone 1 | Zone 2 | Zone 3 | Zone 4 |
|---|---|---|---|---|
| Land suitable for agriculture (du) | 132 000 | 123 300 | 142 600 | 83 700 |
| Land suitability for agriculture (%) | 27% | 26% | 30% | 17% |
| Actual agricultural % per zone | 84% | 95% | 33% | 50% |
| Fruit trees % per zone (2005) | 56% | 10% | 31% | 9% |
| Field crops % per zone (2005) | 16% | 15% | 10% | 2% |
| Vegetables % per zone (2005) | 28% | 75% | 59% | 89% |
| Percent area of soil class-A | 43% | 29% | 18% | |
| Percent area of soil class-B | 41% | 27% | 17% | |
| Percent area of soil class-C | 13% | 12% | 7% | |
| Percent area of soil class-D | 3% | 32% | 58% | |

Source: DOS 2005, (du = dunum =1,000 $m^2$)

| Characteristics - 2013 | Zone 1 | Zone 2 | Zone 3 | Zone 4 |
|---|---|---|---|---|
| Fruit trees % per zone (2013) | 55% | 12% | 18% | 5% |
| Field crops % per zone (2013) | 14% | 6% | 9% | 1% |
| Vegetables % per zone (2013) | 32% | 82% | 73% | 93% |

Source: DOS 2013, (du = dunum =1,000 $m^2$)

The semi-arid climate, the fertile soil and the abundance of good water quality of the KAC enables this zone to support most types of agricultural crops. However, farmers are likely to enlarge the area devoted to fruit trees at the expense of vegetables and field crops because (1) fruit prices are always higher and more stable than those of vegetables; (2) the risk of changing agricultural policies, especially in drought seasons, is less with fruit trees; and (3) growing fruit trees always occupies a higher social rank in the minds of farmers and is seen as a sign of wealth and power.

**Agricultural Zone 2 (Deir Alla)**

As illustrated in the tables above, the soil classes A and B in Zone 2 (Deir Alla) constitute about 95% of the total area in this zone. Fruit trees in Zone 2 constitute about 10% of the total area. The soil in this zone is suitable for growing both fruit trees and vegetables. Vegetables and field crops are grown on 90% of agricultural land of this zone, which is a very good percentage and meets the goals of the initial development plans for this zone. The cultivated area mainly depends on the availability of water of low quality, as a result of the partial use of treated wastewater from the King Talal Dam. Typical vegetable crops, mainly tomato, constitute the highest percentage of farmed vegetables. Although the marketing problems for tomatoes each year from excess production, the farmers still practice this typical agriculture.

**Agricultural Zone 3 (South Shouneh)**

Class-C and class-D soils form about 65% of the total agricultural area of this zone. The low-quality water from the KTD adds to soil problems and decreases crops productivity. Another noticeable aspect is the increase in fruit trees, especially banana during the years 2000 – 2005 with slight decrease in the current year which constitute 49% of fruit trees in the zone. This increase is at the expense of vegetables. In contrast to Zone 1, which has fairly abundant water of good quality and fertile soil, making fruit farming feasible, zone 3 has no such conditions, and irrigating fruit trees there depends mainly on private wells with highly saline groundwater. Major problems with growing vegetables in this zone stems from typical farming practices, excess production, and marketing difficulties.

**Crop Water Requirements**

In 2012, Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ) carried out a comprehensive study to determine the crop water requirements in the Jordan Valley under surface and drip irrigation systems, open and greenhouse agriculture, and in the different agricultural zones of the Valley.

**Table 17 - Water needs for the most important fruit trees in the Jordan Valley ($m^3$/dunum)**

| Crop | Area | Irrigation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Citrus** | Northern Shouneh | Surface | 40 | 41 | 75 | 106 | 136 | 139 | 143 | 131 | 104 | 79 | 63 | 41 | 1098 |
| | | Drip | 34 | 38 | 67 | 97 | 123 | 125 | 125 | 120 | 96 | 71 | 57 | 38 | 991 |
| | Deir Alla | Surface | 41 | 46 | 83 | 118 | 151 | 154 | 159 | 146 | 116 | 88 | 70 | 45 | 1217 |
| | | Drip | 38 | 42 | 75 | 107 | 137 | 139 | 139 | 133 | 106 | 79 | 63 | 42 | 1100 |
| | Southern Shouneh | Surface | 29 | 35 | 66 | 95 | 125 | 140 | 144 | 135 | 104 | 72 | 41 | 27 | 1013 |
| | | Drip | 26 | 33 | 60 | 87 | 112 | 126 | 130 | 123 | 94 | 66 | 36 | 25 | 918 |
| **Bananas** | Northern Shouneh | Surface | 53 | 58 | 107 | 152 | 204 | 230 | 246 | 226 | 179 | 135 | 108 | 69 | 1767 |
| | | Drip | 48 | 53 | 96 | 137 | 184 | 206 | 221 | 203 | 161 | 122 | 97 | 62 | 1590 |
| | Southern Shouneh | Surface | 41 | 50 | 94 | 136 | 187 | 230 | 247 | 232 | 178 | 124 | 69 | 46 | 1634 |
| | | Drip | 37 | 45 | 84 | 122 | 168 | 207 | 222 | 209 | 160 | 111 | 62 | 41 | 1468 |
| | Safi* | Surface | 50 | 55 | 103 | 139 | 184 | 220 | 232 | 217 | 174 | 120 | 76 | 46 | 1616 |
| | | Drip | 45 | 50 | 93 | 125 | 166 | 197 | 209 | 195 | 156 | 108 | 69 | 41 | 1454 |
| **Palm** | Northern Shouneh | Surface | 48 | 54 | 100 | 144 | 184 | 188 | 194 | 178 | 142 | 107 | 86 | 55 | 1480 |
| | | Drip | 44 | 48 | 90 | 129 | 167 | 170 | 176 | 161 | 129 | 96 | 77 | 50 | 1337 |
| | Deir Alla | Surface | 53 | 60 | 111 | 159 | 204 | 209 | 216 | 198 | 158 | 119 | 95 | 61 | 1643 |
| | | Drip | 48 | 54 | 101 | 144 | 185 | 188 | 195 | 179 | 143 | 107 | 86 | 56 | 1486 |
| | Karamah** | Surface | 37 | 46 | 88 | 129 | 169 | 189 | 195 | 183 | 140 | 98 | 55 | 36 | 1365 |
| | | Drip | 33 | 42 | 80 | 117 | 152 | 170 | 176 | 165 | 126 | 89 | 50 | 33 | 1233 |
| | Safi | Surface | 45 | 50 | 97 | 132 | 166 | 180 | 183 | 172 | 138 | 95 | 60 | 36 | 1354 |
| | | Drip | 41 | 45 | 87 | 119 | 150 | 162 | 165 | 155 | 125 | 86 | 54 | 33 | 1222 |
| **Grapes** | Northern Shouneh | Drip | | 18 | 62 | 117 | 148 | 152 | 157 | 125 | 69 | | | | 848 |
| | Deir Alla | Drip | | 20 | 69 | 130 | 165 | 169 | 174 | 139 | 76 | | | | 942 |
| | Karamah | Drip | | 15 | 54 | 105 | 137 | 153 | 157 | 129 | 67 | | | | 817 |

*Safi is outside the borders of the Jordan River Valley. The Safi area starts at the southern shores of the Dead Sea and extends south.

**Karamah is a small town south of Deir Alla and north of Southern Shouneh.

**Fruit Trees**

The table above lists the monthly and annual water requirements for the most common fruit trees in the Jordan Valley; the areas of Northern Shouneh, Deir Alla and Southern Shouneh represent the previously described agricultural zones 1, 2 and 3 respectively. Citrus and Banana trees are the most common especially in zone 1, but there has been a growing interest of palm trees during the last decade.

**Vegetables and Field Crops**

The monthly and total water requirements for the most common vegetables and field crops grown in zones 1, 2 and 3 of the Jordan Valley are presented in the table below. In the Jordan Valley, vegetables are either grown in open fields or plastic greenhouses; and thus water requirements vary in each case. The tables below indicate this. It can be seen that in zone 1, no greenhouse agriculture is practiced. The most common zone for greenhouses is number 2.

**The Two-Period Water Allocation System**

The Jordan Valley Authority (JVA) delivers water according to a system that separates two periods in the year, as shown in below table. The period between December and April of every year is called the winter period; the period with low temperature, low solar radiation, high humidity and scattered rain. The water in this period is not scarce; farmers can receive the volumes they want, according to their demand.

**Table 18 - The water allocation system used by JVA in 2003 and 2014**

| Crop | December to April | May to November |
|---|---|---|
| Banana | On- demand | 8 mm / day |
| Citrus | | 4 mm / day |
| Vegetables | | 2 mm / day |

Source: Petitguyot, 2003

| Crop | December to April | May to November |
|---|---|---|
| Banana | On- demand | 6 mm / day |
| Citrus | | 4 mm / day |
| Vegetables | | 1.5 mm / day |
| Palm | | 5 mm / day |
| Other trees | | 3 mm / day |

Source: JVA, 2014

However the system has only two limits, the first one deal with operational hours; that pumping stations are not operated more than 6 to 8 hours per day. The second one is organizational; that farmers water demand requests have to gather and reach a minimum number of 8 to 10 in order for JVA decide to operate the pumping station. However, these two limits generally don't bother farmers, since irrigation requirements are low at this period due to frequent rains, and farmers usually agree to gather in this

request. Normally around the first of May, this system shifts to another one (summer period), based on a weekly rotation schedule, according to which farmers receive water.

The allocated amounts are fixed for this whole period, and calculated according to the category of crop they grow. To be able to compute this allocation, JVA uses the cropping patterns that are recorded by ditch-rider's (authorized employees who monitoring miss uses pertaining irrigation process) records every month for every farm units, allocation is decided according to a rough pattern that separates bananas, citrus, vegetables and permanent fallow. The quotas reported were designed at the time of the initial irrigation project, according to computed crop requirements, and are still considered as reference allocations. The two periods are named respectively "on-demand" and "quota" period. The dates of shifts may change from one year to another, as the on-demand system starts with the first heavy winter rainfalls, generally at the end of November. The highest volumes are distributed during the quota period, related to highest crop needs. Shift from on-demand to quota also corresponds to an increase in allocated volumes. Consumptions of irrigation water in May and months after often reach up to five times the winter ones.

**Water Allocation of Extra Hours**

In addition to this allocation, JVA may decide to allocate specific volumes to farmers when they have specific needs. As consumptions are usually accounted as hours of water delivery, these selective allocations are usually named "extra-hours". Usually, these extra-hours are decided by the JVA and granted in same amounts to every farmer at specific periods (for example at the time of land preparation, especially in green houses, or due to exceptionally hot weather). In some cases, JVA may decide to operate the pressurized network during an additional day (extra-operational day). Farmers may also ask individually for extra-hours. Their request is considered in Stage Offices where JVA decides to grant them water or not according to their current resource needs. These requested extra-hours usually range from 2 to 8 hours a week. This system is useful as it is the unique source of flexibility in a quite rigid allocation system. However, this is considered one source that enhances both equity and transparency.

**Irrigation Water Tariff**

A water tariff for irrigation water in the JRV was first introduced in 1961, when the price was set at 1 fills per cubic meter. In 1966, this rate was raised to 2 fills per cubic meter for users above 1800 $m^3$ per month. The JVA allocates water to farmers every month according to the irrigated area and to crops needs. In 1974 the price was raised to 3 fills per $m^3$ regardless of consumption. Again in 1989, the price was raised to 6 fills per $m^3$ and, farmers are billed according to their consumed water, metered monthly until 1995. As many investments were done to improve efficiency and to construct dams, it was decided to increase this tariff, and thus increase cost recovery. Present system uses increasing block rate pricing as explained in below table. Despite this increase, it is estimated that only 30% of JVA operational costs were covered through billing in the year 2001 (JVA, 2001).

As a result of this system, a farm unit with only vegetables (average consumption of 2 mm/day or 1800 $m^3$/month for 30 du) pays 0.011 JD/$m^3$ = (1000 $m^3$*0.008 JD/$m^3$+800 $m^3$*0.015 JD/$m^3$)/1800 $m^3$), a citrus farm (4 mm/day) = 0.018 JD/$m^3$, and a banana farm (8 mm/day) = 0.026 JD /$m^3$.

**Table 19 - The water tariff system used by JVA till 1994 and since 1995**

| Water Consumption $m^3$ / Farm Unit / Month | Tariff – till 1994 (JD / $m^3$) |
|---|---|
| 0 – 1000 | 0.008 |
| 1001 – 2000 | 0.012 |
| 2001 – 3000 | 0.020 |
| > 3000 | 0.035 |

| Water Consumption $m^3$ / Farm Unit / Month | Tariff – since 1995 (JD / $m^3$) |
|---|---|
| 0 – 2500 | 0.008 |
| 2501 – 3500 | 0.015 |
| 3501 – 4500 | 0.020 |
| > 4500 | 0.035 |

Source: JVA, 2015.

**Production Prices**

The prices to produce vary according to its marketing stage and location within the market. For the purposes of this study, the farm gate prices were adopted. Following is a summary of the different types of produce prices as defined by Food Agriculture Organization's (FAO) experts.

*Farm Gate Prices*

The farm gate prices are in principal the prices received by farmers for their produce at the location of farm. Thus the costs of transporting from the farm gate to the nearest market or first point of sale and market are charges for selling the produce, by definition, not included in the farm gate prices. Thus the prices collected from such markets may be adjusted for these costs to arrive at farm gate prices. In a number of countries, some commodities are sold at farm-gate, while others are sold at markets or delivered to purchasers. Sometimes the recorded off-farm prices are adjusted to the farm-gate equivalent by allowing transport costs but in many cases no adjustment is made.

In many developing countries, agricultural marketing is not well organized and farmers use the entire range of distributive channels: farm-gate, local village markets, wholesale and retail markets and sales of export crops to marketing boards. In order to approximate farm gate prices information on the marketing channels used and quantity sold for different crops and other products is required. Average prices should then be worked out using the output disposed of through various channels as weights. Thus the prices that producers receive when they sell their output should be used, as the attempt to separate the trade and transport margins is usually neither practical nor useful. Choosing gate prices in the analysis is just to ensure no interference in the analytical process other than farming costs and/or water cost, therefore, benefit-cost analysis is based on solid basis.

*Wholesale Prices*

After an agricultural product leaves the farm-gate, it may pass through one or even two wholesale markets and a chain of middlemen before reaching the retailer from whom the ultimate consumer buys it. In a primary wholesale market, the wholesale price of a product may refer to the price at which the wholesale buyer makes purchases from the produce-seller or his agents. This price would differ from the price the producer-seller gets, depending upon whether the buyer or the seller bears the incidental charges; and if

both bear them, then in what proportion. In a primary wholesale market, the wholesale price of a product may also refer to the price at which the wholesaler offers it for sale to the retailers, etc. This price should exceed the price by the wholesaler's margin of profit. In a secondary wholesale market, the wholesale price of a product may refer to the price at which the wholesaler sells it to the retailers, etc.

This price should exceed the price by transportation charges, incidental expenses and margin of profit. The effect of the above is that if the notional price received by the farmer for an agricultural product at the farm gate is to be derived from any of the above types of wholesale prices, it will be essential to make arrangements for determining the magnitude of deductions on account of transportation and marketing charges, etc. Wholesale prices of agricultural products are collected in most countries. These prices are required for three broad reasons. Firstly, the wholesale markets are usually well organized and consequently wholesale prices are easy to record. Secondly, wholesale prices are quoted throughout most of the year and can, therefore, be obtained with the needed frequency, whereas farm gate prices are obtainable only for that period after the harvesting of crop over which the agricultural producer disposes of his surplus. Lastly, the dealers in a wholesale market are usually well informed of the supply and demand situation of the product, so that the wholesale prices tend to reflect the sensitivity of the market to forces of supply and demand; this essentially is the element of price statistics of greatest interest to most economists and administrators.

*Other Production Prices*

Apart from wholesale and retail prices, which are very often available in many countries, some other type of price data is sometime available in many countries. The two famous types of prices, which are very often quoted, are "export prices" and "prices fixed by the government/supported prices". Depending upon the commodities and needs, these prices can be adjusted to arrive at farm gate prices which are required by policy makers. A brief detail of these prices is given below.

*Export Prices*

Export prices are determined in export markets for products intended for delivery outside the customs boundary of the country. Export markets are also described as terminal wholesale markets, where the valuation of the product is made as "free-on-rail", or "free-alongside-ship" or "free-on-board". If the producer (seller) sells his product in such markets, the notional farm gate price is worked backwards by deducting from the export price the transportation charges and all other incidental expenses.

*Agricultural Support Prices*

Prices of some of the crops at the farm gate markets are fixed by Government to follow various economic policies relating to welfare of farmers or to obtain food-grains or any essential crops for distribution through various plans and programs (e.g. poverty alleviation or rural development programs) or to develop foreign trade. Normally such prices are listed annually and are applicable to the total country. The agricultural support prices have various categories depending upon price policy instruments.

These can be termed as: (a) guaranteed minimum prices; involvement prices in which farmers are encouraged to grow certain new crops which do not have developed assured market and government assures farmers that in case of any difficulty or an abrupt fall in the price level government would either buy the produce or provide cash subsidies to the farmers. Generally such subsidies are provided through extension workers; and (b) fixed purchase prices in which to provide direct benefit for foreign trade or in case of commercial crops (e.g. sugar cane) to safeguard interest of farmers Government announces fixed prices.

**Fish Production in the Eastern Jordan River Valley**

Although fisheries legislation has been in place (and essentially unchanged) since 1943, there is no designated authority in Jordan responsible for fisheries management. The Ministry of Agriculture, however, has broad regulatory powers in the field of commercial fishing in the Territorial Waters of Jordan and, through the Agricultural Code of 1973 (Part IV, Articles 180-186, on Aquatic Resources) administers the licensing of fishermen and vessels, mainly for regulating the fishing sector in Aqaba. However, no regulations have been developed to regulate fish ponds in the Jordan Valley, separate from the requirement to undertake environmental impact assessments for new project initiatives.

*Policy Framework*
There is no designated authority in Jordan for fisheries management and, accordingly, the development of fisheries management policy has not occurred to any great extent. Fisheries are administered by the Ministry of Agriculture with this administration being restricted to licensing of fishermen and fishing vessels and simple regulations such as the prohibition of explosives for fishing.

The administration of the small marine fisheries industry of Jordan is undertaken within the broader context of marine environmental management. In particular, Jordan is active in protecting its coral reef areas (which form the basis of a thriving tourist and recreational fishing industry) and therefore restricts commercial fishing activities and harmful fishing methods in these coral reef areas. However, this does not relate to fish ponds activities in the Jordan Valley.

*Fish Production in the Jordan Valley*
Producing fish in the Jordan Valley started in 1965. Currently there are around 20 fisheries of different producing capacities in the Valley. Table 13 below lists the major fisheries in the Jordan Valley along with their annual production which total at around 700 tons/year. All these statistics are from 2012.

In addition, fish is produced in the King Abdulla Canal (approximately 20 tons/year) and in a number of dams (approximately 30 tons/year).

Almost all fisheries rely on ground water resources for fish production. Effluent is filtered and re-used in irrigation. Farmers appreciate the nutrient content of this water. Several studies by the Ministry of Agriculture and the Ministry of Water and Irrigation have indicated that there is more potential for the production of fish from the Jordan Valley. Lack of financial resources and the know-how have hampered this sector from reaching its full potential. It is worth noting that currently, Jordan produced only 5% of its fish consumption.

**Table 20 - List of the main fisheries and associated annual production in tons**

| | Location | Zone | Fish Type | | Production | Number of Basins | | | Area |
|---|---|---|---|---|---|---|---|---|---|
| | | | Comb | Carp | (ton) | Cement | Earth | Fiber | (ha) |
| 1 | Al Mansheya | 1 | 30 | 22 | 52 | 3 | 11 | 52 | 47 |
| 2 | Ghor Albalawneh | 2 | 20 | 40 | 60 | 12 | 24 | - | 70 |
| 3 | Al Kipran | 3 | 15 | 40 | 75 | 5 | 12 | - | 70 |
| 4 | Ghor Athahadat | 2 | | 14 | 14 | - | 5 | - | 20 |
| 5 | Ghor Masood | 2 | | 125 | 125 | - | 9 | - | 110 |
| 6 | Sharia Shamalia | 1 | 5 | | 5 | | 8 | | 3.5 |
| 7 | Al Karama | 3 | 100 | | 100 | 36 | 10 | | 14 |
| 8 | Sharia Shamalia | 1 | 5 | | 5 | 5 | | | 5.2 |
| 9 | Tahara Dharat | 2 | | 20 | 20 | 8 | 12 | | 11 |
| 10 | Ghor Al Balawneh | 2 | | 70 | 70 | - | 7 | - | 40 |
| 11 | Al Cannal | - | 4 | | 4 | 4 | - | - | 2 |
| 12 | Sharia Janubia | 3 | 1 | | 1 | 12 | 1 | - | 2.5 |
| 13 | Valleys | 3 | 15 | 7 | 22 | 6 | 5 | - | 6.5 |
| 14 | Al Ramah | 2 | | 7 | 7 | - | 5 | - | 6 |
| 15 | Al Bakura | 1 | 1 | | 1 | | 2 | | 2 |
| 16 | Sharia Janubia | 3 | 5 | | 5 | 1 | | | ? |
| 17 | Al Mashara | 1 | 1.2 | | 1.2 | | 3 | | 1.6 |
| 18 | AL Ramah | 2 | | 2 | 2 | | 2 | | 1 |
| 19 | Al Balawneh | 2 | | 120 | 120 | | 15 | | 150 |
| 20 | Al Bahath | - | 18 | | 18 | 1 | 12 | | 10 |

### 2.3.4 Tourism

Tourism is one of the most important sectors in Jordan's economy. In 2010, over 8 million people from various countries visited Jordan, of which approximately 3.6 million tourists. Since 2003, when Jordan's tourism deteriorated in response to the war in Iraq, the sector saw a gradual growth, not to mentioned hundreds of thousands of Iraqi refugees. In 2005 Amman was hit by three bombing attacks at various hotels, which lead to a second dip in arrivals towards the end of 2005 and into 2006. In 2007, the sector had its best performance yet with 6.7 million visitors. Since then Jordan saw a steady growth up to the 8 million people visiting the country in 2010.The annual revenues from foreign visits mounted to about 3.5 billion dollars, of which approximately 1.01 billion JD was generated by the tourism sector. The major

tourist attractions of Jordan are the ancient sites like Petra, the religious tourist sites in the Jordan Valley and the Western Highlands, the seaside sites at Aqaba and the Dead Sea.

Within the Lower Jordan Valley, the three main tourist destinations in Jordan are : (1) the Jordanian east coast of the Dead Sea, which has evolved into a major hub of both religious and health & wellness tourism in the region; (2) The site Bethany Beyond the Jordan, where according to Christian traditions Jesus was baptized by of John the Baptist's; and (3) Mount Nebo, visited according to Jewish traditions by the prophet Moses. Health tourism focused on the Dead Sea area and several international hotel chains have established hotels with health resort for patients with skin and respiratory disturbances.

The private sector in Jordan has invested heavily in the infrastructure for tourism in the form of luxury hotels, spas, resorts, and real estate projects. The focus of the investments is on the affluent Persian Gulf vacationers in Amman for sightseeing/shopping and in Aqaba for seaside vacations. These investments may have also positive spin off to the number of visits to the Lower Jordan Valley.

In addition, Jordan also invested in nature conservation through the Azraq Wetland Reserve, the Dana Biosphere Reserve and the Mujib Nature Reserve. The latter is the lowest nature reserve in the world, with a spectacular array of scenery near the east coast of the Dead Sea, close to the Lower Jordan Valley. The reserve is located within the deep Wadi Mujib Gorge that enjoys a magnificent bio-diversity, which is still being explored and documented. Over 300 species of plants, 10 species of carnivores and numerous species of permanent and migratory birds have been recorded.

The National Jordanian Tourism Strategy for 2011 – 2015 aims to build upon the significant achievements made since the launch of the first strategy in 2004, which resulted in significant annual growth until 2009, when the global financial crises emerged. In 2010 the tourism sector accounted for 12.4% of Jordan‘s GDP. During the last few years the tourism sector in Jordan experiences a slight decline. The focus of the 2011 – 2015 Tourism Strategy is to enhance public – private partnerships and introduce world class tourism regulations; to increase spending of international tourists throughout the year, to improve marketing and promotion of Jordan as prime tourist destination using also using e-marketing and social networks, using the high potentials widely available in Jordan. Arrivals to Jordan are at approximately 1.6 million visitors, and about 22,000 people, mostly Jordanians and male, work in the tourism sector. The average length-of-stay is 4-5 nights.

The JRV has considerable tourism potential and offers numerous historical, scenic and religious attractions. Tourism contributes between 7 and 14% to the economy of Jordan. Tourism in the JRV is strongly linked to the unique geographic features and its historic, religious, cultural and archeological features. Tourist destinations include health/spa tourism, nature areas, and cultural heritage (including religious) sites. Many international tourists combine a day trip to the Jordan Valley as part of their overall vacation itinerary.

However, tourism facilities are still relatively undeveloped in the JRV. The potentials in terms of recreation, thematic site visits and touristic tours are huge. The JRV is the home of a unique combination of tourist attractions. The archaeological and biblical sites have been described earlier in this report. The Jordan River is one of the sacred places, both historically and symbolically, for Muslims, Jews and Christians throughout the world. In addition, the flora and fauna inside the valley are very diverse as a consequence of the area‘s particular geological and climatic conditions. Potentials to be further developed could include hiking or biking along the Jordan River and Dead Sea Trails, camping, rock climbing and boating in dam waters along the Jordan River or in the Jordan River itself. Other potentials could be religious tours such as a Pilgrims Path of the Companion of the Prophets (Islamic tour), the Hajj Trail (regional tour), a journey

in the Footsteps of Moses, John, and Jesus in the Land of Moab, and many others. In addition, there could be potentials for deepening the linkages between established tourism accommodations and rural communities, such as organizing excursions and traditional meals in Arab and Bedouin communities, guided tours to nature reserves and bird watching, and horse and camel riding in the desert.

Further the Jordan River feeds the Dead Sea, which has no outlet and has the geographical reputation as "the lowest point on earth," lying almost 400 meters below sea level. This results in high evaporation and in extremely high contents of salt and other minerals. Swimming in the Dead Sea water is beside a special experience also considered to have curative effects for skin and respiratory diseases. Finally huge numbers of migratory birds fly yearly twice through the Jordan Valley moving from their breeding grounds in North and West Europe and their wintering grounds in South and East Africa. This diversity of tourist attractions gives the Lower Jordan River Basin the potentials to become one of the main tourist destinations in the Middle East Region.

However for developing these potentials the government will have to create a supportive policy environment. The tourism sector is very sensitive to political tensions in the region and the number of tourists decline sharply when disputes escalate. Although tourists become more adventure-oriented, they avoid destinations where they consider that their safety is at risk. The socio-political developments in Middle East with its growing encounters between political and religious fractions and alliances had negative effects on the Jordan Valley‘s reputation as a diverse and safe tourist destination.

The table below provides an indication of the main tourism indicators in the Jordan Valley. These figures are based on information from the Jordanian Ministry of Tourism & Antiquities (2010) supported with data from the Department of Statistics (2010) and some assumptions.

**Table 21 –Jordan River Valley Tourism Indicators (2010)**

| Indicator | Jordan (2010) | |
|---|---|---|
| | Nation | JV* |
| Foreign Visitors per Year | 3,644,267 | 491,000 |
| Local Visitors per Year | 451,444 | 8.638 |
| Number of Hotels available | 487 | 28 |
| Number of Beds available | 46.141 | 2.496 |
| Number of Hotel Guests | | |
| Bed Nights – foreigners | 4,557,024 | 24,651 |
| Bed Nights – nationals | | ? |
| Same Day Visitors (for + nat) | 3,690,112 | 387,215 |
| Revenues from Tourism | 1.01 B JD | 11.1 M JD |
| Employees in Tourism sector | 41,900 | 2,266 |
| Main Tourism Season | July, August, Sept | July, August, Sept |

* JV = in the Jordan Valley, excluding Dead Sea

*Italic* = best estimate

The Baptism site in Jordan is visited about by about 80,000 foreign tourists per year, while Mount Nebo, along the boundary of the Lower Jordan River Basin is visited by 394,993 foreign visitors and 1566 Jordanian nationals per year. The Dead Sea in Jordan is visited by 16,873 foreign visitors and 7,072 local visitors per year. Based on these figures it has been assumed that a total of about 491,000 foreign tourist visit the study area on an annual basis.

Most visitors come to the area on a one-day basis. Only about 1% of foreign visitors stay overnight in the study area during their trip, leading to approximately 134,000 Bed Nights per year in the study area. Most of the international tourists have night accommodation in other parts of the region, mostly in Amman.

The revenues from tourism in the study region cannot be separated sharply from the national tourist revenues. Direct revenues in the region include hotel and restaurant costs, local travel costs, purchase of goods and souvenirs and admission fees to various sites and attractions. Indirect revenues relate international flights, day trips to wider parts of the region, and the theoretical percentage of tourists that decide to come to the one of the three countries for reasons directly related to touristic sites in the Lower Jordan Valley.

It is estimated that approximately 1% of the total tourism revenues within Jordan is directly earned in the study area, or about 11 million Jordanian Dinars out of approximately a total tourism related national revenue of 1 billion JD.

### 2.3.5 Industry

The industrial sector is weakly developed in the Lower Jordan Basin. Agriculture related services including industries supplying greenhouses, on-farm water management equipment and agricultural inputs are the major forms of industry in the LJRV. An initiative was taken to develop a fruits processing plant; however it failed in the opinion of many farmers.

The Jordanian section of the Lower Jordan Valley houses a number of mainly small industrial operations, including:

- The Wadi Rayyan Free Zone, between Pella and Karamah, including a gold and jewel factory.
- The Pella Trading Gypsum Board plant;
- The Indian Jordanian Chemical Company;
- The Insustrong Polystyrene Factory south of El Arda;
- A small polystyrene factory between Sleikhat and Karn;
- The Jordan Plastics Factory at Facku Rama;
- The Jordan Fertilizer Company north of Arda; and
- The Travertine Company Ltd. (TRAVCO) located in the Middle Jordan Valley at Fanoush – Ghor Damia.

Agricultural developments in the LJRV had strong links with the service sector but contributed marginal to industrial development. Sophisticated water management equipment is imported. Jordan has an advanced position in the production of phosphate and potash fertilizers but the plants are in Aqaba because of the transport advantages. USA and European agri-business companies dominate the markets for agricultural seeds and chemical inputs. Many of these international companies have their headquarters in Amman and one sales and service office in the valley.

Agriculture processing industries have a poor base in the JRV. Fruits and vegetables production is focused on fresh products that are directly sold to the Jordanian consumers or exported. During the 1980s the Jordanian Government invested in the establishment of a processing plant for fruits and vegetables with support of the European Union. The processing plant was established in Deir Alla, and the Department of Industries and a local organization of commercial farmers jointly managed it for the production of tomato paste. The farmers liked the plant since it enables them to process their low-grade tomatoes or to sell their

products when prices dropped too much. Farmer leaders have the opinion that management of the plant deteriorated after the Jordanian Government ousted the farmer representatives from the management and sold the plant to a foreign private investor, who was interested in its assets. The remaining agro-industries are small-scale family enterprises for the processing of minor agricultural products like grains, olives and dates.

The backward linked industries in the JRV consist predominantly of small industries for the construction sector and package industry. There are several quarries that produce materials for the construction of buildings and infrastructures in the north-eastern governorates of Jordan. Some quarries even export marble. There are also several metal processing plants in the central and southern part of the Jordan River Valley that produce metal frameworks of greenhouses and install these for commercial farmers that invest green houses. These small plants spread over the valley that produces wooden and plastic crates and boxes for the commercial farmers, for packing their produce in accordance with the demands of the export markets.

At the southern end of the Dead Sea, outside the Jordan River Valley, the Arab Potash Company has built a potash processing plant with vast evaporation ponds. The plant is located at Karak in the Ghor Safi District and the ponds cover over 10,000 hectares along the shore of the Dead Sea to evaporate and extract potash from the mineral-rich waters. The total production for the year 2011 was 2.26 million tons of which 77.2% was exported via the Aqaba Port mainly to Arab and Asian countries. The remaining 22.8% were sold to local users and inland processing industries in Aqaba, like the Arab Fertilizers and Chemicals Industries (KEMAPCO), the Nippon-Jordan Fertilizers Company (NJFC) and the Jordan Bromine Company. The Arab Potash Company has developed into one of the world‘s leading potash exporters.

Other industrial sites in the Jordan River Valley include small stone quarries, cement production, pumps, tubes, pipes, textiles, leather, furniture, paper, printing, chemicals, metals, mechanical and electrical equipment, and transport.

In November 2013, Israel and Jordan agreed on construction of a multimillion-dollar joint industrial zone on the border between Israel and Jordan near Beit She‘an (Bissan). This is considered to be the first large-scale economic co-operation project since the peace treaty was signed in 1994. It is foreseen that the Israeli section of the park will include offices, warehouses, export and trade-related activities, while the Jordanian section will include various large scale industrial production complexes.

The park will consist of two parallel industrial and employment zones that will be connected by a bridge spanning the Jordan River. From both sides, only authorized personnel and visitors will be allowed to enter the industrial park, while Israeli law will apply to the Israeli side and Jordanian law to the Jordanian side. A new governmental body called the Jordan Gateway Authority will be created to oversee activity on the Israeli side of the park. Movement of employees from both nationalities within the Park limits will not be restricted.

However, there are serious environmental concerns related to this project because of its chosen location on pristine land on the banks of the River Jordan. EcoPeace proposes that the site location be reconsidered and moved to land adjacent to the existing crossing point at Sheikh Hussein Bridge.

### 2.3.6 Human Water Demands and Supply

The human water demands in the Jordan River Valley have been divided into two categories: domestic/industrial and agricultural water demands. An assessment has been made of the current domestic and industrial water demands based on the available population data in the year 2010, and per capita water requirements. For the sake of uniformity these per capita water requirements have been set throughout the basin at 90 $m^3$ per capita per year.

Agricultural water demands in the valley have been assessed on the basis of agricultural land use, current cropping patterns and crop water requirements. A distinction has been made between vegetables in the open field; vegetables in green houses, fruit trees and field crops. The agricultural water demands have been defined on the basis of currently utilized agricultural lands, and the potential agricultural lands that have not been developed so far.

Water demands for livestock, fish farming and industrial activities have been made on the basis of their current size and extension in the valley, in combination with data from earlier work done by the Austrian Research Centre in their water resources management study for the Jordan River Valley.

The total water demands are not fully met by actual water supply figures. In general the basin experiences a gap between the required water demands and the actual water supply, as elaborated below as well. The table below provides a summary of the total human water demands in the Jordan River Valley in 2010.

**Table 22 - Assessment of the water demand in the Jordan River Valley districts for 2010**

| **Total Domestic Water Demands** | | **2010** |
|---|---|---|
| JMD 1 | Northern Jordan Valley | 6,536,580 |
| JMD 2 | Deir Alla | 4,075,500 |
| JMD 3 | South Shouneh | 4,217,640 |
| JMD 4 | *Informal population (according to JVA)* | *7,410,000* |
| JMD 5 | to Amman | 60,000,000 |
| **TOTAL ($m^3$ / yr)** | | **82.239.720** |

| **Total Agricultural Water Demands** | | **2010** |
|---|---|---|
| JAD 1-4: North JV | Zone 1 (87,000 dunum) | 103,596,865 |
| JAD 5-8: Middle JV | Zone 2 (90,000 dunum) | 107,169,170 |
| JAD 9-12: South Shouneh | Zone 3 (55,000 dunum) | 65,492,271 |
| | **TOTAL** | 276,258,306 |

| | |
|---|---|
| **Total Water Demands ($m^3$ / yr)** | **358,498,026** |

The domestic water demand has been calculated using the assessment of the current valley population and the national domestic water use per capita presented in the tables below. The per capita domestic water demands are very variable between the three riparian states and between the urban and rural populations. For the assessment of the current domestic water no differentiation has been made between the lower per-capita water consumption in rural villages and the higher consumption in urban agglomerations, and the annual per-capita water demand is supposed to grow to 60 $m^3$ / yr today up to 80 $m^3$ / yr per person in 2050.

The Jordan Valley Authority (JVA) in Jordan delivers water according to a system that separates two periods in the year. The period between December and April of every year is called the winter period; the period with low temperature, low solar radiation, high humidity and scattered rain. The water in this period is not scarce; farmers can receive the volumes they want. However they have to collaborate with the neighbors since the JVA only operates the pumping stations along the main KAC canal when farmers along a tertiary of secondary canal coordinate their demands and jointly request bulk water supply.

Normally around the first of May, this system shifts between the demand and supply operation modes that are named respectively "on-demand" and "quota" systems. A weekly rotation schedule is applied and farmers have fixed water duties based on the crops and areas they want to cultivate. To be able to compute this allocation, JVA uses the cropping patterns that are recorded by ditch-riders. The dates of shifts may change from one year to another, as the on-demand system starts with the first heavy winter rainfalls, generally at the end of November. The highest volumes are distributed during the quota period, related to highest crop water demands. Shift from on-demand to quota also corresponds to an increase in allocated volumes because during the summer season the irrigation systems are operated at their peak design capacities.

The actual water supply in the Jordan River Basin is presented in below table. As shown here, specifically in the southern most irrigation zones suffer from current water shortages, which are estimated to be around 90 MCM / yr.

**Table 23- Water Demand versus Supply in the Jordan River Valley in 2010**

| Jordan River Valley | Number | Unit | Demand Type | Demand (CM) | Actual Supply (CM) | Deficit (CM) |
|---|---|---|---|---|---|---|
| North JV | 108,943 | Population | Domestic | 6,536,580 | 6,536,580 | 0 |
| Deir Alla | 67,925 | Population | Domestic | 4,075,500 | 4,075,500 | 0 |
| South Shouneh | 70,294 | Population | Domestic | 4,217,640 | 4,217,640 | 0 |
| Informal | 247,000 | Population | Domestic | 7,410,000 | 7,410,000 | 0 |
| To Amman | | | Domestic | 60,000,000 | 60,000,000 | 0 |
| | | | | | | |
| North JV | 87,000 | Dunum | Agriculture | 103,596,865 | 77,697,649 | -25,899,216 |
| Deir Alla | 90,000 | Dunum | Agriculture | 107,169,170 | 75,973,510 | -31,195,660 |
| South Shouneh | 55,000 | Dunum | Agriculture | 65,492,271 | 32,746,135 | -32,746,135 |
| | | | | | | |
| | | | **Total 2010** | 358,498,026 | 268,657,014 | -89,841,012 |

### 2.3.7 WEAP Model for the Lower Jordan River Basin

This section provides a description of the water model that has been developed for the Lower Jordan River Basin under this study. The model has been constructed using the open source "Water Evaluation and Planning" (WEAP) software. This WEAP model has been built upon earlier models that have been developed for the area, including the WEAP model for the Roadmap for the Rehabilitation of the Lower Jordan River, the Harmonized Water Database for the Lower Jordan Valley; the Model for Water Supply and Demand for Effective Water Management Allocation in the Jordan Valley and the WEAP Model for an Integrated Approach to Sustainable Management of the Jordanian Water Resources under Global Change by GLOWA.

WEAP is based on the principle of closing the water balance in a basin, in order to understand the balance between the total water resources on the one hand, and the total water consumption on the other hand, leading to a model for the monthly and annual flows in the Lower Jordan River, as well as the salinity levels in the river. A preliminary step to devising future planning alternatives is creating a model of the present state, or current account.

General issues relate to the river modeling, including the timeframe, salinity, direct contact between groundwater and the river, runoff, and evapotranspiration from the river. The water demands and supply that have been used in the model have already been discussed in section 2.3.6.

**Time Frame**

The hydrological year taken in this study starts at October 1$^{st}$ until September 30$^{th}$ of the next year, with monthly model steps in between. The model strives to describe the current situation (current accounts) of one average year, which is this WEAP model runs from October 1$^{st}$ 2009 until September 30$^{th}$ 2010.

**Salinity**

In the WEAP model, salinity is the only indicator of water quality. Designated salinity values of water sources are mentioned below and are documented in the model itself. The calculations of Chloride (Cl) concentrations in the different reaches are based on simple mass balance with no decay mechanisms: Salinity of all the water sources is fixed throughout the year:

- Particularly, the salinity of Tiberias Lake does not change with water level and is fixed at 280 mg/L;
- Runoff salinity is 50 mg/L;
- Salinity of return flow from irrigation is 800 and 1500 mg/L for fresh and saline water respectively;
- Salinity of Israeli Sewage is 350 mg/L;
- Effect of evaporation on salinity in the Jordan River itself is neglected.

**WEAP Model in the Eastern LJR**

*Upper Yarmouk*

The Yarmouk was historically the largest tributary of the LJR after Tiberias Lake. Today most of its water is diverted by a series of dams, including the Unity Dam (El-Wihdeh) at the border with Syria with a storage capacity of 125 MCM. Its reservoir gets rarely more water than 1/3 of its full capacity, and the Jordanian share is fully utilized, including for the KAC. Downstream of the Unity Dam there are some tributaries, the largest one being Maqaren, but there is no data on their flows. In the WEAP model the Upper Yarmouk

has been modeled with the recorded inflow into the Unity dam and ends at Adassiya Dam and the diversion to the KAC.

*Yarmouk River below Adassiya Dam*

The Yarmouk River below the Adassiya dam is disconnected from its upstream segment, since Jordan diverts all the water to the KAC except for some 25 MCM/Yr that is provided to Israel according to the peace agreement, and some additional water for winter storage at Tiberias Lake. This water is pumped by the Israeli JVWA from the Yarmouk at station No. 229662 into Tiberias Lake. The transfer from Jordan, which comprises the entire flow in the Lower Yarmouk, is measured by a hydrometric station of the IWA, situated below gate 121 (Station No. 34160). This station however, is not very accurate: until 2006, the recorded flow at this station was substantially lower than the recorded pumping. Also, the recorded flows have dropped significantly since 2006, corresponding to the completion of the Unity Dam by Syria and Jordan, which effectively ceased runoff from upstream. In March 2009 however, the Lower Yarmouk witnessed an unusual large flow of nearly 14 MCM.

*Wadi Al Arab*

Wadi Al Arab is located in the northern part of Jordan Valley about 10 km south of Tiberias Lake and 25 km west of the city of Irbid. The average annual rainfall in the Wadi Al-Arab watershed is approximately 400 mm, which occurs between October and April (60% of rainfall is confined to the period from December to February). The estimated precipitation per year is 7000 $m^3$ and the average discharge of the Wadi is around 28 MCM a year equally distributed to between base and flood flows. The catchment area is agrarian and most population is concentrated in Irbid city. The months from June to September are considered dry and hot (31 C and 14 C are the mean monthly temperatures in the summer and winter respectively). The Wadi Al-Arab Dam Reservoir was constructed in 1987, with a total capacity of 20 MCM. Its principal features are: a reservoir catchment‘s area of 262 $km^2$ with gross, effective and dead storage capacity of 20.0, 16.9 and 3.1 million cubic meters, respectively. Daily evaporation causes a decrease in water level from 4.8 mm in January to 8.9 mm in July.

Current sources of water in the Dam are: base and winter flow of the Arab Wadi; and water pumped up from the KAC during winter time. Due to the drilling of a number of wells by WAJ, summer base flow is reduced to a minimum or nil. The Arab Dam is linked to the KAC by a dual system that allows water to flow in both directions. The KAC supplies the Dam with water during the winter. This water originates from the Tiberias Lake, the Yarmouk River, and the Mukheibeh Wells. In addition, winter and base flows from the Arab Wadi are stored in the Dam.

The water stored in the Arab Dam in the winter is then returned back to the KAC during the summer. In light of water shortages in Jordan, north to Zarqa River the bi-directional flow and winter storage in the dam were neglected from the model, as even in the winter water is in short supply. The reservoir water is used to irrigate about 12,500 dunum in the Northern Jordan Valley, mainly around the area of North Shouneh and Al Baqura. It also serves as a drinking water source for the city of Amman in periods of water shortage through the KAC. Previously, treated waste water from the city of Irbid and surrounding communities was treated and stored in the Arab Dam. Currently, and because the dam is being used for drinking purposes, the treated waste water is diverted through a closed pipe into the Jordan River near the town of Hamamreh. The average daily flow rate of this treated waste water is estimated at 19,700 $m^3$/day, or 7500, 12000, and 2000 from Foara, Dogara, and Shallala water treatment plants respectively.

*Wadi Tayyiba*

Two minor valleys that are not dammed are Wadi Tayyiba and Wadi Abu Zeyad. The base flows of these valleys is used in irrigation along their courses and partly at the foothills of the Jordan Valley. Runoff flows

may still reach the Lower Jordan River, but the combined average flow of these wadis is less than 0.25 MCM/Yr and thus, they were neglected from the WEAP model.

*Wadi Ziglab*

The catchment area of Wadi Ziglab measures 106 km$^2$. Its eastern parts in the highlands receive an average amount of precipitation of 500 mm/year, whereas its western parts in Jordan Valley receive only 300 mm/year. Various springs along Wadi Ziglab produce the base flow of the valley. In addition wadi Ziglab drains floodwater in the winter. A dam was constructed in Wadi Ziglab with a total capacity of 4.3 MCM in 1966, and it captures winter flow and floods. Currently, no water flows in the Wadi Ziglab during the summer. WAJ drilled 7 new wells recently (2012-2013), which reduced springs summer flow drastically. Ziglab dam water is used for irrigation in the Northern Jordan valley area on about 12,500 dunum. The Ziglab dam also supplies water to the KAC depending on its availability. In the WEAP model it supplies water only to the KAC, as the regional demand is grouped to one site.

*Wadi Jurm*

Around 90% of the flow in this wadi is used for drinking to the city of Irbid. The rest is diverted to KAC, but its contribution to the KAC is getting lower every year. Some runoff reaches the Jordan River, which is included in the WEAP model. There is no dam on Wadi Jurm.

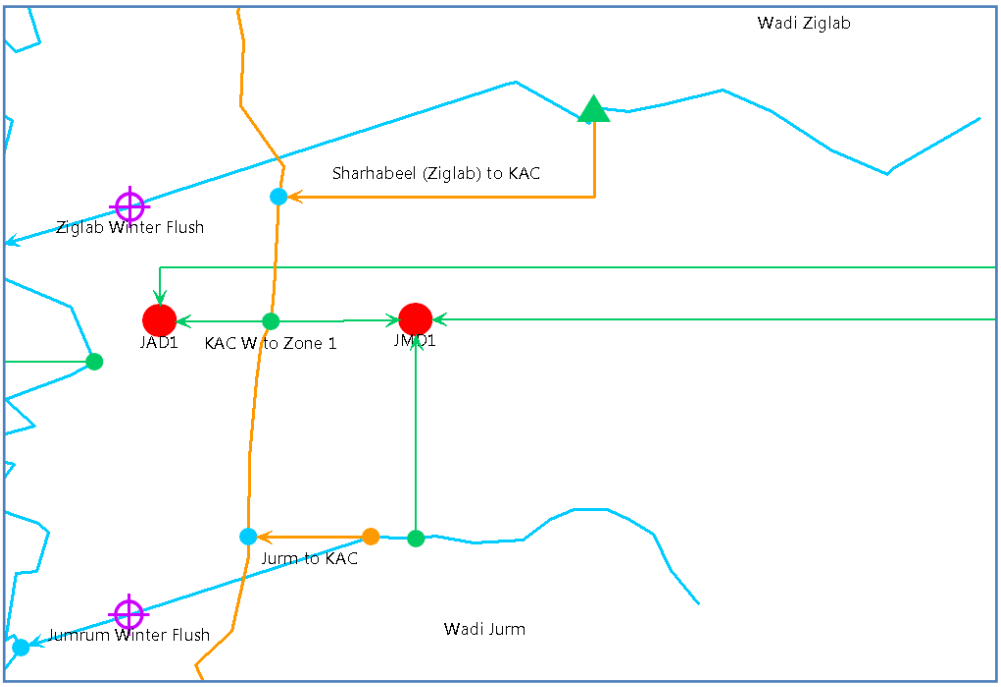



**Figure 36 – WEAP Scheme Detail for Wadi Ziglab and Wadi Jurm**

*Wadi Rayyan (previously known as Wadi Yabis)*

This wadi is not dammed, the rainfall in its 124 km$^2$ watershed ranges from 150 mm/year up to 550 mm/year, with potential evaporation rates ranging from 2100 mm/year to 2700 mm/year. Base flow is used for irrigation on the sides of the wadi. The Wadi is connected to KAC through a diversion weir. Currently, during the summer and because of irrigated agriculture on the side of the Wadi, almost no flow reaches the Jordan Valley or Jordan River. In the winter, early season rains related runoff and flood water reaches the Jordan River. This is allowed to clean the bed of the Wadi. After that, water is diverted to the KAC.

*Wadi Kufranja*

Wadi Kufranja basin comprises an area of about 112 km$^2$. This basin is a typical rural and agricultural area. The topography and relief of this basin is rather complex. It changes rapidly from east to west towards the outlet of the basin. The mean annual rainfall at Wadi Kufranja ranges from about 600 mm to about 300 mm. Wadi Kufranja is not connected to KAC anymore because its water now contains treated wastewater. It is used directly for irrigation.

*Wadi Rajib*

Wadi Rajib total watershed area is 85 km$^2$. It receives its waters from a multitude of smaller tributaries and several natural springs, therefore the main Wadi never falls entirely dry, even though the discharge varies substantially between the winter and the summer season. Wadi Rajib has reasonably good water quality for irrigation, but substantial pollution from household waste, livestock and agricultural production makes the water unsuitable for human consumption, nevertheless several of the tributaries are used for pumping water into cistern trucks, particularly in summer. There are also 13 major springs located within the watershed, most of them being used for either human or livestock water supply. Currently, during the summer and because of irrigated agriculture on the side of Wadi Rajib, almost no flow reaches the Jordan Valley or Jordan River. In the winter, early season rains may reach the Jordan River. This is allowed to clean the bed of the Wadi. After that, water is diverted to the KAC.

*Wadi Zarqa and King Talal Dam*

The water that originates from the King Talal Dam (KTD) is used for irrigation in the Jordan Valley (82,000 dunums in the middle Jordan Valley). KTD water is a mixture of treated waste water and precipitation. It is transferred to the King Abdulla Canal, downstream of the point where fresh water in the KAC is pumped to Amman for drinking. South to Abu-Zeighan stream, in the Jordan valley itself, lies the Karameh Dam. This reservoir was meant to develop local water sources but failed due to the high salinity of the water. Today it serves as an operation reservoir for water coming from the KTD and does not affect the water balance. As such, it was not included in the WEAP model.

**Figure 37 - Mixing of water from the KAC with water from the King Talal Dam**

The reach of river downstream from KTD receives fresh water, mainly in the winter, and saline water throughout the year from groundwater springs. At the village of Abu Zeighan, in the Jordan Valley, 350 m below sea level, ground water with a Total Dissolved Solid concentration of 7000 mg/L is extracted from

wells. At the Abu Zeighan Water Treatment Plant (Reverse Osmosis) a total of 60,000 m3/day of water is treated by oxidation, pre-filtration in pressurized sand filters and a two stage reverse osmosis plant with a recovery rate of 75 %. The treated water is conveyed to a storage tank from where it is pumped in several steps to Amman, about 800 m above sea level. The water is used for household drinking water and irrigation. The Abu Zeighan Reverse Osmosis Plant is capable of supplying 250,000 people with drinking water. In the WEAP model, the freshwater from Abu Zeighan is discharged to the KAC, upstream the pumping to Amman, while the 5.5 MCM of brine with a salinity of 9,500 mg/l is discharged into the Zarqa, downstream the KAC and flows to the LJR.

*Wadi Shueib*

Wadi Shueib drains an area of approximately 180 $km^2$ lying to the west of Suweileh region at elevation of 1200 m down to below sea level. Precipitation over the catchment area partly falls in the form of snow in its eastern parts and ranges on averages from 500 mm/year in Suweileh and the Salt Mountains to 150 mm/year in the Jordan valley area. Wadi Shueib is located in the Salt Valley of Jordan, a tributary watershed of the Jordan River. The city of Salt is located at the headwaters, and during the summer months the municipal sewage of Salt makes up a large portion of the Shueib's base flow.

Wadi Shueib was studied as a comparative example of a tributary to the Jordan, for the establishment of effective pollution and agriculture management practices. Wadi Shueib is traditionally rich in culture and agriculture, like Wadi Fara'a in the west. In contrast to Wadi Fara'a the Salt Valley has a well-managed water development policy and an effective sewage treatment facility, which is one of the best in the region.

In the catchment area different towns and villages, like Fuheis and Mahis, discharge their treated and untreated wastewater along the wadi and its tributaries. A dam was constructed in Wadi Shueib in 1968 with a capacity of 2.3 MCM and with the aim of using its water for irrigation in the Jordan valley. In addition to base flow and flood water this dam now receives also irrigation return flows and the effluent of the well-functioning salt wastewater treatment plant. Fresh water in wadi Shueib was reduced to comply with the water increasing demand of cities and have greatly affected the flow of the springs. The flow was replaced by the effluent of the treatment plants, a process that changed the ecological balance over time. Shueib Dam is not connected to KAC. It is used for local irrigation (2500 dunums) in its vicinity.

*Wadi Kafrein*

The watershed area for Wadi Kafrein is about 189 $km^2$. The Kafrein Dam receives flood and base flow, irrigation return flows, treated and untreated wastewaters and groundwater discharged from artesian wells and springs. As the other Wadis, Wadi Kafrein does not show perennial flow evidence. Rainfall takes place only during the winter months. During and after the rainy events, floodwater drains down to the Jordan Valley.

Wadi Kafrein is not connected to KAC. Its water is used to irrigate and develop Hisban –Kafrein project and irrigation areas 31 and 32 (1,247 dunums). Wadi Hisban's flow is part of Wadi Kafrein in the WEAP model. The catchment area of Wadi Hisban is about 81 $km^2$. The water of Wadi Hisban is captured above sources with a high salt content and channeled directly to the Hisban-Kafrein irrigation area since 1979, to avoid siltation of Wadi Hisban's water. Other approved extensions, such as the connection of the Hisban-Kafrein irrigation area to the KAC, a pilot plant producing 5 MCM/yr of desalinated water was proposed in the Kafrein/ Hisban area, and recently studies were carried out to desalinate 30 MCM from Kafrein/Hisban for the urgent needs of Amman. The Hisban project could be implemented by 2015. This project should deliver some 9–15 MCM/yr.

*Lower Jordan River*

The current account run of the WEAP model clearly shows the impacts of these water demands on the Lower Jordan River itself. The annual flow in the northern section of the LJR is only 22 MCM at the point where the Saline Water Carrier enters the river, and consequently the salinity levels are high with 2,409 mg/L salt. Near Wadi Al Rayyan the flow slightly increases to about 80.5 MCM per year with 1,448 mg/L of salt. When it finally meets the Dead Sea the flow has reached a maximum with about 102.5 MCM per year. Clearly, these values don‘t meet any of the criteria for lifting the river to a healthy ecological status, and concise interventions will be needed starting with reducing the salt and pollution content in the river, and thus mitigating their polluting sources, and eventually finding sustainable and sensible solutions for a steady increase of the river‘s base flow.

## 2.4 Governance

### 2.4.1 Stakeholders

Stakeholders can be identified furthermore on various criteria: power, support, influence and importance. There is a correlation between the stakeholders' interest in the consultation issue and their support or lack of support for the project initiative. The stakeholders' interest in the consultation issue can change during the consultation process and a stakeholder can become more or less supportive towards the initiative. Balancing between economic and environmental interests of various stakeholders is a sensitive process. Therefore the identification and selection of the stakeholders is a critical step that influences the constituencies of the Master Plan that will be developed.

Irrigated agriculture is a core economic activity in the JRV and therefore stakeholders are distinguished for the agricultural, the water and the environmental sectors. Concerning Integrated Water Resources Management the stakeholders representing the agricultural and environmental interests take very divergent opinions and it is hoped that through interactions they start to take more convergent positions. Exclusion or inclusion of stakeholders for the consultations can have far-reaching consequences on the discussions and the compromises reached through the negotiations, but also for the constituency of the plans. For the identification of the stakeholders a distinction will be made between public, private and non-government organizations, keeping in mind that these are the three societal pillars of effective water governance systems. Special attention will be given to potential stakeholders, who are expected to have a positive influence on the consultations through the formulation of compromises based on common needs of stakeholders with perceived antagonist's interests.

For the water sector in Jordan the MWI, the JVA and the WAJ represent the public sector. Representatives of the southern Shouneh Chambers of Commerce represent respectively the agricultural and industrial water users. The WUAs, which are community based organization with financial support from the public sector (JVA in this case), represent a partnership between the public sector and communities. Of the NGOs in Jordan, the EcoPeace Middle East has developed various water related initiative in the Jordan River Valley and therefore is recommended to represent the non-governmental sector.

**Table 24 - Stakeholders representing the Jordanian Water Sector**

| Sectors | Formal organizations that are identified to represent a stakeholders group | Groupings whose involvement is recommended for the Master Plan initiatives |
|---|---|---|
| Public | - Ministry of Water and Irrigation<br>- Jordan Valley Authority<br>- Jordan Water Authority | MWI and WUAs participate in the Jordan Valley Water Forum that the World Bank Institute facilitates. |
| Private | - Irbid Chamber of Industry | |
| Public-Private | - Water users Associations | |
| Non-government | - EcoPeace Middle East - Jordan Valley network | Women organization that represents the women as stakeholder in water and environmental services in the residential areas of the Jordan Valley |

For the agricultural stakeholders in Jordan, the Ministry of Agriculture and NCARE are recommended to represent the public sector. The Jordan Farmers Unions, the Irbid and Southern Shouneh Chambers of Commerce and the Fruits and Vegetables Association are recommended to represent the private sector organizations. Of the environmental NGOs, the Jordan Environmental Society is working on tensions between economic and environmental issues in relation to irrigated agriculture. In the agricultural sector of the Jordan Valley representatives of the three major tribal clans have to be involved to obtain a critical mass among farmers. Unfortunately there is not yet a farmer‘s organization for the promotion of LEISA production techniques that can represent the interests of this sub-group of farmers, which the HEIA farmers might not allow the Jordan Farmers Union to do.

**Table 25 - Stakeholders representing the Jordanian Agriculture Sector**

| Sector | Formal organizations that are identified to represent a stakeholders group | Groupings whose involvement is recommended for the LJRB NGO Master Plan initiative |
|---|---|---|
| Public | - Ministry of Agriculture<br>- National Centre for Agricultural Research and Extension<br>- Agricultural Credit Corporation | |
| Private | - Irbid and Southern Shouneh Chambers of Commerce<br>- Fruits- and Vegetables Exporters Association | Representatives of El Wakid, El Ghezawi and El Adwan clans representing the Al Ghawarna family farmers |
| Non-government | - Jordan Environmental Society Jordan Valley Branch Office<br>- Jordan Farmers Union | Grouping of LEISA family farms that has as objective to promote environment-friendly agriculture production technologies in the JRV |

**Table 26 - Stakeholders representing the Jordanian Recreation and Environmental Sectors**

| Sector | Formal organizations that are identified to represent a stakeholders group |
|---|---|
| Public sector | -Ministry of Tourism<br>-Ministry of Environment |
| Private sector | -Southern Shouneh Chamber of Commerce<br>-Dead Sea Tourism Board |
| Voluntary sector | -Jordan Hashemite Fund for Human Development (JOHUD)<br>-Royal Society for the Conservation of Nature<br>-Jordan Environmental Society Jordan Valley branch |

The Southern Shouneh Chamber of Commerce and the Dead Sea Tourist Board are recommended to represent the private sector organizations. Of the environmental NGOs, the Royal Society for the Conservation of Nature and the Jordan Environmental Society are both involved in the discussions about sustainable development and natural resources management initiatives.

.

## 2.4.2 Governance of the Jordan River Valley

This section provides an overview of the governance structure and major governmental organizations and their responsibilities in the Jordan River Valley. First, a list and description of the major governmental organizations in Jordan:

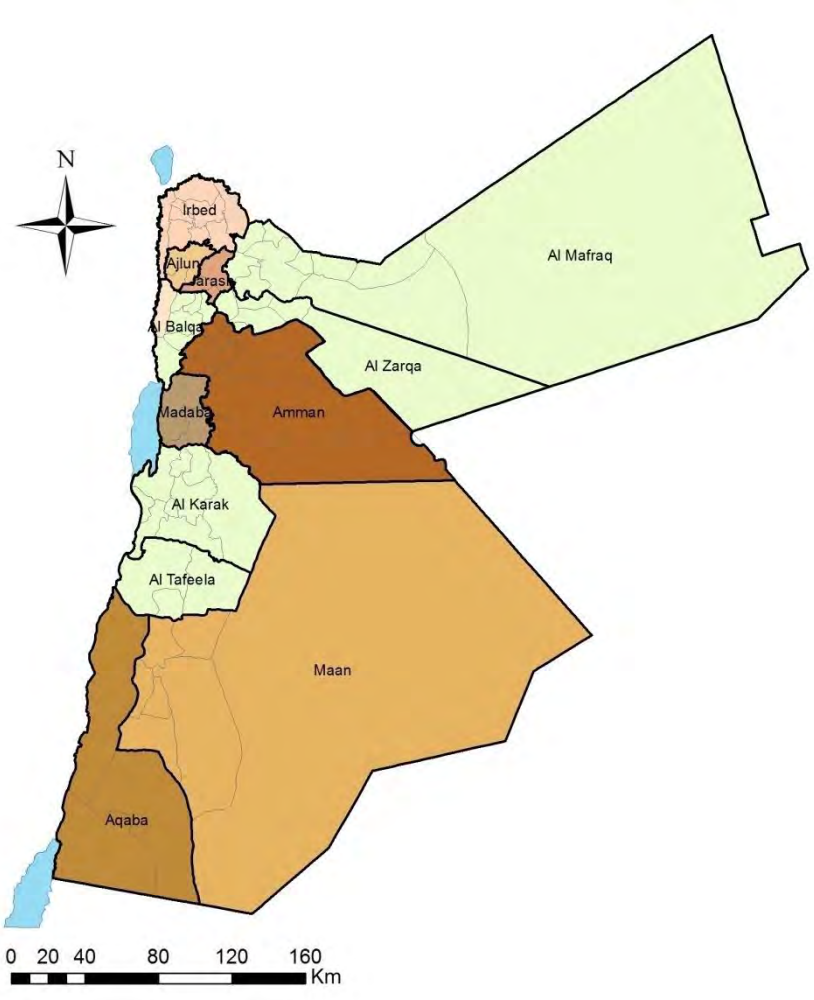



**Figure 38 - Jordanian Governorates and Districts**

*Ministry of Planning and International Cooperation (MoPIC)*
MOPIC's role is to channel funds from international donors. MoPIC is also carrying out programs that are contributing to small scale enterprise development.

*Jordan Valley Authority (JVA) under the Ministry of Water and Irrigation (MWI)*
JVA is the most influential organization in the Lower Jordan River Basin. Its mandate area stretches throughout the valley areas, up to the 300 m contour line north of the Dead Sea and up to the 500 m contour line south of the Dead Sea. JVA was created to take up development in the Jordan Valley, with an

emphasis on irrigation development, tourism and industrial development. All technical ministries are represented in its management board. At present, JVA operates largely as a regulatory body rather than as a planning organization due to the fact that many plans have been developed during the previous years. It controls all new development initiatives and approves on these on the basis of the Land Use Master Plan, prepared in 2004.

*Water Authority of Jordan (WAJ)*
The tasks of JVA and the WAJ are not precisely delineated. Both are dealing with water resources development. JVA focuses on water to be used in the Jordan Valley, especially for irrigation, WAJ focuses on water for domestic and industrial use. Consequently, JVA's activities are not all confined to its mandate area, depending on the sources of water.

*Ministry of Environment (MoE)*
The Ministry of Environment (MoE) was created in 2003 and is still in the process of institutional development and internal capacity building, and of preparation of its legislation. MoE is responsible for environmental protection as a whole, including nature conservation. RSCN is assisting MoE in environmental legislation (for example regulation on protected area designation) based on more profound experiences in this field. The Ministry of Environment delegated the RSCN to manage the natural reserve under the supervision of the Ministry through a memorandum of understanding (MoU). The Environmental Police Department, Rangers, was established in 2006. It became the Royal Department for Environment Protection (RDEP) in 2008. Administratively the Rangers are a unit of the Public Security Directorate (PSD) of Jordan and act on directives from the PSD and MoE; they bring violator of environmental laws to the court and enforce court decisions. The Rangers are operating in coordination and cooperation with nine strategic partners consisting of govt. institutions and environmental conservation organizations.

*Ministry of Tourism & Antiquities (MoTA)*
The Ministry of Tourism & Antiquities (MoTA) is responsible for management of the tourist sector and the antiquities in the Jordan River Valley.

*Ministry of Agriculture (MoA)*
The Ministry of Agriculture (MoA) supports the agricultural sector and governs the natural forests in Jordan, based on the Provisional Law of Agriculture No. 44 (2002), which describes the responsibility for achieving the objective of ~~-s~~sustainable use of the natural agricultural resources without harming the environment", and for ~~-c~~ombating desertification and conserve biodiversity". The Agricultural Law focuses on plant production and protection and on animal production and health, and also includes a number of articles concerning forests/ forest lands and rangelands and fishery. Desertification control and biodiversity conservation are also vested in the law. Biodiversity is given explicit attention in articles on protection of wild birds and wild animals in the Law of Agriculture. Important activities are Forestry, Rangelands and Agricultural production support, promotion of integrated pest management and biological farming, Plant Protection, Extension services. Furthermore it houses the National Centre for Agricultural Research and Technology Transfer (NCARE).

*Ministry of Municipal Affairs (MoMA)*
The Ministry of Municipal Affairs (MoMA) may play a role through municipalities as a focal point for local level and alternative livelihood development.

*Ministry of Transport (MoT)*
The Ministry of Transport (MoT) has the overall statutory authority for transport planning in Jordan.

*Department of Land and Surveys (DLS), Ministry of Interior*
The Department of Land and Surveys (DLS) is responsible for land management and registration.

*Natural Resources Authority (NRA)*
The Natural Resources Authority (NRA) is responsible for mineral exploration. In its latest map (2005) of potential mining areas, sites are depicted both inside and outside protected areas.

*Jordan Army Forces (JAF)*
The Jordan Army Forces (JAF) is important, since is manages the security zones along the western and northern borders in the LJR Basin. JAF has reportedly expressed its willingness to allow access to the areas for ecological surveys and other project activities.

*Department of Statistics (DOS)*
The Department of Statistics is responsible for managing and dissemination of statistical information about Jordan for a wide variety of sectors.

Ministry of Water and Irrigation (MWI) is the official body responsible for regulating the water sector in Jordan, including management of water resources, water supply and wastewater systems, and development of national water strategies and policies, research and development, and management of information systems. MWI is supported by several donor organization projects that have assisted in the development of water policy and water master planning as well as restructuring the water sector.

The Ministry of Water and Irrigation includes two entities dealing with operational water management in Jordan: The Water Authority of Jordan (WAJ) in charge of water & sewage systems; and the Jordan Valley Authority (JVA) responsible for the socio-economic development of the Jordan Rift Valley, including water resources development and distribution of irrigation. Agricultural water supply in the LJR Basin is provided by the JVA, mainly though the King Abdullah Canal (KAC) running from north to south throughout the Lower Jordan Valley. Domestic water supply is provided by the WAJ, mainly through groundwater resources in and around the LJR Basin.

The MWI developed a water strategy with the aim to realize adequate, safe and secure drinking water supply; greater understanding and more effective management of groundwater and surface water; healthy aquatic ecosystems; a sustainable use of water resources, and implemented fair, affordable and cost reflective water charges by the year 2022. These aims are triggered by the fact that groundwater levels have dramatically declined during the last decades, and that serious water shortages are envisaged due the foreseen population growth and economic developments, despite huge improvements in infrastructure to supply water. Furthermore, the water strategy aims at stopping further deterioration of water quality. This requires that water sources are actively protected from pollution through actions of the Ministry of Water and Irrigation and others like the Ministry of Environment, for instance through implementing groundwater and surface water protection zones and related land use planning.

It is estimated that the water deficit in terms of water demands minus actual water supply on a national scale in 2010 is about 600 MCM per year. Within Jordan River Valley this deficit is estimated in this study to be about 90 MCM per year. To develop additional water resources major projects are foreseen, such as the Red Dead conveyance project, starting from 2022. Furthermore the water strategy aims at fully utilizing treated wastewater effluent by 2022. Related Jordanian policy objectives are:

- An efficient and effective institutional reform.
- A drastic reduction in the exploitation of the groundwater.
- Efficient use of water resources.
- Irrigated agriculture in the highlands will need to be capped and regulated and related by-laws need to be reinforced
- Appropriate water tariffs and incentives will be introduced in order to promote water efficiency in irrigation and higher economic returns for irrigated agricultural products

Within the MWI, the Performance Monitoring Unit (PMU) is in charge of water supply and wastewater projects with private sector participation. It has also carried out major investment projects such as the water loss reduction program in Amman and has regulated the private operator in Amman from 1999 to 2006. The PMU was supposed to be an embryonic unit for a future semi-autonomous water regulatory agency for the entire country, to be established by law outside of the Ministry of Water and Irrigation. As a step in that direction, a Water Sector Audit Unit (WSAU) was established in the PMU in May 2008. The unit has set up a benchmarking system using performance indicators that have initially been applied to the Aqaba Water Company. Due to the absence of a regulatory agency, tariff setting is the responsibility of the Cabinet, after proposal from the Ministry of Water and Irrigation.

Within the Jordan Valley, most of the water is supplied by the JVA through the KAC. The table below illustrates the current usage of the KAC for irrigation and drinking purposes the same time. Using the KAC for drinking water supply is relatively a recent development, since the canal was initially built solely for irrigation purposes.

**Table 27 - Amounts of KAC water used for different purposes for 2010 and 2011 (MCM)**

| Purposes | 2010 | 2011 |
|---|---|---|
| Amount of water used in different irrigation projects | 129.374 | 123.716 |
| Amount of water pumped from King Abdullah canal for drinking purposes * | 53.636 | 53.541 |
| Amount of water pumped from southern conveyors lines for drinking purposes | 46.665 | 45.016 |
| Total amounts of water used for different purposes | 229.675 | 222.273 |

** Including water supply to Amman; Sources: JVA and WAJ annual reports, 2010, 2011.*

In addition, WAJ is responsible for delivery of piped domestic water supply in the Jordan Valley. Its water supply system is largely based on groundwater resources from within the basin, as well as from outside, such as groundwater fields south of Amman, from which water is conveyed to the southern regions of the Lower Jordan Valley.

Exact figures to how much water is supplied for domestic and industrial purposes in the Jordan River Valley are not available. However, it is estimated that about 17 MCM per year of water is provided within the Lower Jordan River Valley.

Agriculture is the major consumer of water resources in the valley, which is divided into four agricultural zones: (1) North Shouneh; (2) Deir Alla; (3) South Shouneh and (4) Ghor Safi. Within the framework of this study, an estimate has been made of the total annual water consumption. It is estimated that 70% of the demands, or 192 MCM / yr is actually supplied to the agricultural sector, including 129 MCM / yr through the KAC and the remainder from rain fed and local groundwater sources.

Within the Jordan valley farmers pay in the range of 1 to 5 USD cents per $m^3$ of water, with an average of 2.7 cents per $m^3$. While the actual costs of delivering irrigation water in the Jordan Valley are estimated to be about 0.32 USD per $m^3$.

The costs for domestic water supply are approximately 25 USD cents per $m^3$, while the actual cost of domestic water delivery is about 1.14 USD per $m^3$. Therefore, it is estimated that the government subsidizes the domestic water supply in the Jordan Valley by approximately 70 Million USD annually to bridge the gap between the actual cost for supply and the revenues from fee collection.

### 2.4.3 Transboundary and International Binding Agreements

#### 2.4.3.1 The Jordan-Israel Peace Treaty

The Israel – Jordan Treaty of Peace, sometimes referred to as the Wadi Araba Treaty, was signed by the State of Israel and the Hashemite Kingdom of Jordan in December 1994. With regard to water related matters the following elements of particular importance within the context of the current study.

*Water Allocation from the Yarmouk River*
The agreement stipulates that during the summer period from 15 May to 15 October of each year, Israel shall receive 12 MCM and Jordan is to keep the rest of the Yarmouk water flow. During the winter period, from 16 October to 14 May of each year, Israel is entitled to receive 13 MCM and Jordan is to keep the rest of the flow. Furthermore, Israel is entitled to borrow an additional 20 MCM during the winter period, to be transferred back to Jordan during the next summer. With regard to excess flood waters from the Yarmouk that would otherwise flow into the Lower Jordan River, it was agreed that both Jordan and Israel are allowed to utilize this water in equal portions for their own purposes.

*Water Resources from the LJR*
The agreement stipulates that during the summer period of each year, Jordan shall receive 20 MCM from the Lower Jordan River upstream of the Yarmouk from Israel. During the winter period Jordan shall receive an additional 20 MCM from Israel from the LJR south of the Yarmouk. With regard to remaining water flows in the LJR south of the Yarmouk it was agreed that both Jordan and Israel are allowed utilize this water in equal shares for their own purposes, provided that neither party would harm the water quality of the LJR. A Joint Jordanian – Israeli Water Committee has been established to monitor the actual water flows and water allocations.

*Saline Springs and additional water resources*
Furthermore, the agreement stipulates that Jordan is entitled to receive 10 MCM of desalinated water from Israel, originating from the saline springs near Lake Tiberias, provided that this is financially feasible. If so, it has been agreed not to discharge the brine into the LJR basin. Currently, this saline water is conveyed from these springs directly to the LJR through the Saline Water Carrier by Israel. The agreement confirms that Israel will explore the possibility of financing the operation and maintenance cost of supplying this desalinated water to Jordan, while Jordan will explore the possibilities to finance the required capital expenditures. Finally, the agreement includes the intension to jointly develop an additional 50 MCM of drinkable water, without yet specifying its source, for the benefit of Jordan.

*Operations and Maintenance*
From an operational point of view, the agreement states that Israel accepts responsibility for operating, supplying and maintaining systems on Israeli territory that supply water to Jordan. Under this set-up Jordan is allowed to choose the related operator, provided these operations only serve Jordan (so not

Israel at the same time). Israel guarantees easy access for the involved operations personnel and equipment.

*Water Storage*
Both parties agree to co-operate in the development of a new water storage dam in the Yarmouk River, downstream of the Adassiya Diversion, and of a storage facility in the LJR south of the Yarmouk confluence and north of Wadi Al Rayyan.

*Water Quality*
Both parties agree to protect the Jordan and Yarmouk Rivers and related groundwater systems and water supply systems against pollution, contamination, harm and unauthorized withdrawals of each other's allocations. They agree to jointly monitor the quality of water along their border, using jointly (to be) established monitoring stations under the Joint Water Committee. This includes treatment of municipal and industrial wastewater to agricultural standards before discharging it into the Yarmouk and the Jordan Rivers. It also includes trans-boundary supply of water under this agreement against the national quality standards.

*Groundwater*
Under this agreement Israel is entitled to retain the previous use of groundwater wells in Wadi Araba now under Jordanian sovereignty as detailed by the agreement. Meanwhile Jordan agrees to enable repair or replacement of any failing well by Israel, connect it to the Israeli electricity and water systems and treat it, and Israel agrees to supply Jordan with related well logs and technical information. Furthermore, if the Joint Water Committee decides this is hydro-geologically feasible and not harming Jordan‘s interests, Israel may increase the extraction rate from these Jordanian wells up to 10 MCM per year above the 1994 yields. Such an increase had to be carried out within five years from signing of the agreement.

*Information and Notification*
The agreement stipulates that the Joint Water Committee is the official body through which relevant data on water resources is to be exchanged from one party to the other. The JWC can assign sub-committees to perform technical tasks, such as a northern sub-committee and a southern sub-committee. Furthermore, deliberate changes in the Jordan and Yarmouk Rivers require prior mutual agreement. In particular, both parties agreed to six months advance notice of projects likely to change the quality or flow of either river along their common boundary via the Joint Water Committee. Also, planning for increasing water supplies and improving efficiency is to be done in a co-operative manner within the context of bilateral, regional or international cooperation agreements.

The international legal agreements applicable to the Jordan River Valley include the following:

**The Helsinki Rules**

The Helsinki Rules, on the Uses of the Waters of International Rivers, adopted by the International Law Association in 1966 and the 1997 UN Convention on the Law of the Non-Navigational Uses of International Watercourses are two of the most referenced and developed of international legal agreements on the uses of transboundary watercourses. The latter, provides principles of water rights, and exists for the equitable and reasonable allocation of freshwater resources between riparians in a river basin.

**The UNESCO Convention**

The UNESCO Convention concerns the Protection of the World Cultural and Natural Heritage of 1972. The Jordan Valley falls under the protection of this agreement as a cultural heritage area. Thus, the agreement binds Jordan as responsible states to protect and develop the Jordan Valley under the principles of the agreement based on the needs of the area.

Other international agreements that are applicable to the Jordan River are:

i. The Seoul Rules on International Groundwaters (Adopted by the International Law Association at the Sixty-Second Conference Held at Seoul in 1986)
ii. The Berlin rules 2004 (an update of the Helsinki rules that are already added in the international legal agreements section).
iii. United Nations Convention on Biological diversity (1992) and Cartagena Protocol on Biosafety;
iv. Convention on International Trade in Endangered Species (CITES);
v. Ramsar Convention (Wetlands);
vi. Bonn Convention on Migratory Species;
vii. World Heritage Convention (indirectly by protecting biodiversity habitats)
viii. The Hague conventions and fourth Geneva convention : international Humanitarian law / international customary law on prohibition of pillage of dead sea ( unlawful exploitation of natural resources and appropriation of Palestinian lands)

### 2.4.3.2 Security Arrangements along the Jordan River

Since 1967, the Jordan River has been under the control of the Israeli and Jordanian military, which operate checkpoints and bases on both sides. The area contains covert listening stations, radar sweeps and thermal- and night-vision cameras. On the mountain tops that rise steeply from the valley floor, Israel maintains a series of early-warning stations. Troops are on constant patrol along the river and the passes, and on both sides of the river a key strip of land is inaccessible for the general public.

On the Israeli side of the river, more than 1,000 hectares of land have been mined, including both antipersonnel and antitank mines. Mined areas are also located near villages such as Kfar Ruppin and include parts of nature reserves such as the East Gilboa Reserve. They also include former Syrian minefields. In the late 90‘s the Israeli Ministry of Tourism initiated activities to remove former Syrian mines in certain areas along the Jordan River suspected of containing Syrian antipersonnel mines, such as around Kibbutz Gesher. Along the river, Israeli and Jordanian mine fields are still part of the overall security framework.

Bridges connecting Jordan, Palestine and Jordan are subject to strict security measures in terms of trans-passing person and goods. The King Hussein Bridge is located just outside Jericho city and is the only connection between Palestine and Jordan. The Palestinian side of the King Hussein Bridge is considered a border entry point by the Israeli Authorities. The Jordanian authorities recognize the bridge as an international border entry point, but in contrast to other border crossings with Israel, do not grant entry visas to foreign passport holders at this crossing. Palestinians from the West Bank traveling abroad use this bridge to exit the West Bank into Jordan, since they are not permitted to use Ben Gurion Airport near Tel Aviv. Travel permits from both Israeli and Jordanian authorities are required, with varied stringency depending on the political and security situation. Israeli citizens are not permitted to use the terminal.

According to the Israeli's, the Jordan Valley forms the closest border to the heartland of Israel, and is considered by many as the only realistic eastern topographically defendable border against potential aggression from the east. The political upheaval in the Middle and the violence in Syria and Iraq have already caused the large stream of a great variety of refugees entering Jordan. Israel fears that some of these refugees may attempt to infiltrate into Israel. This, together with the radical forces active in these countries and the fear that extremists with advanced weapons will be smuggled into the West Bank underlines the notion that a well defended eastern border is essential for the security of the Israeli people, including secure road access from the west. In 1996, after signing of the Oslo Accords, then-PM Yitzhak Rabin already declared that the eastern security of Israel will be located in the Jordan Valley. Today, PM Netanyahu ordered recently for a construction of a major robust upgrade of the existing security fence along the Jordanian border, including the West Bank.

At the offset of the recent peace talks, the Palestinian position on this subject recognized the need for a transition period in which Israel would retain some military presence in the Jordan Valley, say up to about 5 years. After this period the Palestinians would agree on the deployment of international forces, such as UN forces of NATO along the Jordan River as a way to ensure security and allay Israeli fears, be it without any Israeli soldier left behind. The Israeli position on this subject welcomes cooperative security arrangements with the Palestinians and Jordan under a final settlement, but rejects the idea that at a certain date international forces, such as UN or NATO, would fully replace Israeli troops, since this would undermine Israel's ability to act effectively against terrorist infiltration and weapons smuggling, or to provide a first line of defense against any other future threat from the east.

During the recent peace negotiations, the United States attempted to bridge this gap by drawing on U.S. security experiences in Afghanistan, and proposing the use of high level U.S. provided intelligence and technology, such as advanced sensors; drones and high-tech fences. It has been proposed that during the transitional period, there will remain some Israeli military presence in the Jordan Valley at roughly about 200 – 500 troops plus a number of civilian Israeli security personnel at the border crossings co-operating closely with Palestinian and Jordanian security forces. During this period the security structure would shift towards higher security technology (e.g., scanners, sensors, sniffers, remote sensors etc.), while progressively handing over certain security responsibilities to the Palestinians and Jordan. In the post-transition period, whether defined in advance by specific criteria as Israel demands, or by a set time schedule as the Palestinians demand, Israel would keep a small deployment of "invisible" monitors at border crossings, for instance operating behind two-way mirrors or watching video monitors in adjacent rooms, in combination with a small number of Israeli troops patrolling in collaboration with Jordanians and Palestinians forces a corridor along the Jordan River to provide a joint buffer against infiltration and terrorist activity. Although both parties seem to have been sympathetic to elements of these ideas, eventually Israel seem to have classified them as too much reliance on technology as a substitute for essential military people. The Palestinians on the other hand seem to have rejected this concept, since they rule out any kind of enduring Israeli presence in the Palestinian State once the transition period has concluded.

However, similar challenges have been faced in the past. For instance, during the negotiations for the 1979 peace treaty between Israel and Egypt, both parties repeatedly rejected mutual security proposals, whereas today the situation has evolved into a generally acceptable security framework, including a set of strict security regulations and a framework for mutually tolerated ad hoc interventions when needed. Within the framework of this Master Plan it is believed that continuing the joint Palestinian – Israeli security negotiations on a factual and security-technical basis will eventually lead to a joint security solution for both the transition period and beyond, doing justice to the legitimate rights of the Palestinians for a free and independent state, and the legitimate security rights of the Israeli people.

# 3 PROJECTIONS AND CHALLENGES

## 3.1 Basin Projections for 2025 and 2050

Based on the population projections made by the Jordanian Department of Statistics, an assessment has been made of the total population in the basin in the years 2025 and 2050. This includes natural growth of the autonomous Jordanian population of about 2.45% in the year 2010, declining to about 1.79% in 2025 and to 0.92% in 2050. In addition, this basin plan assumes that the high number of informal foreign workers in the basin will gradually decline as result of assumed improving economic conditions in their countries of origin, including Syria, Iraq and Egypt. It has been assumed that the informal, mainly foreign workers will steadily decrease from about 250,000 people today to 200,000 people in 2025 and 150,000 people in 2050. These assumptions lead to a total estimated and projected population as presented below.

The per capita water demands are expected to grow as result of better economic circumstances from 60 $m^3$ per person per year today to 70 $m^3$ in 2025 and finally 80 $m^3$ in 2050. These assumptions are based on expected economic growth and related growing water demand per capita similar to economically more developed countries in the region, and improved water demand management measures. It has been assumed that the informal workers in the basin continue to use substantially less water (30 $m^3$ per year per person).

The total domestic water demands have next been calculated as the total population times their per capita water demands. As such, it is expected that the total demands will grow from about 82 MCM in 2010 to close to 90 MCM in 2025 and to 101 MCM per year in the year 2050. Local industrial water demands are relatively small, less than 5% of the domestic demands, and are therefore considered to be included in these total estimates.

The agricultural water demands in the Jordan River Valley are about 358 MCM per year. This includes demands in the northern agricultural zone 1 (87,000 dunum); in the central agricultural zone 2 (90,000 dunum) and in the southern agricultural zone 3 (55,000 dunum).

**Table 28 – Projected population and water demand by district for 2025 and 2050**

| Jordan Population by District | | Population 2010 | 2025 | 2050 |
|---|---|---|---|---|
| JMD 1 | Northern Jordan Valley | 108,943 | 149.713 | 261,463 |
| JMD 2 | Deir Alla | 67,925 | 93.345 | 163,020 |
| JMD 3 | South Shouneh | 70,294 | 96.600 | 168,706 |
| JMD 4 | *Informal population (according to JVA)* | *247,000* | *200,000* | *150,000* |
| TOTAL formal population | | 247,162 | 339,658 | 593,189 |
| TOTAL, incl informal population | | 494,162 | 539,658 | 743,189 |
| Growth percentages compared to 2010 | | | 137 % | 240 % |

| Per Capita Water Demands ($m^3$) | | 2010 | 2025 | 2050 |
|---|---|---|---|---|
| JMD 1 | Northern Jordan Valley | 60 | 70 | 80 |
| JMD 2 | Deir Alla | 60 | 70 | 80 |
| JMD 3 | South Shouneh | 60 | 70 | 80 |
| JMD 4 | *Informal population (according to JVA)* | *30* | *30* | *30* |
| Growth percentages compared to 2010 | | | 117 % | 133 % |

| Total Urban Water Demands ($m^3$) | | 2010 | 2025 | 2050 |
|---|---|---|---|---|
| JMD 1 | Northern Jordan Valley | 6,536,580 | 10,509,846 | 20,917,056 |
| JMD 2 | Deir Alla | 4,075,500 | 6,552,796 | 13,041,600 |
| JMD 3 | South Shouneh | 4,217,640 | 6,781,336 | 13,496,448 |
| JMD 4 | *Informal population (according to JVA)* | *7,410,000* | *6,000,000* | *4,500,000* |
| JMD 5 | From KAC to Amman | 60,000,000 | 80,000,000 | 100,000,000 |
| | TOTAL | 82,239,720 | 109,843,979 | 151,955,104 |

In this Master Plan it is assumed that the total agricultural water demands will not increase, but instead will remain at the same level (358 MCM) also for 2025 and 2050. This Master Plan proposes interventions that will increase the production as well as economic output for each cubic meter of water provided to the agricultural sector. Based on these assumptions, the total (domestic and agricultural) water demands in the Jordan River Valley will grow, as a result of the growth in domestic demand, to 386 MCM in 2025 and to 428 MCM per year in 2050. See table below.

**Table 29 – Total current and projected water demands for 2025 and 2050**

| Total Agricultural Water Demands | CM/year | | |
|---|---|---|---|
| | 2010 | 2025 | 2050 |
| Zone 1 (87,000 dunum) | 103,596,865 | 103,596,865 | 103,596,865 |
| Zone 2 (90,000 dunum) | 107,169,170 | 107,169,170 | 107,169,170 |
| Zone 3 (55,000 dunum) | 65,492,271 | 65,492,271 | 65,492,271 |
| **TOTAL Agriculture Demands (CM/year)** | **276,258,306** | **276,258,306** | **276,258,306** |
| | | | |
| **TOTAL Water Demands (CM/year)** | **358,498,026** | **386,102,285** | **428,213,410** |

The total amount of wastewater that will be generated within the basin directly relates to the domestic water consumption. In this Master Plan it is assumed that 80% of the total domestic water demands will return to the system as wastewater, leading to a total of about 24 MCM of wastewater being generated in 2025 and about 33 MCM of wastewater generated in 2050. Within this Master Plan interventions are proposed to fully treat and reuse the wastewater generated locally, meaning that in 2050 the basin should have wastewater treatment capacities for around 33 MCM per year, or about above 91,000 $m^3$ per day. See the table below. If fully reused for agricultural purposes, this water is sufficient to supply water to 20,000 to 30,000 dunum of agricultural land, which is between 9 and 13% of all agricultural land in the Jordan River Valley. External and additional treated wastewater reaches the Jordan River Valley as well through the Zarqa River. This is discussed at a later stage in this section.

In terms of solid waste generation, this Master Plan assumes that the per capita waste generation will increase from 400 kg per person today to 475 kg in 2025 and to 600 kg per person per day in 2050. These assumptions are based on expected economic growth and related growing waste generation per capita similar to economically more developed countries in the region. This leads to a total waste generation of about 197 thousand tons in 2010; to about 270 thousand tons per year in 2025 and close to 400 thousand tons per year in 2050. This Master Plan proposes interventions that will process and treat these waste streams in a fully sanitary fashion, based on a maximum of reuse and recycling, and including the use of sanitary landfills.

Assuming that in 2050 about 50% of the domestic waste stream consists of organic waste, this leads to about 200,000 tons of organic waste being generated in 2050. Regional experience shows that a maximum of 50% of the organic waste stream could be physically separated, leading to 100,000 tons of organic waste being separated in 2050. If fully processed into compost, this leads to a compost production in 2050 of 50,000 tons per year, which is sufficient to support about 30,000 to 50,000 dunum of agricultural land, or 13 to 20% of the total agricultural area in the Lower Jordan Valley.

The remaining waste fraction is to be treated separately. Eventually this might be done through incineration or sanitary land filling. Assuming that sanitary land filling is the preferred treatment technology in the Lower Jordan River Basin, this leads to a total required land filling capacity until 2050 of about 3.5 MCM of waste. Assuming average sanitary landfills with a height of 15 meters, this will a require sanitary landfill surface area of about 240 dunum until 2050, excluding related infrastructure.

**Table 30 - Waste and Wastewater Projections for 2025 and 2050**

| **Wastewater Generation ($m^3$) 80% return flow** | | **2010** | **2025** | **2050** |
|---|---|---|---|---|
| JMD 1 | Northern Jordan Valley | 5,229,264 | 8,407,877 | 16,733,645 |
| JMD 2 | Deir Alla | 3,260,400 | 5,242,237 | 10,433,280 |
| JMD 3 | South Shouneh | 3,374,112 | 5,425,069 | 10,797,158 |
| JMD 4 | Informal population | 5,928,000 | 4,800,000 | 3,600,000 |
| JMD 5 | Return flow from Amman & Northern Governorates | 48,000,000 | 64,000,000 | 80,000,000 |
| Total | ($m^3$) | 65.791.776 | 87.875.183 | 121.564.083 |

| **Per Capita Waste Generation (kg)** | | **2010** | **2025** | **2050** |
|---|---|---|---|---|
| | | | 118.75% | 150 % |
| JMD 1 | Northern Jordan Valley | 400 | 475 | 600 |
| JMD 2 | Deir Alla | 400 | 475 | 600 |
| JMD 3 | South Shouneh | 400 | 475 | 600 |
| | Informal population | 200 | 200 | 200 |

| **Total Waste Generation (ton/year)** | | **2010** | **2025** | **2050** |
|---|---|---|---|---|
| JMD 1 | Northern Jordan Valley | 43,577 | 71,114 | 156,878 |
| JMD 2 | Deir Alla | 27,170 | 44,339 | 97,812 |
| JMD 3 | South Shouneh | 28,118 | 45,885 | 101,223 |
| | Informal population | 98,832 | 107,932 | 148,638 |
| Total | (tons / year) | 197,697 | 269,269 | 504,551 |

The population and foreseen economic growth will require a larger spatial need for urban and infrastructure requirements. In 2010, the Jordan River Valley included 116 $km^2$ (116,000 dunum) of built up area. Extrapolation in terms of population growth this will lead to a land requirement of 160 $km^2$ (160,000 dunum) in 2025, and 215 $km^2$ (215,000 dunum) in 2050.

Under the current EcoPeace Scenario for the Jordan River Valley, it is assumed that the basin as a whole will see increasing economic developments, due to strong regional and trans-boundary co-operation and related synergetic economic impacts. In the current projections, this assumption has been translated in the following socio-economic parameter projections:

- Average number of people per household will decrease from 5 persons today to 3.5 persons per household in 2050, similar to economically more developed countries in the region
- Average income per person per year will increase from 1408 JD per year day, to about 10,000 JD in the year 2050
- The economy will become more service and high added value oriented, with a higher percentage of people being employed in the service sector (from 28.5% today to 54.2% in the year 2050), and less people employed in for instance agriculture (from 20% today to 5% in 2050), similar to economically more developed countries in the region
- The GDP in the Lower Jordan Valley will increase from a level of 4,200 JD per person today to about 30,000 JD per person in 2050.

These assumptions lead to a total number of household units of 130,000 in 2050, compared to about 41,000 today. This will require substantial investments in related housing projects (about 5 to 10 Billion JD housing construction investments until 2050), with relative higher number of smaller units that required today. It also requires expansion of roads and traffic safety measures, such as bypasses around urban centers, traffic lights and signs, pedestrian sideway capacities etc.

It will also lead to a total household income of 4.5 Billion JD in 2050, compared to 350 Million JD today, and to a total of 23,000 people working in the agricultural sector, compared to at least 50,000 people today. It will also lead to a boost of the total GDP in the area to 13.7 Billion JD in 2050, compared to 1 Billion JD today. These assumptions imply that governmental tax revenues will increase similarly, which in turn will enlarge the options for local authorities such as the municipalities and the Jordan Valley Authority to invest in required land, environment and water related infrastructure. It will also increase possibilities of the population to pay for water and sanitation services, increasing fee collection efficiencies substantially in 2050.

**Table 31 - Projections of Socio-economic Parameters for 2025 and 2050**

| Built up area requirements (urban / infrastructure) | | Area ($Km^2$) | | |
|---|---|---|---|---|
| | | 2010 | 2025 | 2050 |
| JMD 1 | Northern Jordan Valley | 19.6 | 29.9 | 40.3 |
| JMD 2 | Deir Alla | 12.3 | 18.7 | 25.3 |
| JMD 3 | South Shouneh | 12.7 | 19.3 | 26.1 |
| | Total ($Km^2$) | 44.6 | 67.9 | 91.6 |

| **Socio-economic parameters** | **2010** | **2025** | **2050** |
|---|---|---|---|
| Average Household size (persons) | 6.0 | 5.1 | 3.5 |
| Average Income pppy (JD) | 1,408 | 4,630 | 10,000 |
| Employment Agriculture (%) | 20.0% | 14.4% | 5.0% |
| Employment Manufacturing / Construction | 25.0% | 22.0% | 17.0% |
| Employment Tourism / Commerce | 20.0% | 20.0% | 20.0% |
| Employment Transportation | 6.5% | 5.5% | 3.8% |
| Employment Services / others | 28.5% | 38.1% | 54.2% |
| GDP per person (JD) | 4,200 | 13,875 | 30,000 |
| Average Household size (persons) | 6,0 | 5,0625 | 3,5 |

| **Socio-economic parameters Jordan River Valley** | **2010** | **2025** | **2050** |
|---|---|---|---|
| Number of households | 41,193.7 | 67,092.9 | 130,842.1 |
| Total Income (Million JD / year) | 348 | 1,573 | 5,932 |
| Employees Agriculture | 49,432 | 48,826 | 29.659 |
| Employees Manufacturing / Construction | 61,791 | 74,725 | 100.842 |
| Employees Tourism / Commerce | 49,432 | 67,932 | 118.638 |
| Employees Transportation | 16,066 | 18,639 | 22.541 |
| Employees Services / others | 70,441 | 129,537 | 321.508 |
| GDP Jordan Valley (Million JD, Jordan) | 1,038 | 4,712 | 17.796 |

## 3.2 Strategic Planning Objectives

### 3.2.1 Introduction

The key challenge for the Jordan Valley is to create a healthy economic development perspective for the Jordan River Valley and its people, including a Jordan River with sufficient environmental flows to sustain a healthy eco-system; equitable sharing of water resources and free public for all nationalities within an appropriate security framework, and sufficient water to supply the projected water requirements for 2025 and 2050 as presented above.

In an earlier document researched and published by EcoPeace Middle East, the target environmental flow for the river was identified as an estimated 400 MCM per year, with the target return flow of 220 MCM, 100 MCM and 90 MCM identified for Israel, Syria and Jordan respectively. In Jordan, water scarcity and the un-natural population growth due to Syrian refugees might hinder Jordan's ability to meet this target. In addition, given both the political situation in Syria and that there is no possibility for a Syrian team to be party to this planning effort, there is therefore no attempt to determine in any detail from where and how the 100 MCM requirements from Syria would flow into the river by 2050, other than stating that it would lead to an additional 100 MCM flow from the Yarmouk River into the Jordan River. Therefore the 100 MCM annual contribution is not part of the WEAP model developed below and the model therefore targets a 300 MCM annual flow to the Dead Sea.

The key strategic planning objectives that would promote sustainable development for the Jordan River Valley have been identified below:

### 3.2.2 Pollution Control

The objective in terms of pollution control is to eliminate all sources of environmental pollution in the Lower Jordan River Basin by 2025. This requires full and adequate treatment and reuse of all wastewater flows in the basin and to embark on fully integrated solid waste management, including:

- Separate solid waste collection, transportation and transfer;
- Reuse and recycling of solid waste;
- Selection, planning, design and construction of a sanitary landfill;
- Closing of existing non-sanitary dump sites; and
- Developing composting facilities.

All the above will be based on the polluter – pays – principle and progressive taxation for heavy consumers.

In terms of environmental management, the challenge will be to implement an integrated environmental management system, including monitoring, enforcement and public awareness on wastewater and solid waste management, also focused on non-pollution sources; groundwater protection; water quality management; soil quality and air quality; overgrazing, as well as implementing dedicated impact assessment tools, such as Strategic Environmental Assessments to test new policies and strategies related to the LJR Basin.

Good environmental management in the basin also requires enhancing water and environmental awareness of all communities, schools and municipalities in the valley, and implementing environmental

standards instance according to the ISO norms 14000 and 14001. In terms of agricultural environmental management the challenge is to assist farmers in applying sustainable agronomic practices, including regulation of the use of pesticides and fertilizers and promotion of environmentally sustainable substances. This will assist farmers to reaching EU agricultural import standards.

### 3.2.3 Sustainable Water Management and River Rehabilitation

In terms of water management the challenges clearly relate to overcoming the water scarcity related problems in the Lower Jordan Valley. This means creating a sustainable water supply system that meets that current and future domestic and agricultural water demands; and at the same time to preserve the water resources for future generations. This requires an Integrated Water Resources Management regime for the whole Jordan River, based on international co-operation among Israel, Jordan and Palestine, supported with adequate water management tools (WEAP) to ensure sustainable water supply and an increase of the base flow and rehabilitation of the ecological values of the Jordan River.

This requires a series of interventions, including adequate water data monitoring and modeling; maximized reuse of locally and regionally treated wastewater; promotion of water saving and water demand management measures in all sectors; provision of related training and institutional strengthening support services; improved regulations and enforcement on groundwater abstractions to stop groundwater depletion and salination; and implementation of efficient water pricing policies and related enforcement.

A specific challenge in the Lower Jordan Valley relates to wastewater management and sanitation, both from a public health and environmental point of view, as for the water reuse efficiency point of view.
The full treatment of wastewater generated in the study area and full reuse for agricultural purposes is a key strategic objective. This will both reduce public health related risks and strengthen the agricultural sector. This requires development of a detailed technical and financial plan, including designs and tender documents, for full scale collection, treatment and reuse of the locally generated wastewater flows, including domestic, industrial (mainly olive oil wastewater in Jordan) and manure management.

Another key challenge is to restore the function of the Jordan River as a natural river and water conveyor in the valley for supply purposes, by keeping its flow as long as possible in the river. Rehabilitating the river will include actions in terms of realizing at least one minor flood (c.a. 20-50 $m^3$/sec) per year. In order to bring back the original habitats of the river, also the flow bed of the river are to be widened to about 50-70 m in the north and at least 30 m in the south, with flood plains on both sides.

The salinity of the Jordan River has a natural tendency to increase downstream. This is caused by natural drainage of brackish groundwater into the river, particularly in the southern part of the valley near the Dead Sea. The key challenge is to prevent any inflow of salt or brackish surface water into the river above the point where the river would still be fresh, i.e. above the confluent with Wadi Hisban. This implies bypassing the salt water from the Israeli Saline Water Carrier (SWC), the brackish water from the Israeli Fish Ponds, and the brine from the Abu Zeighan desalination plant to a new outflow located south of the river‘s confluent with Wadi Hisban, close to the Dead Sea. If this will be done, the river will be able to provide water of good quality for different user functions. In terms of chloride concentrations this means a maximum of 400 mg/l for drinking water purposes; 600 mg/l for fresh water irrigation; and 1500 mg/l for irrigation of date palms.

Another key challenge is to maintain total agricultural water demands at the same level as today. To achieve a sustainable water balance within the basin and sufficient flows in the river it will furthermore be required that sometime before 2050 Israel will cease pumping water out of the basin from Tiberias Lake

through the National Water Carrier (NWC), meanwhile maintaining its present agricultural consumption at the basin of Tiberias Lake; that Tiberias Lake will be kept on a medium water level between the top and bottom red lines ("green line" as defined by the Israeli Water Authority); and that by 2050 Jordan will stop diverting water from the Yarmouk and other tributaries to the King Abdullah Canal (KAC) to the extent possible, and instead will use the Jordan River as main conveyor for its irrigation supply purposes. In addition, by 2050 Palestine would also use the Jordan River as its main water conveyor, meaning that the planned development of the West Ghor Canal will not be built.

In terms of water governance, the challenge will be to strengthen the authorities, including JVA in their role as regulator of the water sector in the Jordan Valley. This includes skills with regard to water data collection and management; water resources planning; efficient operations of the water storage and supply system; and strengthening the co-operation of JVA with the local water user associations.

### 3.2.4 Sustainable Agriculture

The challenges for the irrigated agricultural land in the Jordan River Valley are to improve water use efficiencies and economic outputs per unit of water used, and meanwhile stabilize, or even reduce the total water demands for the agricultural sector. This will require adequate tariff policies on water used for irrigation, including enforcement, to stimulate more efficient use of water and to reduce the overall agricultural share of water in Jordan. This also includes maximized reuse of treated wastewater, efficient use of pesticides and fertilizers, expansion of efficient water use practices such as drip irrigation and greenhouses; introduction or expansion of growing cash crops and high yield crops, and improving extension services and post harvesting support to the farmers to enable them to create higher economic returns.

Greenhouses are a very effective manner to improve water efficiencies and economic outputs in the agricultural sector, provided that traditional agricultural practices and abandoned at the same time. Furthermore, using greenhouses reduces the production related risks, provide for better quality crops and provide wider options for crop diversification. Finally, evapotranspiration from greenhouses is substantially less than from open field agriculture and it does not cause soil salinity. However, many farmers would require adequate and reliable micro-credits in order to invest in greenhouses.

Drip irrigation is another effective manner to improve water efficiencies in the open fields. The challenge is to set up sustainable drip irrigation systems in the Lower Jordan Valley, including appropriate operations and maintenance and monitoring systems. This requires also financial facilities for farmers to invest, standardization of designs and manufacturing and provision of technical support services.

A related challenge will be to strengthen the Extension Services for the farmers in the Lower Jordan Valley. These services might be provided through the existing water user associations in the North, Middle, Karamah regions, and shall be coordinated NCARE, who have worked on strengthening these services before. Nevertheless, the current level of extension services is still limited, and need to be expanded. This may include mobile unit for water and soil quality testing, and irrigation maintenance services.

In terms of rural economics, an important challenge is to improve the post-harvesting and marketing potentials of the farmers in the Jordan Valley, including setting up product organizations, better information about markets (nationally and internationally) and related product requirements and creating better access to export markets. This might include fair-trade related markets.

In addition, the challenge is also to strengthen the governance in the Lower Jordan Valley, including monitoring, regulations and enforcement of surface water and groundwater abstraction practices; protection of sensitive shallow aquifers, efficient tariff policies, and reduction of agricultural pollution loads.

### 3.2.5 Jordan River Valley Governance

*Institutional Strengthening*
The institutional challenge will be to strengthen responsible land and water authorities, municipalities and related authorities in their role as authority and regulator of the Jordan Valley. Improvements are required in areas such as water data collection and management; water planning; water storage and distribution operations, including IT and wireless data transfer, economic and land use planning and related support services. This will also require improved coordination and cooperation between various stakeholders involved in water management, to enable to more efficient and beneficial water economy. The subsidiary principle is here recommended where decision making and empowerment should take place at the level of authority closest to the resident for the issue concerned. This would result in considerable investment in municipal authorities.

*Advocacy and Local Community Empowerment*
Development of the Lower Jordan River Basin requires that local communities will fully participate in identifying their needs and in implementing the interventions for addressing these needs. This requires that local communities are educated and empowered; and that the general public awareness on the current problems and possible solutions in terms of sustainable development is raised. This requires support from local media as well as local governments and municipalities, as well as support from the Jordan Valley Authority and the Water Authority of Jordan.

*Sustainable Economic Development*
In order to further boost a sustainable economic development in the Lower Jordan River Basin and related living standards for its population, additional economic development and private sector initiatives have to be supported, including community development projects; agro-industry and tourism development and specific economic initiatives providing high outputs against low water requirements. Sustainable economic development also requires promotion of the use of renewable energy sources, such as biogas; waste-to-energy; small scale solar energy and wind energy potentials in the basin, as well as promotion of better vocational education facilities in the region.

*Social Responsibility*
If the development of the Lower Jordan River Basin and the related interventions will done in a sustainable manner, this shall also include social responsibilities, including fair payment of wages, inclusion of social security, safe and healthy working conditions, training of employees and equal gender opportunities.

*Institutional Strengthening*
The institutional challenge will be to strengthen responsible authorities, including JVA, WAJ, municipalities and related authorities in their role as authority and regulator of the Jordan Valley. Improvements are required in areas such as water data collection and management; water planning; water storage and distribution operations, including IT and wireless data transfer, economic and land use planning and related support services. This will also require improved coordination and cooperation between various stakeholders involved in water management, to enable to more efficient and beneficial water economy

### 3.2.6 Ecological Restoration

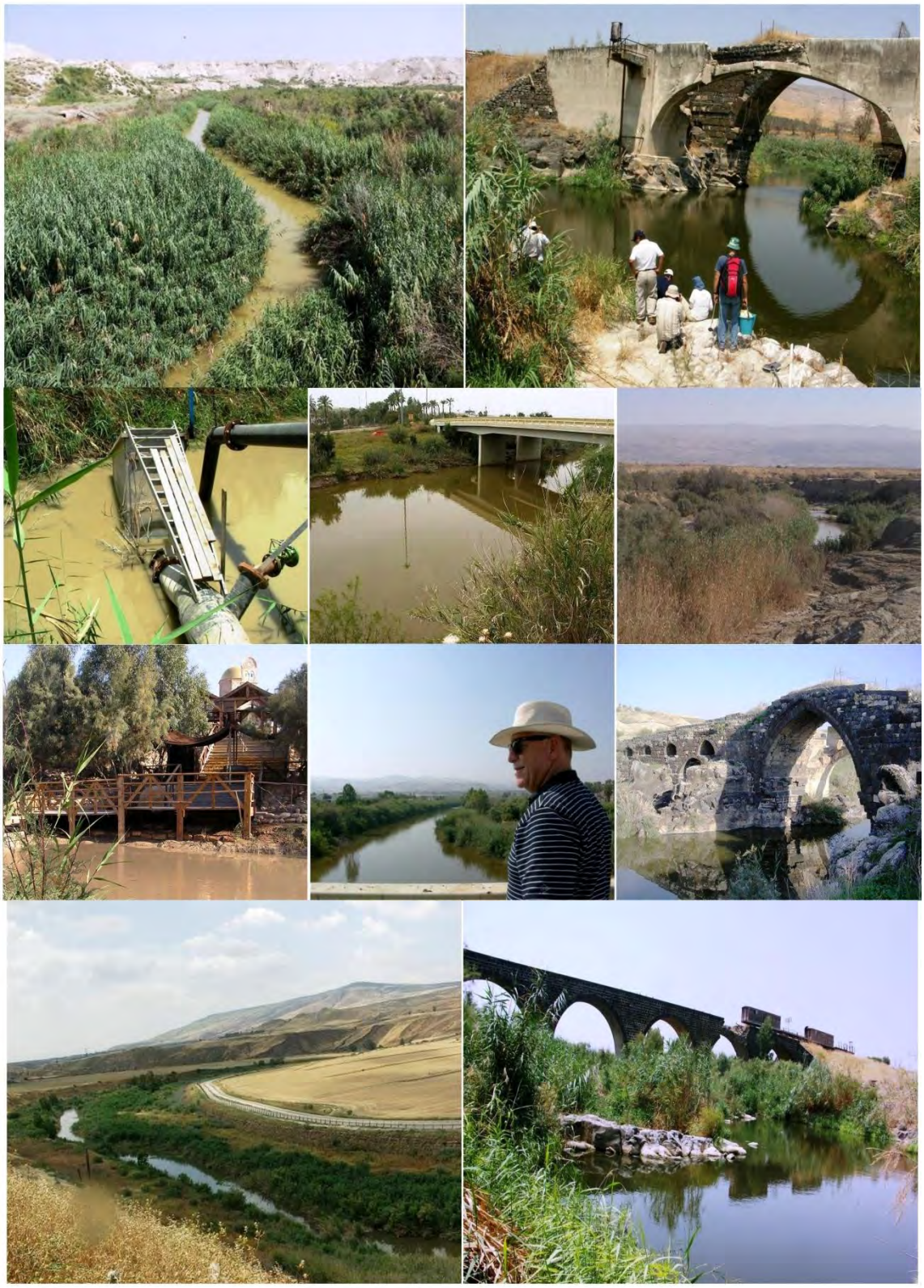
One of the key challenges is to restore the good ecological status of the Jordan River Valley, and the role of the Jordan River as a strategic water conveyor (Green Infrastructure), in line with earlier recommendations of EcoPeace Environmental Flow Study. This includes restoration of ecological (flora, fauna) status of the river, based on environmental flows and good water quality; design and implementation of dedicated ecological restoration projects and eco-parks along the borders of the Jordan River; expansion of currently assigned nature reserves, based on important flora, fauna and bird areas, also in accordance with the Ramsar Convention; and design and develop dedicated nature recreational areas for the urban population.

### 3.2.7 Sustainable Tourism and Cultural Heritage Development

Development of the tourism sector and the cultural heritage in the Jordan River Valley is a major challenge for saving the intrinsic cultural heritage values in the valley, as well as for boosting the economy and creating jobs in the area. This requires investment planning for major sites such as the Pella, the Bakoura National Park and the Hema Hot Springs. It also includes development of tourism tracking trails around various themes including nature protection, faith based experiences and rural sceneries, and cross border tourism attractions and trails such as new access sites along the Jordan River, a free tourism area at head of the Dead Sea between Jordan and Palestine; the Jordan River Peace Park. It may also include linking the Baptism Site to other tourism sites and trails in the valley, and creating synergies and stronger economic development opportunities. Finally this may include rural tourism accommodations, such as bed and breakfast, local restaurants, support of woman‘s center and community centers. In developing tourism facilities, the challenge will also be to fulfill environmental standards and eco-labels, similar to the EU Eco-label or the Green Globe Eco-label, and may also include bio-climatic design practices and use of renewable building materials.

### 3.2.8 Urban and Infrastructure Development

To facilitate the anticipated population and economic growth in the Lower Jordan Valley, it will be crucial to develop sufficient urban housing and infrastructure facilities in the basin, and meanwhile increase traffic safety and public transport capacities. This may include improvement of main north-south road through the valley, including bypass roads around major urban areas; improving traffic safety through traffic lights, lining and public signs; establishment of sidewalks and bicycle trails; prepare for urban planning and housing projects to accommodate the foreseen growing population and its welfare, and development of trans-boundary infrastructure facilities, such as opening up of the Damya Bridge and the Abdullah Bridge over the Jordan River.



# 4 MEETING THE STRATEGIC PLANNING OBJECTIVES

## 4.1 The Interventions

A Long list of interventions for the Jordan River Valley has been identified in co-operation with the key stakeholders, aiming at addressing the strategic planning objectives adequately. The full set of interventions is presented herein and grouped around the various strategic planning objectives. The interventions related to pollution control and water management have an impact of the Jordan River Basin at large, as well as on the Jordan River. Most of the non water / environmental related interventions have an impact on the Valley only.

The proposed pollution control related interventions focus on eliminating all sources of environmental pollution in terms of wastewater and solid waste in the Valley by 2025. This includes full and adequate treatment and reuse of all wastewater flows in the basin and to fully integrate solid waste management. Proposals have been made to include waste collection, transportation; transfer; reuse and recycling of solid waste streams; sanitary land filling and closing of existing non-sanitary dump sites.

The sustainable water management related interventions focus on establishing efficient domestic and agricultural water supply within a basin wide water balance.

The agricultural related interventions focus on improving water use and irrigation efficiencies and the economic outputs per unit of agricultural water used. It is assumed that the total water demands for the agricultural sector in the Jordan Valley will remain stable and that adequate tariff policies on water used for irrigation will be implemented, including enforcement, to stimulate more efficient use of water through for instance green house drip irrigation.

The governance related interventions include strengthening the Jordan Valley Authority and establishing a trans-national Jordan River Basin Organization that will address water management related issues from the basin perspective to the benefit of all stakeholders and inhabitants in the basin.

The ecological interventions focus on restoring the good ecological status of the Jordan River Valley in general and the Jordan River particularly. This includes restoration of the flood plain and the ecological (flora, fauna) status of the river, based on environmental flows and good water quality; design and implementation of dedicated ecological restoration projects and eco-parks along the borders of the Jordan River; expansion of currently assigned nature reserves.

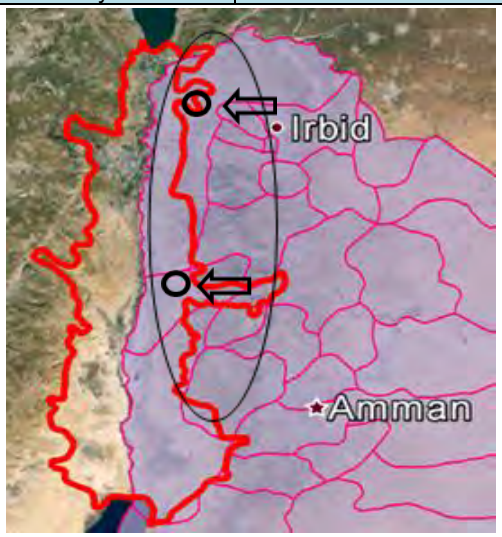
The proposed interventions in terms of tourism and cultural heritage focus on restoration and saving the intrinsic cultural heritage sites in the Basin, as well as for boosting the tourism economy in the area, including parks, hotel facilities, museums and touristic routes through the valley, as well as tourism branding and promotion. The interventions aim at creating basin wide synergies and stronger economic development opportunities for the basin as a whole.

The proposed interventions in terms of urban and infrastructure development focus on developing sufficient urban housing and infrastructure facilities in the basin towards the year 2050, and meanwhile increase traffic safety and public transport capacities.

The interventions, including foreseen planning and related investment costs are presented below for each strategic objective.

### 4.1.1 Pollution Control and Environmental Management

| LIST OF INTERVENTIONS | |
|---|---|
| P01 JOR | Solid Waste Management |
| P02 JOR | Environmental Management & Public Awareness Program |
| P03 JOR | Agricultural Pollution Control Project |
| P04 JOR | Separate waste collection and reuse pilots |

<table>
<tr><td>Name: P01 JOR<br>Solid Waste Management</td><td>Location:<br>Jordan Valley</td><td>Type of Intervention:<br>Pollution Control</td></tr>
<tr><td colspan="2">Objectives:<br>Preparation of an integrated solid waste management plan for the Jordan River Valley, including (separate) waste collection, transportation; transfer; reuse and recycling of solid waste streams; selection, planning, design and construction of a sanitary landfill; closing of existing non-sanitary dump sites; maximizing of composting of organic waste (including feedstock waste) for use in agricultural sector; organizational (JVA) and financial frameworks (polluter pays principles); and international exchange of best practices.<br>On the long term this should lead to full collection and sanitary treatment of all solid waste streams and maximized reuse and recycling of waste streams, including waste to energy.</td><td> 
</td></tr>
<tr><td>Intervention:<br>Setup and execution of an Integrated solid waste management plan for the entire area<br><br>Preparation:<br>• Analysis of the current state of solid waste management (collection, transfer, transport, recycling and disposal)<br>• Exchange of regional experiences (including experiences in Israel) and a regional knowledge transfer with regard to optimal solid waste management and the use of various reuse and recycling options<br>• Discussion with Ministries, municipalities and the Joint Service Council responsible for water management, to determine the basis for future Solid Waste Management<br>• Information campaigns for inhabitants and industries<br>• Information campaign for farmers stimulating the reuse of compost<br>• Inventory of markets for reusables<br>• Analyses of the current situation with regard to closed landfills, Closure/Rehabilitation plan for closed landfills and Post closure plan<br>• Search for temporary landfilling options for the waste from the area<br>• Determination of required land filling capacity<br>• Site selection for 2 sanitary landfills in the Jordan Valley</td><td colspan="2">Construction / realization:<br>• Setting up National criteria for Solid Waste Management (of all waste streams, including domestic, agricultural, industrial, medical and hazardous waste)<br>• Setting up of the Solid Waste Management Plan<br>• Setup of a waste management organization and make arrangements with municipalities (including separate collection)<br>• Tendering for more waste containers and more frequent and separate collection<br>• Startup of composting and recycling pilots<br>• Tendering for the closure and rehabilitation of the landfills and construction of the final cover and other rehabilitation measures<br>• Tendering for the post closure activities<br>• Tendering and construction of the landfills<br><br>Operations:<br>• Waste collection<br>• Fee collection (new tariff system)<br>• Technical and financial management<br>• Start post closure program for closed dumpsites<br>• Operation of recycling and composting pilot facilities<br>• Operation of two sanitary landfills</td></tr>
</table>

| | |
|---|---|
| • Planning & design for the 2 sanitary landfills (based on national criteria described in the Solid Waste Management plan)<br>• EIA's and licenses | |

**Results / Impacts:**

- Introduction of the polluter pays principles
- National criteria for solid waste management (including collection, reuse, recycling, composting, anaerobic digestion and other reuse options)
- Standards for the rehabilitation of old non sanitary landfills and of uncontrolled landfills (illegal dumpsites) and for the realization of sanitary landfills
- Increased capacity for and frequency of waste collection
- Improvement of environmental and public health situation
- Introduction of separate collection of specific organic waste streams (market waste, plant tissue from agriculture)
- improvement of separate collection of plastics, paper en metals
- Decrease of the amount of waste to be landfilled
- Limiting environmental pollution/risks for contamination of drinking water as result of closure old dumpsites
- Waste, which is not reused or recycled, will be fully treated in two landfills located in suitable locations in the Jordan Valley (On average for the coming 30 years 200.000 tons/year, so 6 million tons of waste over 30 years, part of this will be recycled in future)
- This project will have a direct impact on the Jordan River due to more efficient pollution control

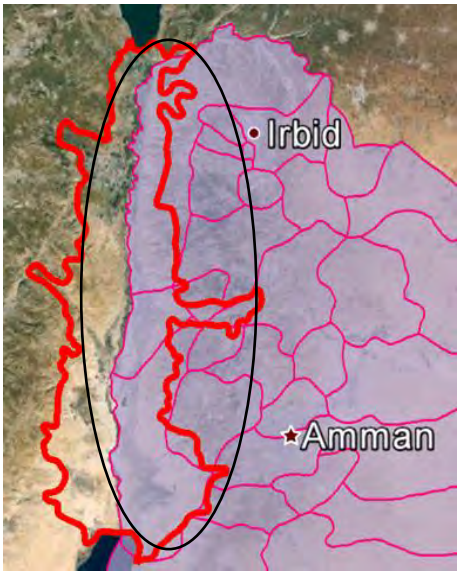
**Organization / Responsibilities:**

- Joint Service Council
- Ministry of Environment
- Local municipalities

| **Costs and Revenues:** | **Implementation Period** |
|---|---|
| • Preparation costs: JD 1.300.000<br>• Construction costs: JD 20.000.000,- (for landfills (30 years) and composting)<br>• Operation costs: 5 Million JD / yr (including collection)<br>• Annual Revenues: 2 Million JD in 2050, based on waste fees of about 20 JD / household / yr | • Preparation time: 2 years<br>• Construction time: 5 years |

**Other remarks:**

- Short Term action
- Take into account both the inhabitants and small industries.
- Start with the more inhabited areas (larger towns along the main road like Deir Alla)
- start-up of (mechanical) waste separation, reuse, recycling and composting (or maybe anaerobic digestion) pilots
- Start with the more inhabited areas, like Deir Alla (maybe combination with the current composting facility for agricultural waste and manure)
- The current landfill in Deir Alla and the closed Manshea dumpsite in North Shouneh are not designed and the sites are not selected according to appropriate criteria. These landfills have no lining system or leachate collection and treatment system. They pose a threat to nearby communities and ground water/drinking water reservoirs. Landfilling in these locations should be stopped (short term) and the sites should be rehabilitated with at least a final water proof cover (middle term).
- The waste should temporarily be brought to sanitary landfills outside the Jordan Valley.
- Site selection and designs of the new sanitary landfills middle Term, Realization long term

<table>
<tr><td colspan="2">Name: P02 JOR<br>Environmental Management & Public Awareness Program</td><td>Location:<br>Jordan Valley, Jordan</td><td>Type of Intervention:<br>Pollution Control</td></tr>
<tr><td colspan="2">Objectives:<br>The aim of this project is to set up an integrated environmental monitoring, enforcement and public awareness program for the Lower Jordan River Basin, including monitoring of wastewater and solid waste major pollution sources, including fish farms; ambient surface and groundwater quality; soil quality and air quality. The purpose of this program is to enabling JVA and related authorities to establish the environmental baseline of the LJR Basin; to increase public awareness on environmental protection and water demands; and to monitor the impacts of pollution control measures, such as solid waste management and wastewater management interventions. The project will also include development of dedicated impact assessment tools for JVA, such as Strategic Environmental Assessments to be used to test new policies and strategies related to the LJR Basin.</td><td colspan="2"> 
</td></tr>
<tr><td colspan="2">Intervention:<br>• Protecting, preserving and improvement of the environment through monitoring and law enforcement.<br>• Raising the awareness of the inhabitants and companies regarding the local environment and possible sources of pollution.<br><br>Preparation:<br>• Planning<br>• Assessment of the environmental hot spots<br>• Elaborate 2014 EcoPeace proposals for groundwater protection zoning<br>• Setting up an implementation plan including all relevant aspects (technical, financial, logistical, etc.)<br>• Development of dedicated impact EIA tools<br>• Information material (Flyers, brochures, leaflets, TV material etc.) for Public Awareness<br>• Preparation of workshops</td><td colspan="2">Construction / realization:<br>• Establish an environmental baseline<br>• Highlighting of the environmental key elements<br>• Determination of the key threats to these key elements<br>• Identification of the most vulnerable environmental areas/locations<br>• Setup of relevant legislation along with a penalty system<br>• Strategic Environmental Assessments for the new policies and strategies<br>• Information campaign for inhabitants and companies<br>• Strengthening of JVA and other authorities<br>• Setup of an enforcement organization<br>• Setup and introduction of a monitoring system<br><br>Operations:<br>• Environmental Monitoring and rehabilitation<br>• Pollution control<br>• Law enforcement</td></tr>
<tr><td colspan="4">Results / Impacts:<br>• Improvement of the awareness regarding the protection and the preservation of the Environment<br>• Improvement of urban and environmental planning capacities<br>• Improvement of the enforcement regarding waste water, air quality, waste and water resources (penalties and incentives)</td></tr>
</table>

- Enhancement of environmental data collection
- Strengthening of the capabilities of local governance
- A better coordination between JVA, MoA and local municipalities
- Empowerment of relevant authorities on monitoring, and enforcement (waste, wastewater etc.)
- Improvement of the knowledge and increase of public awareness of the inhabitants and companies in the Jordan Valley regarding the consequences of environmental pollution (littering, dumping, health issues) and the possibilities of waste collection and management, waste water collection and environmental collection. Final result will be improvement of environmental and health quality.
- This project will have a direct impact on the Jordan River due to more efficient pollution control

**Organization / Responsibilities:**

- JVA
- MoA
- Local municipalities
- Ministry of environment
- Civil society organizations

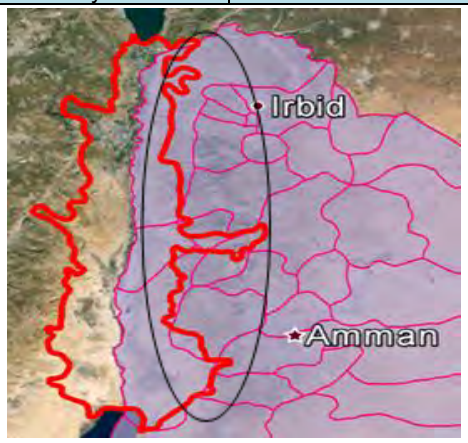
**Costs and Revenues:**

- Preparation costs: € 1,000,000
- Construction costs: € 2,100,000
- Operation costs: € 300,000 /year

**Implementation Period**

- Preparation time: 2 years
- Construction time: 3 years

**Other remarks:**

<table>
<tr><td>Name: P03 JOR<br>Agricultural Pollution Control Project</td><td>Location:<br>Jordan Valley</td><td>Type of Intervention:<br>Pollution control</td></tr>
<tr><td colspan="2">Objectives:<br>The aim of this project is to assist farmers and their organizations in applying sustainable agronomic practices, including minimized use of pesticides and fertilizers; regulation and distribution and types of pesticides on regional or national levels, and promotion of environmentally sustainable substances; stimulation of the reuse of organic agricultural waste as compost; improve the management of agricultural waste; improvement of the environmental performance of fish farms.</td><td> 
</td></tr>
<tr><td colspan="2">Intervention:<br>Introduction of environmentally sustainable practices in agriculture (including fish farms)<br><br>Preparation:<br>• Inventory of the agricultural market situation and common agricultural practice including waste management<br>• Analysis of the possibilities of turning certain agricultural plant tissues remains into animal food.<br>• Awareness raising, information campaign and training for farmers (stimulation of the reuse of organic agricultural waste as feedstock for animals or for compost, improved waste management, promotion of environmentally sustainable substances, limitation of use of pesticides and fertilizers<br>• Inventory and assessment of the environmental performance of fish farms (location, capacity, technical state, manner of operations, potential pollution loads → e.g. Jordan Valley fish farm of Taloubi (closed?), The Arab fish farm in the North, Al-Natoor Fisheries, Al-Taba'a Fisheries)<br>• Awareness raising, information campaign and training for operators of the fish farms</td><td>Construction / realization:<br>• Stimulation program for environmentally sustainable farming<br>• Tendering for agricultural waste management and composting.<br>• Setting up of regulations for pesticide and artificial fertilizers<br>• Rehabilitation plan for fish farms to prevent pollution of the ground water or uncontrolled/ untreated spillage of the water to the river, including planning and costs<br>• Tendering and rehabilitation/construction of fish farms<br><br>Operations:<br>• Adjust manure application to plant requirements<br>• Limit the use of pesticides and fertilizers<br>• Supervision/improvement of manure application (risks in areas with high runoff potential, high chances of rainfall, areas of high vulnerability to contamination)<br>• Use of organic agricultural remains as fodder or for compost production<br>• Waste collection and treatment<br>• Reuse of waste water in fish farms</td></tr>
<tr><td colspan="3">Results / Impacts:<br>• Improvement of environmental situation<br>• Improvement of public health situation<br>• This project will have a direct impact on the Jordan River due to more efficient pollution control<br>• Improvement of the reuse of organic agricultural waste</td></tr>
</table>

<table>
<tr><td colspan="2">

- Reduction of the use of pesticides and artificial fertilizers, thus limiting pollution and costs for farmers
- Increase of the organic matter content of soils
- Minimization of the potential of contamination of spring water and shallow aquifers.

</td></tr>
<tr><td colspan="2">

**Organization / Responsibilities:**

- JVA
- MoA
- Farmers organizations
- Ministry of Environment (MoENV)

</td></tr>
<tr><td>

**Costs and Revenues:**

- Preparation costs: JD 500,000
- Construction costs: JD 1,000,000
- Operation costs: JD 300,000 /year

</td><td>

**Implementation Period**

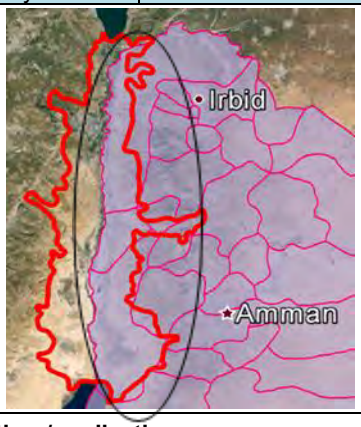
- Preparation time: 1 year
- Construction time: 2 years

</td></tr>
<tr><td colspan="2">

**Other remarks:**

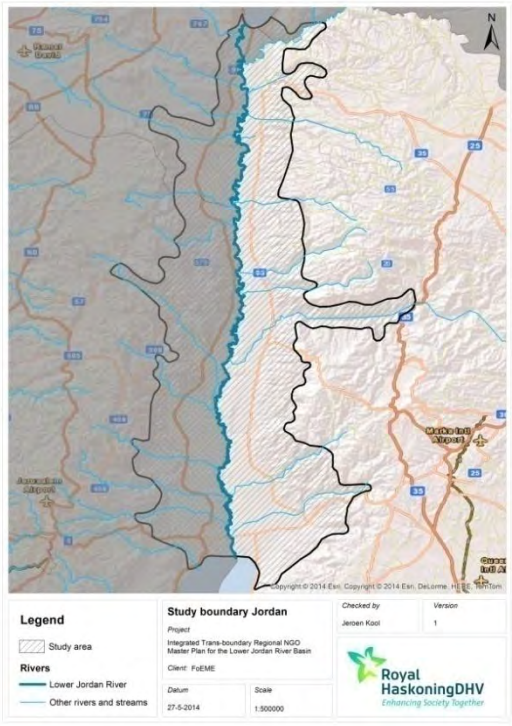
- Agricultural waste includes but is not limited to plant tissue remains, manure, runoff from feedlots, waste water from farm buildings, dead animals, plastics, chemicals, empty containers, old machinery, animal health care products, etc.
- Various plant tissue remains, which are considered agricultural waste, can be used as feeing material for animals
- Concentrations of animal manure and carcasses on farms may cause environmental pollution (risk for groundwater) and health risks (diseases) for both animals and humans. Therefore, collection and treatment (or use in the case of manure if possible) is required.

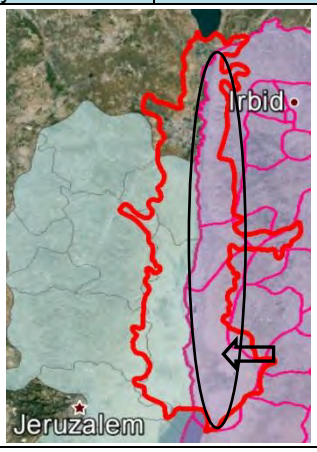
</td></tr>
</table>

<table>
<tr><td>Name: P04 JOR<br>Separate waste collection and reuse pilots</td><td>Location:<br>Jordan Valley</td><td>Type of Intervention:<br>Pollution Control</td></tr>
<tr><td colspan="2">Objectives:<br>To stimulate the reuse of resources/waste streams and limit the amount of waste to be landfilled; Research to investigate the possibilities and bottlenecks for separate collection and reuse of certain waste streams.</td><td> 
</td></tr>
<tr><td>Intervention:<br>Preparation and execution of pilot projects<br><br>Preparation:<br>• Selection of communities to perform pilots<br>• Information campaign for inhabitants with regard to a pilot for separate collection<br>• Information campaign for farmers with regard to a pilot for the use of compost<br>• Planning of the separate collection and composting pilots<br>• Basis design and operations manual for the composting pilot<br>• Test program</td><td colspan="2">Construction / realization:<br>• Tendering for the waste containers and collection contract for the separate collection pilot<br>• Tendering for and realization of the composting pilot facility<br>Operations:<br>• Separate collection of organic waste and recyclables<br>• Composting of the organic waste to compost<br>• Application of the compost by a selected group of farmers<br>• Analysis of results of the separate collection, composting and farming pilot and comparison with a reference group of farmers</td></tr>
<tr><td colspan="3">Results / Impacts:<br>• Introduction of separate collection of specific organic waste (market waste, plant tissue from agriculture)<br>• Improvement of separate collection of plastics, paper and metals<br>• Decrease of the amount of waste to be landfilled<br>• This project will have an indirect impact on the Jordan River due to more efficient pollution control</td></tr>
<tr><td colspan="2">Organization / Responsibilities:<br>• JVA<br>• MoA<br>• Selected communities<br>• Organization of farmers<br>• Ministry of Environment (MoE)</td><td></td></tr>
<tr><td>Costs and Revenues:<br>• Preparation costs: € 100,000<br>• Construction costs: € 200,000<br>• Operation costs: € 100,000 / year</td><td colspan="2">Implementation Period<br>• Preparation time: 0.5 years<br>• Construction time: 0.5 years</td></tr>
<tr><td colspan="3">Other remarks: [Short Term]<br>• Start-up of (mechanical) waste separation, reuse, recycling and composting (or maybe anaerobic digestion) pilots<br>• Start with the more inhabited areas, like Deir Alla (maybe combination with the current composting facility for agricultural waste and manure)</td></tr>
</table>

### 4.1.2 Sustainable Water Management and River Rehabilitation

| LIST OF INTERVENTIONS | |
|---|---|
| W01 JOR | Improved Lower Jordan River Valley Management Project |
| W02 JOR | Wastewater collection, treatment and reuse project |
| W03 JOR | Emergency Wastewater Management Project |
| W04 JOR | Wastewater reuse pilot projects |

<table>
<tr><td colspan="2">Name: W01 JOR<br>Improved Jordan River Valley Management Project</td><td>Location:<br>Jordan Valley</td><td>Type of Intervention:<br>Water Management</td></tr>
<tr><td colspan="2">Objectives: The goal of this Project is to improve the basin water management in terms of operational and information management of the Jordan Basin, and to prepare for full collection, treatment and reuse of locally generated wastewater in the basin. This includes investment planning and a pilot wastewater collection and reuse scheme, to demonstrate to the inhabitants in the basin the advantages of reusing treated wastewater for agricultural purposes.</td><td colspan="2">Map:<br> 
</td></tr>
<tr><td colspan="2">Interventions:<br>LJR Basin Management Investment Planning<br>1- Water Resources and demand data updating, WEAP and IWRM<br>2- Sanitary Assessment of municipality in basin<br>3- Alternative sanitary and wastewater reuse strategies<br>4- Elaboration of the preferred strategy<br>5- Outline designs and tender packages<br>6- Promotion of tender packages<br>Pilot Wastewater Reuse in Muaz Bin Jabal<br>7- Pilot Project design and tender documents<br>8- Construction of the Pilot works<br>9- Technical Assistance to the operation WWTP<br>10- Technical Assistance pilot reuse scheme<br>Regional Co-operation<br>11- Project Information workshop<br>12- Consultation workshop Investment interventions<br>13- Final workshop Investment Plan<br>14- Information workshop Pilot wastewater reuse<br>15- Consultation workshop Pilot wastewater reuse<br>16- Final workshop Pilot wastewater reuse<br>17- Regional information and dissemination event</td><td colspan="2"></td></tr>
<tr><td colspan="4">Results / Impacts: Improved IWRM; Full sanitation investment plan ready; pilot reuse project in operation; regional co-operation completed. This project will have a direct impact on the Jordan River due to more efficient water use.</td></tr>
<tr><td colspan="2">Organization / Responsibilities:<br>• JVA / WAJ / MWI in steering committee<br>• Waternet, RHDHV, EcoPeace, operating partners</td><td colspan="2">• Muath Bin Jabal Municipality<br>• Linking project to ISSP National Wastewater Master Plan</td></tr>
<tr><td colspan="2">Costs and Revenues:<br>• Costs: 1.7 M€<br>• 70% subsidy already requested from Netherlands Sustainable Water Fund</td><td colspan="2">Implementation Period<br>• Implementation Period: 2 years</td></tr>
<tr><td colspan="4">Other remarks:<br>• Follow up project will be to implement the sanitary investment plan prepared under this project</td></tr>
</table>

<table>
<tr><td colspan="2">Name: W02 JOR<br>Wastewater collection, treatment and reuse project</td><td>Location:<br>Jordan Valley</td><td>Type of Intervention:<br>Waste water</td></tr>
<tr><td colspan="2">Objectives:<br>1. To realize adequate and safe collection of wastewater from all the communities in the study area (by constructing wastewater collection networks) 540,000 people in 2025 and 607,000 people in 2050.<br>2. To treat the generated wastewater from the different communities<br>3. To realize full scale reuse of treated wastewater in the Lower Jordan Valley (24 MCM per year in 2025 and 33 MCM in 2050)</td><td colspan="2">Map:<br> 
</td></tr>
<tr><td colspan="2">Intervention:<br>In accordance with the Investment Plan prepared under intervention W01 JOR, connect all wastewater generation units (buildings) to wastewater collection networks<br>This will be attained through the construction of wastewater treatment plants in accordance with the above investment plan in the study area and the potential expansion of the existing wastewater treatment plants<br><br>Preparation:<br>• Planning and design of a wastewater collection networks and WWTP‘s<br>• EIA‘s and licenses<br>• Setting up organizational structure<br>• Finance planning<br><br>Construction / realization:<br>• Tendering and construction/expansion of the sewerage systems<br>• Tendering and rehabilitation/expansion of cesspits in the more remote areas<br>• Tendering for waste water collection with trucks</td><td colspan="2">• Tendering for the feasibility/engineering and EIA studies for the conveyance of the effluent along with the WWTP location selection and design<br>• Tendering for wastewater collection with trucks<br>• Tendering and construction of the wastewater collection networks and WWTP‘s<br>• Training for operators<br><br>Operations:<br>• Data collection<br>• Assessment of the existing sewerage systems (baseline conditions)<br>• Need assessment<br>• Preparation of the engineering designs (plans and profiles)<br>• Preparation of bill of quantities<br>• Financial analysis (costing)<br>• Construction<br>• Technical and financial management<br>• Surveying<br>• Excavations<br>• Rehabilitation<br>• Tendering<br>• Fee collection</td></tr>
<tr><td colspan="4">Results / Impacts:<br>• Realization/expansion/improvement of the current wastewater collection system to a system to which all wastewater producers are connected without leakage of wastewater, treated and reused<br>• Improvement of environmental situation<br>• Improvement of public health situation<br>• Improvement of a WW collection system by realizing a sewerage system in combination with cesspits for remote areas, so wastewater producers are connected without leakage of wastewater.<br>• Produced wastewater will be fully treated and reused</td></tr>
</table>

<table>
<tr><td colspan="2">

- This project will have a direct impact on the Jordan River due to more efficient water use

</td></tr>
<tr><td colspan="2">

**Organization / Responsibilities:**

- Municipalities and village councils
- JVA and WAJ (regulation)
- Ministry of Agriculture and WUA;s (farmers support)
- Farmer / Water User Association (beneficiary)

</td></tr>
<tr><td>

**Costs and Revenues:**

- Preparation costs: € 200,000
- Construction costs: € 30,000,000
- Operation costs: € 1,750,000 / yr
- Annual Revenues: € 3,000,000 / yr

</td><td>

**Implementation Period**

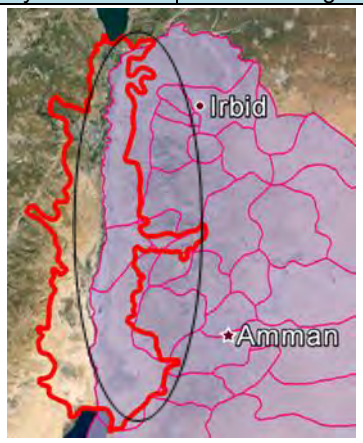
- Preparation time: 1 year
- Construction time: 5 years

</td></tr>
<tr><td colspan="2">

**Other remarks:**

- Short Term actions: Analysis and improvement of cesspits and of collection by tanker trucks
- Short term action: Analysis of current state of sewerage
- Middle term action: improvement/expansion of the sewerage system

</td></tr>
</table>

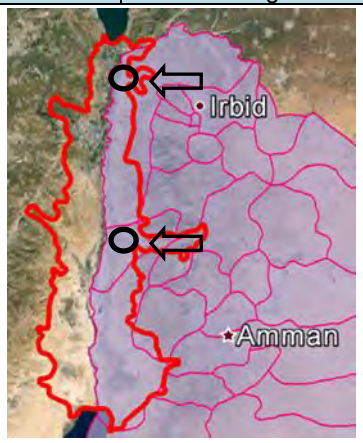
<table>
<tr><td colspan="2">Name: W03 JOR<br>Emergency Wastewater Management Project</td><td>Location:<br>Jordan Valley</td><td>Type of Intervention:<br>Water management</td></tr>
<tr><td colspan="2">Objectives:<br>Currently most wastewater in the Jordan Valley is collected in cesspits, which are partly in bad condition or irregularly emptied. This poses immediate threats for the public health and the environment. The aim of this project is to make an assessment of the scope and extend of the current problems; to plan for a basin wide cesspits rehabilitation program; to increase capacities for emptying cesspits; to purchase additional tanker trucks for wastewater collection; to plan for related organization and operational aspects; and to implement these short term emergency measures.</td><td colspan="2"> 
</td></tr>
<tr><td colspan="2">Intervention:<br>Introduction of short term emergency measures for adequate and save collection of waste water thus limiting environmental and health risks<br><br>Preparation:<br>• Inventory and Assessment of cesspits in the Jordan Valley (number, exact locations, capacity and technical status (maintenance and design))<br>• Improvement plan for the cesspits (capacity and technical status), including planning and costs, or alternative solutions such as the use of biodigestors at household level.<br>• Discussions with municipalities and the organization which will be made responsible for wastewater collection<br>• Improvement plan for organization and capacity of wastewater collection</td><td colspan="2">Construction / realization:<br>• Tendering and rehabilitation/construction of cesspits<br>• Tendering for additional tanker trucks to empty cesspits for increased capacity and frequency of wastewater collection<br>• Setup organization and make arrangements with municipalities<br><br>Operations:<br>• Wastewater collection<br>• Fee collection<br>• Technical and financial management</td></tr>
<tr><td colspan="4">Results / Impacts:<br>• Better understanding of the scale of the cesspit problem in the Jordan Valley and a plan for improvement to deal with this problem<br>• Adequate and save collection and treatment of waste water<br>• Less leakage of waste water out of cesspits and less overflow of cesspits.<br>• Improvement of fee collection and lower fees for waste water collection (now expensive due to long transportation distances).<br>• Improvement of environmental and public health situation<br>• This project will have a direct impact on the Jordan River due to more efficient water use</td></tr>
<tr><td colspan="4">Organization / Responsibilities:<br>• WAJ<br>• Municipalities</td></tr>
</table>

| | |
|---|---|
| **Costs and Revenues:**<br>• Preparation costs: € 100,000<br>• Construction costs: € 20,000,000<br>• Operation costs: € 200,000 / year<br>• Annual Revenues: € 200,000, / year | **Implementation Period**<br>• Preparation time: 0.5 years<br>• Construction time: 5 years |
| **Other remarks:**<br>• Take into account both the cesspits of houses and of small industries.<br>• Start with the more inhabited areas (larger towns along the main road like Deir Alla)<br>• To lower the fees extra WW treatment capacity on lower distance should be made available (see intervention sheet W02 PAL) | |

| **Name:** W04 JOR<br>Wastewater reuse pilot projects | **Location:**<br>North Shouneh or Tal al Mantah | **Type of Intervention:**<br>Water management |
|---|---|---|

**Objectives:**

Preparation and Implementation of a pilot wastewater reuse project in the Lower Jordan River Basin to serve as an example for the wider water and agricultural sector and as core for further expansion of local wastewater reuse throughout the basin. The pilot project shall be linked to collection and treatment of wastewater from existing cesspits in the Jordan Basin.




**Intervention:**

Preparation and execution of pilot projects

**Preparation:**

- Selection of farmers to perform pilots
- Information campaign for farmers with regard to a pilot for the use of the treated wastewater
- Planning and test program for the reuse pilot (current maximum capacity of WWTP's is 600.000 $m^3$/year

**Construction / realization:**

- Supply contracts with farmer organizations
- Training for operators and farmers

**Operations:**

- Main and Tertiary treatment and distribution of wastewater
- Analysis of results of the wastewater reuse and farming pilot and comparison with a reference group of farmers

**Results / Impacts:**

- Better understanding for authorities and farmers of the benefits and attention points of local wastewater reuse serving as an example for the wider water and agricultural sector and as core for further expansion of local wastewater reuse throughout the basin.
- This project will have a direct impact on the Jordan River due to more efficient water use

**Organization / Responsibilities:**

- MoA
- Selected communities
- Organization of farmers or WUA
- Ministry of Environment
- WAJ
- MWI

**Costs and Revenues:**

- Preparation costs: € 100,000
- Construction costs: € 1,000,000
- Operation costs: € 100,000 / yr
- Annual Revenues: € 180,000 / yr

**Implementation Period**

- Preparation time: 1 year
- Construction time: 2 years

### 4.1.3 Sustainable Agriculture

| LIST OF INTERVENTIONS | |
|---|---|
| A01 JOR | Jordan Valley Greenhouses Expansion Project |
| A02 JOR | Extension Services Improvement Project |
| A03 JOR | Drip Irrigation Improvement Project |
| A04 JOR | Jordan Valley Post Harvesting Support Project |
| A05 JOR | Irrigation Operation Efficiency Improvement Project |
| A06 JOR | Jordan Valley Authority Support Project |

<table>
<tr><td colspan="2">Name: A01 JOR Jordan Valley Greenhouses Expansion Project</td><td>Location: Agricultural areas PS 41 and PS 55</td><td>Type of Intervention: Sustainable Agriculture</td></tr>
<tr><td colspan="2">Objectives:<br>The aim of this intervention is to expand the number of greenhouses in the LJR to increase agricultural production and revenues, particular in areas PS 41 and PS 55, and the meanwhile keeping the total agricultural water demands at the same level. This intervention also relates to intervention A04 – Post Harvesting Support.</td><td colspan="2"> 
</td></tr>
<tr><td colspan="2">Interventions:<br>(1) micro credit facilities for farmer to make investments (for instance through IFAD);<br>(2) provide services to the farmers on the management of greenhouses;<br>(3) provide advice on optimizing crop selection for the greenhouses, including options for organic products and applying (EU) Bio-label systems; Fair Trade products, and more;<br>(4) provide water management services aiming at reducing total water demands</td><td colspan="2">Target:<br>• The project targets to establish about 1000 new greenhouses on the defined areas<br>• Considering an average investment of 2000 JD per GH, including structure; plastic; water system; monitoring) this would be a total investment of 2 Million JD to be done by farmers through micro financing<br>• Farmers to be reached through their Water User Association</td></tr>
<tr><td colspan="4">Results / Impacts: Lower Risk in terms of production<br>• Totally 1000 extra greenhouses<br>• Substantially higher production rates per m3 of water used, or m2 of land required<br>• Better Quality crops<br>• Promotion of organic farming where possible<br>• More options for farmers to diversify crops<br>• Better conservation of soil quality: greenhouses do not leach into the ground, cause no salinity of the soils and reduce carbon in the soil.<br>• Lower Evapotranspiration rates. GH have about 60% less ET than open field agriculture, but on the other hand enable a longer growing season leading to extended water demands<br>• Indirect impact positive on the Jordan River</td></tr>
<tr><td colspan="4">Organization / Responsibilities:<br>• Steering Committee: JVA, MoA, WUA‘s<br>• Implementation by WUA Support Unit, with external technical assistance (TA) support and micro-financier<br>• Financing through micro-credit organization, such as IFAD, with support from international financiers for TA services<br>• Support, dissemination by EcoPeace</td></tr>
<tr><td colspan="2">Costs and Revenues:<br>• Preparation costs: 100,000 JD<br>• Credit Program: 2,000,000 JD<br>• TA costs: 200,000 JD<br>• Annual Revenues: 400,000 JD (for farmers)</td><td colspan="2">Implementation Period<br>• 1 year preparation<br>• 4 years micro-financing / TA<br>• 1 year follow up support</td></tr>
</table>

| **Name:** A02 JOR Extension Services Improvement Project | **Location:** North, Middle and South of JRV | **Type of Intervention:** Agriculture Improvement |
|---|---|---|

**Objectives:**

The aim is to increase the quality of extension services to the farmers in the LJRB, and link these services to the existing 26 WUAs in the basin

**Interventions:**

(1) Assessment and analysis of current extension services and related flaws, based on field visits and interviews

(2) provision of improved extension services to better manage and monitor water use and distribution, and reduce energy consumption (ref. to EU AgriClimate Change project)

(3) A training center in the Jordan Valley- special focus on agricultural water and water-related themes

(4) Provision of services to optimize agriculture field operations and production, including more climate change resistant crops and more organic agricultural practices;

(5) Assisting farmers and their organizations in applying sustainable agronomic practices, including minimized use of pesticides and fertilizers; regulation and distribution and types of pesticides on regional or national levels, and promotion of environmentally sustainable substances


(6) to strengthen the expertise of WUA to provide these services to their farmers;

(7) the improve the co-operation between the WUA's and the JVA and MoA

(8) Mobile Irrigation and Soil Lab- to conduct soil tests and conduct irrigation systems tests and maintenance

**Results / Impacts:**

Farmers enabled to increase agricultural water efficiencies and to generate higher yields and profits per cubic meter of water used; leading to an overall economic strengthening of the agricultural sector in the LJR against a more efficient water use. In addition:

- Raise awareness amongst members of the WUAs
- This project will have an indirect impact on the Jordan River

**Organization / Responsibilities:**

- Extension services provided by WUA Support Unit (North, Middle, Karamah).
- Supported by MoA, JVA and NCARE
- Project Office and TA provided by independent organization
- Dissemination support provided by EcoPeace

**Costs and Revenues:**

- Preparation 100,000 JD
- Offices, hardware: 1 MJD
- International experts required on extension services, related to: irrigation, fertilization, pesticides, plant production; post harvesting techniques: 2 seasons, 2 years: 6 years x 12 x 20,000 JD = 1,440,000
- Operations: 200,000 JD per year
- Annual Revenues: indirectly through better agricultural practices

**Implementation Period**

- Preparation time: 6 months
- Implementation period: 6 years

| **Name:** A03 JOR<br>Drip Irrigation Improvement Project | **Location:** Lower Jordan River Basin | **Type of Intervention:**<br>Agricultural Improvement |
|---|---|---|

**Objectives:**

To expand the use of drip irrigation in the northern part of the Jordan Valley and to increase the operations and efficiencies of drip irrigation of the southern part of the Jordan Valley.


**Interventions:**

(1) development of pilot drip irrigation schemes in the north to show farmers for advantages and best practices of drip irrigation;
(2) Provision of credit facilities and technical support to farmers to invest in and operate drip irrigation schemes in the north, particular for citrus trees
(3) To improve operations and maintenance of drip irrigation schemes in the southern part of the LJR Basin
(4) To improve the life time of existing drip irrigation schemes and reduce annual investment costs
(5) This intervention will be a direct impact on the Jordan River due to more efficient water use

**Targets / Results:**

1. Two pilot drip irrigation schemes for fruit trees realized in the North
2. Finance Credit facilities (50 / 50) and TA support facilitating 30,000 dunum of new drip irrigation schemes for fruit trees in North Shouneh
3. Improved drop irrigation operations in Deir al Alla and Southern Shouneh facilitating 18,000 dunum.
4. Developed standards and certifications for drip irrigation design and equipment, irrigation efficiencies and monitoring applications
5. Developed of vocational training center on the use of drip irrigation and green houses

**Organization / Responsibilities:**

- MoA and JVA as governmental agencies
- NCARE of public entity as project partner
- MIRRA or other firms as drip irrigation design and implementing firms
- International Technical Assistance and Project Management
- Credit facilitator
- EcoPeace for dissemination and stakeholder management

**Costs and Revenues:**

- Pilot drip irrigation projects including events: JD 200,000
- 30,000 dunum with new drip irrigation: 6 Million JD (50% grant; 50% micro credit)
- 18,000 dunum with improved irrigation operations: 1.8 Million JD
- TA on standards, certificates, dissemination and farmers support: 1 Million JD
- TOTAL: 9 Million JD

**Implementation Period**

- Preparation time: 1 year
- Construction time: 5 years

| **Name:** A04 JOR<br>Jordan Valley Post Harvesting Support Project | **Location:**<br>Jordan Valley | **Type of Intervention:**<br>Agriculture Improvement |
|---|---|---|
| **Objectives:**<br><br>To improve the post-harvesting and marketing potentials of the farmers in the Jordan Basin. This interventions also relates to A01 – Greenhouse Extension Project |  | |
| **Interventions:**<br><br>Organizing farmers within the Jordan Valley in product organizations;<br>Provide them with relevant local and international market information; related product quality requirements, prices and logistic requirements<br>Assisting farmers with development of good business models (including fair trade markets, organic product markets; etc), provision of information of product processing and agro-industry (like production of fruit juice, or almonds), marketing approaches and access to export markets;<br>Assisting farmers with implementing joint pilot export initiatives for certain products (like strawberries etc.) | | |

**Results / Impacts:**

1. constructed housing and staffing for Post Harvesting Support Unit
2. At least 5 organized product organizations, linked where needed to existing WUA's
3. information on post harvesting provided to al least 10,000 farmers
4. 10 pilot projects on joint export initiatives implemented
5. This project does not have direct impact on the Jordan River

**Organization / Responsibilities:**

- Farmer Organizations, such as Water User Associations
- MoA and JVA
- Dedicated Implementation organization
- EcoPeace for dissemination and stakeholder information

| **Costs and Revenues:** | **Implementation Period** |
|---|---|
| • Preparation Costs: JD 100,000<br>• Housing / accommodation: 300,000 JD<br>• Operations: 150,000 JD per year / 5 years<br>• 10 Pilot projects: 500,000 JD<br>• TOTAL: 1,650,000 JD | • Preparation time: 1year<br>• Implementation time: 5 years |

| **Name:** A05 JOR<br>Irrigation Operation Efficiency Improvement Project | **Location:**<br>Jordan Valley | **Type of Intervention:**<br>Agriculture Improvement |
|---|---|---|
| **Objectives:**<br>Currently some large farmers outsource their irrigation operations to specialized (private) operating organizations. These specialized firms apply computerized operating system linked to weather stations and dedicated operating software. The aim is to expand these services to other farmers in the Jordan Valley. |  | |
| **Interventions:**<br>(1) provision of information to farmers about the economic benefits of outsources their irrigation operations;<br>(2) setting of pilot projects to show farmers the practicalities of outsourcing irrigation operations;<br>(3) providing technical and contractual support services to farmers to prepare them for outsourcing their operations;<br>(4) monitoring the extend of outsourcing in time | | |
| **Results / Impacts:**<br>This project focuses on creating a central irrigation operations support unit in the Lower Jordan Valley, and offers design, installation, monitoring and management of irrigation systems, tied to local weather stations, and enabling operation support to connected farmers.<br><br>Cooperating farmers need to be connected through installation of a solenoid valve, flow sensors and a controller unit, which costs together about 3000 JD. The project may focus first on the Middle Area as a pilot, where relative bigger farms operate, and then expand to other areas. This project will have a direct impact on the Jordan River due to more efficient water use. | | |
| **Organization / Responsibilities:**<br>• WUAs<br>• MoA, JVA<br>• Private firm contracted<br>• EcoPeace for dissemination and stakeholder management | | |
| **Costs and Revenues:**<br>• Central control unit, including housing and weather station: 300,000 JD<br>• 10 pilot projects: 50,000 JD<br>• Expansion to 1000 farm units: 3 Million JD<br>• TA And operations: 100,000 JD per year (5 years)<br>• Total: 3,850,000 JD | | **Implementation Period**<br>• Preparation time: 6 months<br>• Construction time: 6 months<br>• Operations: 5 years |

<table>
<tr><td>Name: A06 JOR<br>Jordan Valley Authority Support Project</td><td>Location:<br>JVA</td><td>Type of Intervention:<br>Agriculture Improvement</td></tr>
<tr><td colspan="2">Objectives:<br>The aim of this project is to strengthen JVA in their role as authority and regulator of agricultural water supply in the Jordan Valley.</td><td rowspan="2">  </td></tr>
<tr><td colspan="2">Interventions:<br>(1) Strengthening water data collection and management;<br>(2) Strengthening water planning capacities (WEAP, GIS, CAM (computer aided maintenance …etc);<br>(3) Improving SCADA system and its operations of water storage and distribution networks in the Jordan Valley, including IT and wireless data transfer;<br>(4) Strengthen role of the WUAs in the Jordan Valley.<br>(5) This project will include purchase of mobile technical equipped units for light or medium repair works of water distribution networks.</td></tr>
<tr><td colspan="3">Results / Impacts:<br>This project should lead to more efficient JVA in terms of water data management; water allocation planning; water supply systems operations; managing and coordinating with existing Water User Associations; and capacities for immediate and urgent repairs on water supply systems<br><br>This project will have an indirect impact on the Jordan River, due to better water management</td></tr>
<tr><td colspan="3">Organization / Responsibilities:<br>• JVA<br>• WAJ / MWI<br>• Contracted organizations<br>• EcoPeace, dissemination and WUA stakeholder management</td></tr>
<tr><td colspan="2">Costs and Revenues:<br>• Preparation costs: 100,000 JD<br>• Mobile Repair Unit: 100,000 JD<br>• Implementation costs: 2 Million JD</td><td>Implementation Period<br>• Preparation time: 6 months<br>• Construction time: 2 years</td></tr>
<tr><td colspan="3">Other remarks:</td></tr>
</table>

### 4.1.4 Ecological Rehabilitation

| LIST OF INTERVENTIONS | |
|---|---|
| E01 JOR | Ecological Corridors around Valleys and Dams |
| E02 JOR | Wetlands and Aquatic Fauna Restoration |
| E03 JOR | Ecological Monitoring and Management Project |
| E04 JOR | Jordanian Eco parks and Protected Areas |

| **Name:** E01 JOR<br>Ecological Corridors around Valleys and Dams | **Location:**<br>Lower Jordan Valley | **Type of Intervention:**<br>Ecological Management |
|---|---|---|

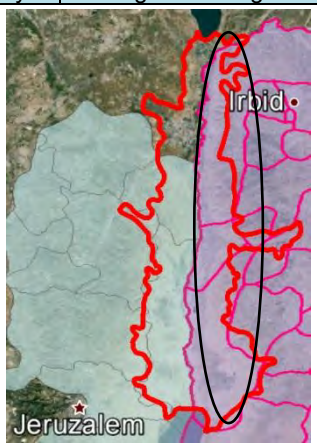
**Objectives:**

The aim of this intervention is to restore the natural vegetation in areas surrounding dams in the eastern Lower Jordan River basin. This includes also restoration activities in areas surrounding the valleys that flow into the Lower Jordan River.

This intervention is designed to support riparian areas ecosystem services and biodiversity, which will have far reaching positive impacts on the biodiversity of the region in general.

In addition, work on this intervention will include the improvement of side valleys channel systems and discharge channels; and the reintroduction to these areas the natural plants and forest species as part of a systematical ecological restoration of the eastern Lower Jordan River basin.

**Map:**




**Interventions:**

- Improve and replant natural trees and plants in and around dams such as: Salix spp., Populus euphratica, Tamarix Spp, Juncus spp. and Phragmytis australis.Pistacia atlantica not Tamarix or Phragmitis. Of patricular significance to the eastern part of the Lower Jordan River basin is the Ceratonia siliqua in the North part and the Acacia raddiana and Salvadora in the South part.
- Improve channel systems and discharge channels and replant with natural plant and forest species such as:Salix spp., Populus Euphratica, Tamarix Spp, Juncus spp., Acacia spp., Ziziphus spp., and Phragmytis australis.
- Establish picnic areas close to each Dam complete with recreational parks and information centers.

**Results / Impacts:**

Eventually, this intervention once implemented will lead to the following:

- Protection and restoration of the natural flora structure of ecosystems in the sub watersheds within the Eastern Lower Jordan River watershed; in particular around dams and side valleys.
- Restoration of the ecosystem services of the Eastern Lower Jordan River watershed.
- Direct positive impact on the LJR through enhancing biodiversity and ecological corridors in the basin.

**Organization / Responsibilities:**

- Ministry of Environment
- Royal Botanical Garden
- RSCN
- Ministry of Agriculture
- NCARE
- Municipalities
- JVA

**Costs and Revenues:**

Preparation and planning: 500,000 USD
Implementation and monitoring:5 MUSD
Operations / maintenance: 500,000 USD / yr

**Implementation Period**

- Preparation time: 1 year
- Implementation time: 5 years

**Other remarks:**

This intervention requires strong coordination between the different Ministries and NGOs, and the strong adaptation by the relevant municipalities.

| **Name:** E02 JOR<br>Wetlands and Aquatic Fauna Restoration | **Location:**<br>Lower Jordan Valley | **Type of Intervention:**<br>Wild and aquatic life management |
|---|---|---|

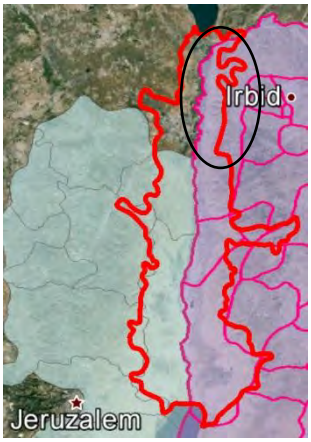
**Objectives:**

The aim of this intervention is to recreate the wetland and aquatic structure of the valleys flowing into the Lower Jordan and Yarmouk rives. This intervention is intended to create a balanced ecological system in which wildlife and aquatic fauna is re-introduced in all relevant elements of the Lower Jordan River basin.

In particular, this intervention targets a select number of endemic dragonflies, reptiles, endangered and rare species of relevance to the Lower Jordan River basin.

In-directly, this intervention will have a positive impact on the aquatic life and ecosystem services of the Lower Jordan river.

**Map:**




**Interventions:**

Secure adequate water sources to:

- Protect the endemic dragonflies of the River such as the Calopteryx hyalina, C. syriaca, Ceriagrion georgifreyi, and Pseudagrion torridumhulae; and the Coenagrionvan brinckae, P. Sublacteum mortoni, Gomphus kinzelbachi, Onychogomphus macrodon, Brachythemis fusco palliata, Crocothemis sanguinolenta species which are considered vulnerable; and finally the following two extinct species: the Rhyothemis semi hyaline syriaca and the Urothemised wardsihulae.
- Restore the population of endangered reptiles of the Lower Jordan River such as: Natrix tesselata and Amphibian Hylasavignyi.
- Protect endangered and rare such as the Common Otter Lutralutra and White Tooth Shrew Crocidura monacha by minimizing the salinity, pesticide and agrochemical residues in the Lower Jordan River and its tributaries.

**Results / Impacts:**

This intervention will aid in the:

- Protection and restoration of the natural aquatic fauna structure.
- Guarantee of the right interaction and balance between all the eco-system elements in the study area.
- Improvement of biodiversity and ecological corridors in the Lower Jordan River basin.

**Organization / Responsibilities:**

- Ministry of Environment
- JVA/ Dams authority
- Ministry of Agriculture
- Water Authority and Municipalities
- Farmers associations
- NGOs
- Universities

**Costs and Revenues:**

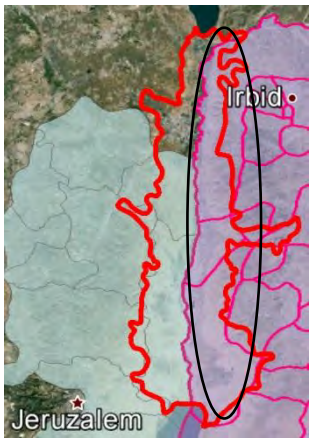
- Preparation and planning: 500,000 USD
- Implementation and monitoring:1 MUSD
- Operations / maintenance: 500,000 USD / yr

**Implementation Period**

- Preparation time: 1 year
- Implementation time: 5 year

**Other remarks:**

Pollution control and salinity management in the Lower Jordan Basin is vital for the success of this intervention.

<table>
<tr><td>Name: E03 JOR<br>Ecological Monitoring and Management Project</td><td>Location:<br>Jordan Valley</td><td>Type of Intervention:<br>Wildlife Advocacy</td></tr>
<tr><td>Objectives:<br><br>The aim of this intervention is to support the implementation and monitoring of the various ecological interventions. It is very well know that inadequate policy and the lack of law enforcement can hamper any effort.<br><br>In particular, policy and law enforcement related to the protection of aquatic life and flora and fauna in the designated areas within the Lower Jordan River basin.<br><br>This intervention consists of dam reservoir management, protection and management and the introduction of a number of protected areas.</td><td colspan="2">Map:<br> 
</td></tr>
<tr><td colspan="3">Interventions:<br>• Protect and regularly monitor the reservoirs of the Arab, Ziglab, Shueib and Kafrein dams from pollution.<br>• Create a water management plan for the dams in order to stabilize the populations of natural fish, Bat, Fresh water turtle, Common Otter Egyptian fruit bat.<br>• Declare the following areas around the Yarmouk and Jordan river as protected national rangeland or forest reserves: Wadi Damiya, Wadi Al Kharar, and King Hussein Bridge surrounding areas.</td></tr>
<tr><td colspan="3">Results / Impacts:<br>This set of interventions will lead to the:<br>• Protection and restoration of the population of natural mammals and amphibian population structure.<br>• Insuring the maintenance of the right interaction between all the eco-system elements in the area.</td></tr>
<tr><td colspan="2">Organization / Responsibilities:<br>• Ministry of Environmental Affairs<br>• JVA / Dams authority<br>• Ministry of Agriculture</td><td>• Water Authority and Municipalities<br>• Farmers associations<br>• NGOs<br>• Universities</td></tr>
<tr><td colspan="2">Costs and Revenues:<br>• Preparation and planning: 500,000 USD<br>• Implementation and monitoring: 2 MUSD<br>• Operations / maintenance: 100,000 USD / yr</td><td>Implementation Period<br>• Preparation time: 1 year<br>• Implementation : 10 years</td></tr>
<tr><td colspan="3">Other remarks:</td></tr>
</table>

| **Name:** E04 JOR<br>Jordanian Eco parks and Protected Areas | **Location:**<br>Jordan Valley | **Type of Intervention:**<br>Policy regulations for protected areas designation |
|---|---|---|

**Objectives:**

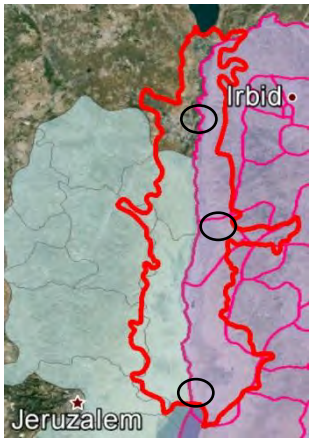
The Lower Jordan River basin is rich in unique cultural and natural sites. The full potential of these can only be harnessed by well planned investment in environmental friendly project.

This intervention envisions a number ecological parks and carefully selected special zones including a number of bird observation sites. Part of this intervention as well is a comprehensive planning and analysis for each of the proposed sites.

Each site will serve and act as a center for spreading and showcasing knowledge and awareness about the value of the Lower Jordan River.

These interventions are expected to have a positive impact on the touristic activities in the Jordan Valley and the overall restoration of the valley ecosystem services.

**Map:**




**Interventions:**

- Designate the Bakoura area, unique for its natural and cultural values, as a National Park.
- Designate the area of the Al Hujaija Tree as a National Natural Monument.
- Designate the Karama dam area as a National Park.
- Set a bird monitoring center at the Bakoura Park, Karama dam area, and the Jordan River meeting point with the Dead Sea complete with cutting edge monitoring technologies.
- Expansion of the SHE ecological park in the westerly direction until reaching the Jordan River.

**Results / Impacts:**

This set of interventions will lead to:

- The development of environmental friendly touristic activities in the LJR basin.
- The enhancement of the economical diversification in the LJR basin.

**Organization / Responsibilities:**

- Ministry of Environmental Affairs
- JVA /Dams authority
- WAJ and Municipalities
- NGOs

**Costs and Revenues:**

- Preparation and planning: 500,000 USD
- Implementation and monitoring:20 MUSD
- Operations / maintenance: 2 MUSD / yr

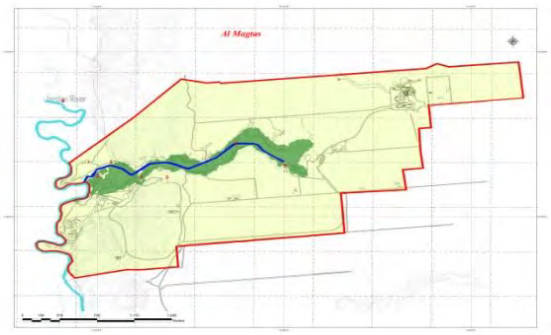
**Implementation Period**

- Preparation time: 1 year
- Implementation time: 10 year

**Other remarks:**

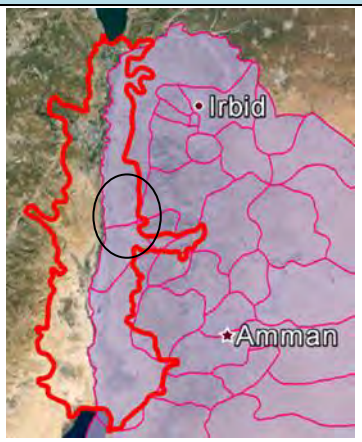
### 4.1.5 Sustainable Tourism and Cultural Heritage Development

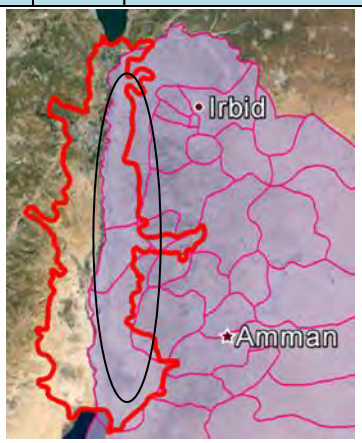
| LIST OF INTERVENTIONS | |
|---|---|
| C01 JOR | Jordan River Baptism Site Improvement Project |
| C02 JOR | Pella Tabaqat Fahl Site Improvement Project |
| C03 JOR | Abu Ubaydah Tomb Improvement Project |
| C04 JOR | Cultural and Historic Museum for the Lower Jordan Valley |
| C05 JOR | Archaeological Landmarks Development Project |
| C06 JOR | Lower Jordan Valley Tourism Information Center |
| C07 JOR | Bakoura National Park |

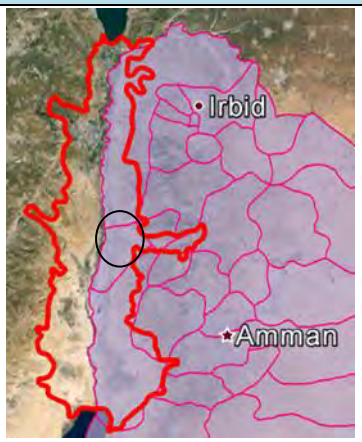
<table>
<tr><td colspan="2">Name: C01 JOR<br>Jordan River Baptism Site Improvement Project</td><td>Location:<br>Jordan River</td><td>Type of Intervention:<br>Tourism and Cultural Heritage Development</td></tr>
<tr><td colspan="2">Objectives:<br>The Baptism Site, —Bethany Beyond the Jordan" (Al-Maghtas) Protected Area is located in the Southern Jordan Valley on the east side of the Jordan River around 9 km north of the Dead Sea and is part of the District of South Shouneh in the Governorate of Al-Balqaa. The site is located a few kilometers to the east of the oasis and ancient site of Jericho and 50 km west of Amman, the capital of Jordan. The site covers an area of 533.7 hectares where five archaeological sites dating back to the Roman and Byzantine periods have been discovered. The precise limits of the archaeological remains are undetermined, although all identifiable cultural traces are included in the protected area.<br>This intervention aims at improving the tourism facilities at the Baptism site along the River Jordan, particularly with regard to establishing a good restaurant, a rest house, a bookshop and souvenirs shop.</td><td colspan="2">  </td></tr>
<tr><td colspan="2">Intervention:<br>• Planning for requested improvements<br>• Development of Commercial Business Model<br>• Design<br>• Tendering</td><td colspan="2">Construction / realization:<br>Restaurant<br>Rest house<br>Book and souvenir shops<br><br>Operations:<br>Outsourcing according to commercial business model</td></tr>
<tr><td colspan="4">Results / Impacts:<br>More attractive tourism destination, leading to higher number of visitors and more revenues<br>This leads to better options for additional investments.<br>Use of bio-climatic design practices and of renewable building materials</td></tr>
<tr><td colspan="4">Organization / Responsibilities:<br>Ministry of Tourism and Antiquities, EcoPeace for dissemination and stakeholder management</td></tr>
<tr><td colspan="2">Costs and Revenues:<br>• Preparation costs: 100,000 JD<br>• Construction costs: 1,000,000 JD<br>• Operation costs: 100,000 JD / yr<br>• Annual Revenues: 300,000 JD / yr</td><td colspan="2">Implementation Period<br>• Preparation time: 1 year<br>• Construction time: 2 years</td></tr>
</table>

<table>
<tr><td>Name: C02 JOR<br>Pella Tabaqat Fahl Site Improvement Project</td><td>Location:<br>Jordan Valley</td><td>Type of Intervention:<br>Tourism and Cultural Heritage Development</td></tr>
<tr><td colspan="2">Objectives:<br>Ancient Pella at Tabaqat Fahl is one of the most important archaeological sites in the Jordan Valley. Its central location in the land of biblical ‗Gilead' on the most strategic east-west trade route to the Mediterranean coast was the key to its prosperity. The city is referred to almost a hundred times in various historical texts including the Old Testament which names this city ‗Penuel'. In the fourth century BC, Pella was established as a Hellenistic city and was later included in the Roman Decapolis league.<br>This intervention aims at improving the tourism facilities at Pella, particularly with regard to establishing a Motel, good restaurant, a rest house, a bookshop and souvenirs shop</td><td>  </td></tr>
<tr><td colspan="2">Intervention:<br>Planning for requested improvements<br>Development of Commercial Business Model<br>Design<br>Tendering</td><td>Construction / realization:<br>Motel<br>Restaurant<br>Rest house<br>Book and souvenir shops<br><br>Operations:<br>Outsourcing according to commercial business model</td></tr>
<tr><td colspan="3">Results / Impacts:<br>More attractive tourism destination, leading to higher number of visitors and more revenues<br>This leads to better options for additional investments<br>Use of bio-climatic design practices and of renewable building materials</td></tr>
<tr><td colspan="3">Organization / Responsibilities:<br>Ministry of Tourism and Antiquities, EcoPeace for dissemination and stakeholder management</td></tr>
<tr><td colspan="2">Costs and Revenues:<br>• Preparation costs: 200,000 JD<br>• Construction costs: 2,000,000 JD<br>• Operation costs: 200,000 JD / yr<br>• Annual Revenues: 400,000 JD / yr</td><td>Implementation Period<br>• Preparation time: 1 year<br>• Construction time: 2 years</td></tr>
<tr><td colspan="3">Other remarks:</td></tr>
</table>

| **Name:** C03 JOR<br>Abu Ubaydah Tomb Improvement Project | **Location:**<br>Jordan Valley | **Type of Intervention:** Tourism and Cultural Heritage Development |
|---|---|---|
| **Objectives:**<br>The Tomb of Abu Ubaydah is one of the most important Islamic sites in the Jordan Valley. He was a relative and one of the ‗Blessed Ten' companions of the Prophet Mohammed. He died during a plague in the central Jordan Valley where he is buried. An impressive modern mosque complex has been built over Abu Ubaydah's tomb, which serves as the principle Islamic centre in the Jordan Valley.<br>This intervention aims at improving the facilities for Muslim visitors, particularly with regard to establishing a good restaurant, a rest house, and souvenirs shop. |  | |
| **Intervention:**<br>Planning for requested improvements<br>Design and Tendering | **Construction / realization:**<br>Restaurant near the Tomb<br>Rest house near the Tomb<br>Souvenir shops<br><br>**Operations:**<br>In co-operation with the Mosque | |
| **Results / Impacts:**<br>More attractive tourism destination, leading to higher number of Muslim visitors and more revenues<br>This leads to better options for additional investments<br>Use of bio-climatic design practices and of renewable building materials | | |
| **Organization / Responsibilities:**<br>Ministry of Tourism & Antiquities, Ministry Of Awqaf & Islamic affairs, EcoPeace for dissemination and stakeholder management | | |
| **Costs and Revenues:**<br>• Preparation costs: 50,000 JD<br>• Construction costs: 500,000 JD<br>• Operation costs: 50,000 JD / yr<br>• Annual Revenues: 100,000 JD / yr | **Implementation Period**<br>• Preparation time: 1 year<br>• Construction time: 2 years | |
| **Other remarks:** | | |

<table>
<tr><td colspan="2">Name: C04 JOR<br>Cultural and Historic Museum for the Lower Jordan Valley</td><td>Location:<br>Deir Alla</td><td>Type of Intervention:<br>Tourism and Cultural Heritage Development</td></tr>
<tr><td colspan="2">General Objectives:<br>• To provide an authentic tourism destination.<br>• To provide information on the natural, historic and cultural history of the valley.<br>• To support growth of the tourism sector in the valley<br>• To include specific information on the pre-historic importance of Deir Alla.<br>• To include a presentation of key natural and cultural heritage objects and artefacts.</td><td colspan="2"> 
</td></tr>
<tr><td colspan="2">Intervention: To develop the museum concept, presentations and construction design.<br>Preparation:<br>• Planning with stakeholders (Concept approach).<br>• Theme research and comparative studies.<br>• Feasibility and Market review.<br>• Museum Concept development.</td><td colspan="2">Construction / realization:<br>• Museum thematic collections and presentations.<br>• Construction (Concept and detailed Designs).<br>• Construction and mounting museum displays.<br>Operations:<br>• Operations and Management Plans.<br>• 2 - 5 years of operational support.</td></tr>
<tr><td colspan="4">Results / Impacts:<br>• It will increase the number of tourists in the Jordan Valley<br>• In combination with all JV portal interventions, the museum is expected to attract about 0.5 -0.8 million visitors per year. During operational period, the museum may provide 50 direct jobs and various indirect jobs.<br>• Use of bio-climatic design practices and of renewable building materials</td></tr>
<tr><td colspan="4">Organization / Responsibilities:<br>Ministry of Tourism and Antiquities, Deir Alla Municipality, EcoPeace</td></tr>
<tr><td colspan="2">Costs and Revenues:<br>• Preparation costs: 0.5 Million JD<br>• Construction costs: 2 Million JD<br>• Annual Operation costs: 200,000 JD<br>• Annual Revenues: 300,000 JD</td><td colspan="2">Implementation Period<br>• Preparation time: 3 Years<br>• Construction time: 3 Years</td></tr>
<tr><td colspan="4">Other remarks:</td></tr>
</table>

<table>
<tr><td>Name: C05 JOR<br>Archaeological Landmarks Development Project</td><td>Location: Jordan Valley</td><td>Type of Intervention:<br>Tourism and Cultural Heritage Development</td></tr>
<tr><td colspan="2">General Objectives:<br>To develop and rehabilitate a series of important archaeological —Tell‘ landmarks in the Lower Jordan Valley, including visiting facilities, provision of touristic and historic back ground information, and linking the various sites with touring tracks for pedestrians and bicyclers. The sites to be developed and linked by —Tell tracks” include: Tell El Hammar; Tell Es Saidiyeh; Tell Es Sakhneh; Tell Kreinah; Tell North Shouneh and Tell Umm Hammad</td><td> 
</td></tr>
<tr><td colspan="2">Preparation:<br>• Planning with stakeholders (Concept approach).<br>• Assessment of Sites for CH and tourism perspective<br>• Define CH improvements and tourist information needs<br>• Define tourism support requirements (restaurants, souvenirs; signs, etc.<br>• Define attractive linking tracks between the tells, and prepare to information, signs and facilities along these tracks.</td><td>• Get agreement on financial and organizational management structures<br>• Prepare for information campaigns, including website<br>• Prepare for designs and tender documents<br><br>Construction / realization:<br>• Rehabilitation of tells<br>• Constructing visitor facilities<br>• Preparing tracks and signs<br><br>Operations:<br>• Operations tell sites and information facilities along the tracks</td></tr>
<tr><td colspan="3">Results / Impacts:<br>• It will increase the number of tourists in the Jordan Valley<br>• In combination with all JV portal interventions, the project is expected to attract tens of thousands additional visitors, both regionally as well as internationally.<br>• Use of bio-climatic design practices and of renewable building materials</td></tr>
<tr><td colspan="3">Organization / Responsibilities:<br>Ministry of Tourism and Antiquities<br>Involved municipalities<br>EcoPeace</td></tr>
<tr><td colspan="2">Costs and Revenues:<br>• Preparation costs: 0.5 Million JD<br>• Construction costs: 3 Million JD<br>• Annual Operation costs: 0.2 Million JD<br>• Annual Revenues: 0.4 Million JD</td><td>Implementation Period<br>• Preparation time: 2 Years<br>• Construction time: 3 Years</td></tr>
</table>

<table>
<tr><td>Name: C06 JOR<br>Lower Jordan Valley Tourism Information Center</td><td>Location: Meeting point of the Jordan River and the Dead Sea</td><td>Type of Intervention:Tourism and Cultural Heritage Development</td></tr>
<tr><td colspan="2">General Objectives:<br>To develop a tourism center, at the meeting point of the Jordan River with the Dead Sea, aiming at providing information and guidance to tourists and visitors to the Lower Jordan Valley. To organize touristic events, happenings and tours in the Jordan Valley particularly during the tourist season, such as theatre performances and music events at key historic sites in the lower basin, or rural traditional meals and events in co-operation with local population. The centre shall be linked to the main tourism related websites for Jordan, and shall be linked to the main tourism support centres in Amman, Jerash; Petra, Wadi Rum and Aqaba.</td><td> 
</td></tr>
<tr><td colspan="2">Preparation:<br>• Planning with stakeholders (Concept approach).<br>• Assessment of most appropriate site<br>• Develop information; materials; website<br>• Develop alternative events; happenings; tours in the region<br>• Define tourism support requirements (restaurants, souvenirs; signs, etc)<br>• Use of bio-climatic design practices and of renewable building materials</td><td>• Get agreement on financial and organizational management structures<br>• Prepare for information campaigns, including website<br>• Prepare for designs and tender documents for the center<br><br>Construction / realization:<br>• Constructing of Tourism Center<br>Operations:<br>• Operation of Tourism Center and websites</td></tr>
<tr><td colspan="3">Results / Impacts:<br>• It will increase the number of tourists in the Jordan Valley<br>• In combination with all JV portal interventions, the centre is expected to attract tens of thousands additional visitors, both regionally as well as internationally.</td></tr>
<tr><td colspan="3">Organization / Responsibilities:<br>• Ministry of Tourism and Antiquities<br>• Involved municipalities<br>• EcoPeace</td></tr>
<tr><td colspan="2">Costs and Revenues:<br>• Preparation costs: 0.2 Million JD<br>• Construction costs: 1 Million JD<br>• Annual Operation costs: 0.2 Million JD<br>• Annual Revenues: 0.4 Million JD</td><td>Implementation Period<br>• Preparation time: 1 Years<br>• Construction time: 2 Years</td></tr>
</table>

| **Name:** C07 JOR Bakoura National park | **Location:** Northern Jordan Valley | **Type of Intervention:** Tourism and Cultural Heritage Development |
|---|---|---|

**Objectives:**

- Establish the Bakoura area as a Jordanian National Park.
- To develop the area around the old workers homes, the —armouk Lake, railway stop and the old hydroelectric power plant.
- To preserve the significant architectural heritage from Roman, Mamaluk, Ottoman and modern era's and commemorate historic Islamic events
- Redevelop the area including the lake into a bird sanctuary, the power station complex into a visitors center and museum, old workers homes into accommodation lodges, utilize railway line, additional business opportunities, advance security arrangements, and picnic and open space areas for visitors between the bridges area and the hydropower station.

**Intervention:**

- Business plan, Feasibility studies & designs of; Lake Restoration (240 – 380 dunum); reconstructing worker's homes into eco-lodges, trails, railway station, entrance gate and picnic areas.
- Design of conversion of former Power Station into visitors / cultural center
- Conduct studies to include security issues and fences, development of panoramas, electricity and water utilities, treatment plant all using renewable energy sources
- Tendering and construction of different phases
- Operation and management.

**Results / Impacts:**

Eventually, this intervention once implemented will lead to the following:

- Major Transboundary Tourism destination –potential ‗Petra of the north'.
- Increase job opportunities for the surrounding local communities.
- Enhancing national and international tourism.
- Preserving cultural, industrial, historic and natural heritage.

**Organization / Responsibilities:**

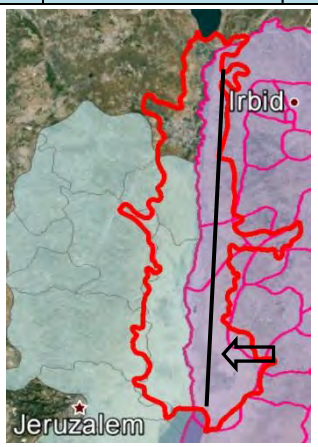
- Jordan Valley Authority (Jordan River rehabilitation committee, representing all authorities)
- EcoPeace Middle East
- Jordanian Municipalities in the northern Jordan Valley
- Ministry of Tourism and Antiquities
- Private Sector

| **Costs and Revenues:** | **Implementation Period** |
|---|---|
| • Preparation and planning: 1 MUSD<br>• Implementation and monitoring: 15 MUSD<br>• Annual Operations / maintenance: 0.5 MUSD | • Preparation time: 2 years<br>• Implementation time: 5 years |

**Other remarks:**

### 4.1.6 Urban and Infrastructure Development

| LIST OF INTERVENTIONS | |
|---|---|
| U01 JOR | Infrastructure Development Project |
| U02 JOR | Urban and Spatial Master Plan |
| U03 JOR | Higher Education and Vocational Development Project |
| U04 JOR | Non-fossil, Renewable Energy Development Project |

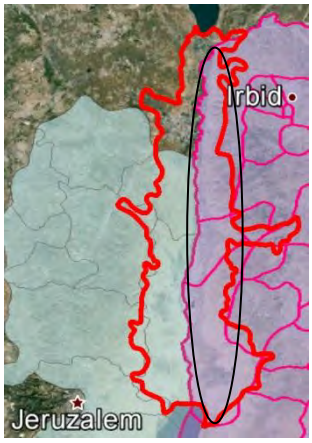
<table>
<tr><td>Name: U01 JOR<br>Infrastructure Development Project</td><td>Location:<br>Jordan Valley</td><td>Type of Intervention:<br>Infrastructure Development</td></tr>
<tr><td colspan="2">Objectives:<br>The current route 65 is the main north south road through the Jordan Valley, and crosses all major villages in the valley. However, traffic along the road is dense and relative dangerous, and intersected by many minor roads and used by pedestrians, slow traffic and heavy traffic alike. This intervention supports the plans of the Ministry of Transportation, who is responsible for Infrastructure, to rehabilitate this road for local traffic purposes only, including safe pedestrian sideways, signs and lighting, and safe crossings, and meanwhile constructing a new parallel North-South highway for heavy traffic that bypass the urban centres.</td><td> 
</td></tr>
<tr><td colspan="2">Preparation:<br>• Planning and design of a infrastructure works, taking into account future urban expansion areas<br>• EIA‘s and licenses<br>• Setting up Organizational structure<br>• Finance planning<br>Operations:<br>• Operations<br>• Maintenance</td><td>Construction / realization:<br>• Tendering and construction/expansion of the existing route 65 infrastructure works<br>• Tendering and rehabilitation/expansion of the new parallel highway<br>• Tendering for rehabilitation of crossings, crossovers and additional infrastructure facilities</td></tr>
<tr><td colspan="3">Results / Impacts:<br>• Realization/expansion/improvement of the traffic and traffic safety<br>• Preparing for urban expansion of the Lower Jordan River Basin</td></tr>
<tr><td colspan="3">Organization / Responsibilities:<br>• Municipalities and county councils<br>• Ministry of Transportation<br>• Jordan Valley Authority<br>• Ministry of Environment</td></tr>
<tr><td colspan="2">Costs and Revenues:<br>• Preparation costs: 10 Million JD<br>• Construction costs: 180 Million JD<br>• Maintenance: 1 Million JD / year<br>• Annual Economic Revenues: 3 -6 Million JD</td><td>Implementation Period<br>• Preparation time: 3 year<br>• Rolling Construction time: 18 years</td></tr>
<tr><td colspan="3">Other remarks:<br>• Infrastructure Planning should be done in an integrated combination with land use and urban expansion planning</td></tr>
</table>

| **Name:** U02 JOR<br>Urban and Spatial Master Plan | **Location:**<br>Jordan Valley | **Type of Intervention:**<br>Planning & Construction |
|---|---|---|

**Objectives:**

The aim of this project is to develop detailed urban, infrastructure and physical land use plans for the LJV, taking into account the foreseen population and economic projections, considering the foreseen growth of the population to over 600,000 people in 2050, requiring a total of about 130,000 housing or apartment units in 2050, including related infrastructure, transport, water, sanitation, electricity and IT related utilities, public services, schools and recreational areas and facilities.

**Map:**




**Interventions:**

To develop the projected requirements for housing and urban facilities, including planning of new urban areas; as well as the need for expansion of secondary and primary roads, linkage to the national highway system and public transport requirements. This includes planning, management and training aspects

At the same time this interventions includes enforcement of land use plans and halting unplanned expansion of urban areas towards dedicated agricultural lands

**Preparation:**

Conduct Physical Master Plans for localities in cooperation with the Jordan Valley Authority and Ministry of Housing and Public Works.

**Construction / realization:**

- Conduct physical planning for existing towns and villages, including roads, residential areas, land development
- Planning for infrastructure, transport, water, sanitation, electricity and IT related utilities
- Planning for public services, schools and recreational areas and facilities
- Elaboration of Investment Plans
- Elaboration of financing and management structures

**Results / Impacts:**

Urban development and housing needs met

**Organization / Responsibilities:**

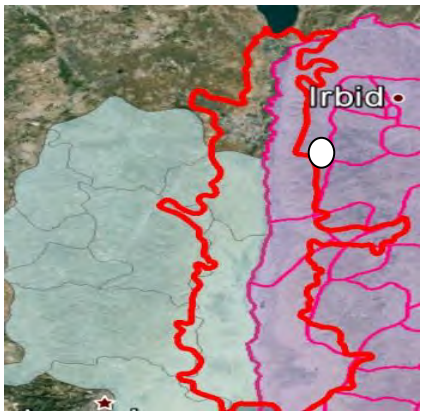
- Jordan Valley Authority
- Ministry of Housing and Public Works
- Ministry of Planning
- Ministry of Transportation
- All other relevant governmental authorities

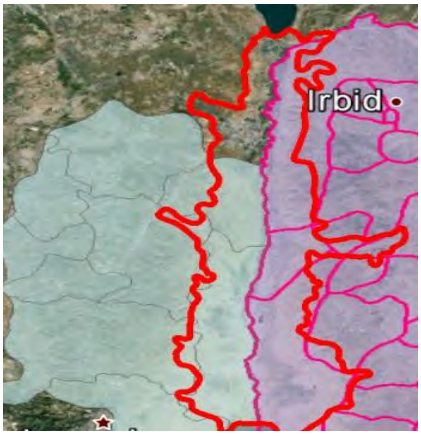
**Costs and Revenues:**

- Planning costs: 10 Million USD
- Construction Costs ~ 1 Billion USD

**Implementation Period**

- Preparation time: 3 Yr. starting 2015
- Implementation Time: on-going up to 2050

<table>
<tr><td colspan="2">Name: U03 JOR<br>Higher Education and Vocational Development Project</td><td>Location:<br>Northern Jordan Valley</td><td>Type of Intervention:<br>Planning & Education</td></tr>
<tr><td colspan="2">Objectives:<br>This program aims at establishing a university in the Lower Jordan Valley to accommodate (future) residents and to utilize hands on education and training to meet the developmental needs and the growing population, including agricultural and environmental research;<br><br>A Vocational Training Center to ensure access to professional trainers and experts who will offer training and information, that will be utilized to develop residents‘ skills and identify their career choices and development objectives</td><td colspan="2"> 
</td></tr>
<tr><td colspan="2">Intervention:<br>• Establish a university in the Northern Jordan Valley<br>• Establish a modern and advanced vocational training centre in the LJV</td><td colspan="2">Preparation:<br>Dependent on the education needs assessment conducted<br><br>Construction / realization:<br>• Build a modern university in the Northern JV<br>• Build an advanced and highly specialized vocational training centre.</td></tr>
<tr><td colspan="4">Results / Impacts:<br>Higher education and vocational training opportunities provided to the JV residents</td></tr>
<tr><td colspan="4">Organization / Responsibilities:<br>• Ministry of higher education<br>• Ministry of education<br>• Jordan Valley Authority<br>• Other relevant authorities</td></tr>
<tr><td colspan="2">Costs and Revenues:<br>• Planning costs: 1 Million JD<br>• Construction costs: 20 Million JD</td><td colspan="2">Implementation Period<br>• Preparation time: 2 Yrs.<br>• Construction time: 3 Yrs.</td></tr>
</table>

<table>
<tr><td colspan="2">Name: U04 JOR<br>Non-fossil, Renewable Energy Development Project</td><td>Location:<br>Jordan Valley</td><td>Type of Intervention:<br>Development projects</td></tr>
<tr><td colspan="2">Objectives:<ul><li>To plan for and realize renewable energy generation schemes in the Lower Jordan River Basin, taking into account the foreseen economic growth to 13 Billion JD / yr and related population growth of 600,000 people in 2050.</li><li>Assuming an advanced economy by 2050, this would require about 1.8 Billion Kwh of energy in 2050</li><li>Assuming 50% renewable energy, this requires renewable energy capacity of 0.9 Billion KwH / yr by 2050, or for instance 750 ha of solar panels (120 KwH / $m^2$)</li></ul></td><td colspan="2"> 
</td></tr>
<tr><td colspan="2">Intervention:<br>Construction of renewable energy schemes such as solar systems and waste-to-energy systems<br><br>Preparation:<ul><li>Selection of the optimal sites for the construction of the renewable energy schemes</li><li>Consideration of land ownership</li><li>Integration of such schemes with the power transmission lines for the served communities</li><li>Scope for operation and maintenance</li><li>Develop legal framework</li><li>Attract investment</li></ul></td><td colspan="2">Construction / realization:<ul><li>Reflect a common vision among the residents of the study area that such a project is vital for the area and its future development</li><li>Appreciate the economic and environmental gains of such schemes</li></ul>Operations:<ul><li>Distribution of electricity</li><li>Fee collection</li><li>O&M</li><li>Technical and financial management</li><li>Provide investment incentives to investors</li><li>Provide land and infrastructure for implementation</li></ul></td></tr>
<tr><td colspan="4">Results / Impacts:<ul><li>Preservation of the environment</li><li>Improvement of the financial status of the residents</li><li>Improvement of the social conditions</li></ul></td></tr>
<tr><td colspan="4">Organization / Responsibilities:<ul><li>Ministry of Energy and Mineral Resources</li><li>Natural Resources Authority</li><li>Jordan Valley Authority</li><li>Ministry of Environment</li><li>Ministry of Planning and International Cooperation (MoPIC)</li></ul></td></tr>
<tr><td colspan="2">Costs and Revenues:<ul><li>Preparation costs: 2 million USD</li><li>Construction costs: 200 million USD</li></ul></td><td colspan="2">Implementation Period<ul><li>Preparation time: 2 years</li><li>Construction time: ongoing up to 2050</li></ul></td></tr>
<tr><td colspan="4">Other remarks:<ul><li>Short Term action</li></ul></td></tr>
</table>

## 4.2 Priority Setting

The sequence and timing of implementing these interventions as presented above depends on various factors. First, some interventions have a logical sequence, where the initiation of one intervention depends on the result of others. For instance, rehabilitation of the ecosystems in the Jordan River depends first on a successful removal of inflow of polluting substances into the river.

Secondly, the sequence of the interventions depends on the sense of urgency felt by the key stakeholders, considering the limited financial resources and absorption capacities of implementing organizations. In this context, the project organized a series of stakeholder meetings, where the long list of interventions were presented, discussed and prioritized in accordance with a pre-set list of evaluation criteria.

These criteria were based on criteria developed by SIWI for prioritizing the interventions. SIWI suggests a quantifiable, cross-cutting approach that scores interventions according to how they contribute to EcoPeace's vision for the Jordan River Valley. These include Prosperity: Interventions should create opportunities to lift residents off poverty and contribute to the region's economic development; Peace: Interventions should have a peace-dividend, contributing to the wider integration of the river basin and create space for constructive cooperation between the three riparians; Sustainability: Each intervention should aim to maintain a positive impact on the environment and avoid degradation of existing resources, maintain a positive impact on society and become self-sufficient financially within a specified period of time.

The stakeholders were asked to evaluate the interventions against the following considerations:

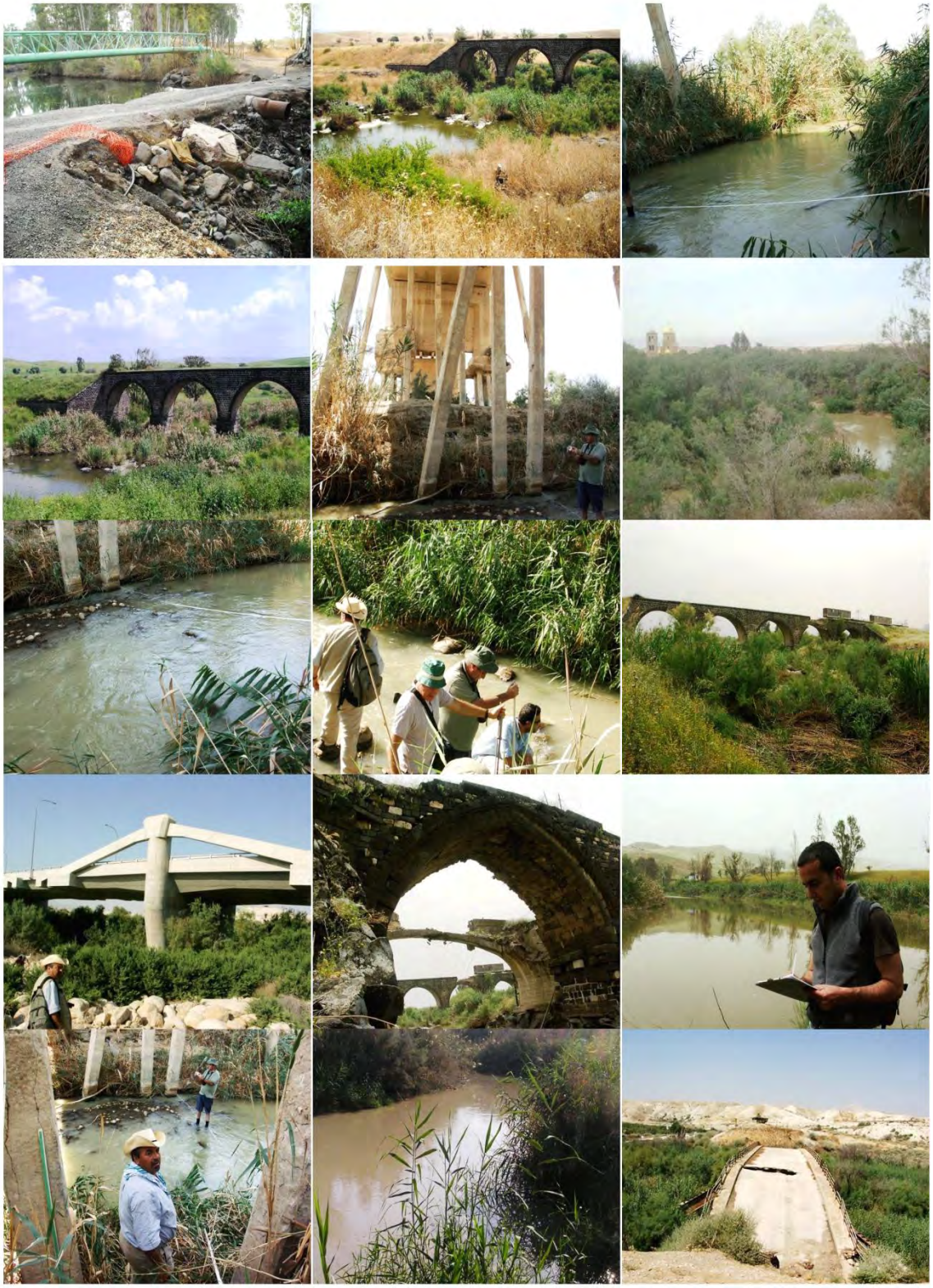
- To what extend does the increase water availability, including drinking water and sanitation?
- To what extend does the project generate positive socio-economic impacts including peace prospects?
- To what extend does the project eliminates vector born diseases and other health impacts?
- To what extend does the project improve habitats and ecosystems?
- To what extend does the project improve water quality?
- To what extend is the project technical sound (e.g. ease of implementation, redundancy and robustness of the solution, flexibility to changing conditions, durability)?
- To what extend is the project compatibility to existing plans and policies?
- To what extend are the required investments costly?
- To what extend does the project receive political support?

## 4.3 Institutional and Governance Aspects

The aim of the proposed interventions in this Master Plan for the Jordan River Valley is to use it as an advocacy tool with national stakeholders, international financiers and various actors of the international community to increase political will for the adoption in full or in part of the proposed interventions. The interventions that have been described include a suggested institutional setting for each. Financing for the proposed interventions has yet to be secured, and will require additional preparation and design activities, including elaboration of the proposed institutional and governance aspects, also depending on the specific requirements of the financiers, either nationally or internationally. However, it is foreseen that the national authorities will play the major role in implementation of most of the interventions, since its main task is the development, protection and improvement of the water and environment in the Jordan Valley.

The Municipalities and the civil community have to play an important role in the further preparation and implementation of the suggested interventions, since they represent the local population living in the basin, and they play a key role in providing services to these inhabitants in terms of water, wastewater collection and solid waste management. The subsidiary principle is again here relevant. In addition, proper Environmental and Social Impact Assessments, including stakeholder participation and if needed Resettlement Action Plans shall be part of all infrastructure preparation works.

Finally, EcoPeace Middle East is foreseen to play a key role in most of the interventions as one of the major NGO‘s active in the Jordan River Valley, particularly with regard to organizing grass root environmental protection activities, and engaging and organizing the local stakeholders in the further preparation and implementation of the proposed interventions. Furthermore, EcoPeace as a unique organization at the forefront of the environmental peacemaking movement, is therefore very well equipped to help promote trans-boundary co-operation and dissemination components of the proposed interventions.



# 5 THE YEAR 2050

## 5.1 The Valley Economy in 2050

Under the scenarios and strategies described in this Master Plan, by 2050 the Jordan Valley will be a co-operative, confident and peaceful region with a healthy economy and strong development perspectives for the people living here. They will experience a clean and healthy environment and sufficient flows in the Jordan River to sustain healthy ecosystems. At the same time the river will act as natural water conveyor and source for water supply, to the extent possible, in the Jordan Basin. Water will be equitably shared among the three riparian countries and the basin will be freely accessible for all nationalities within an appropriate security framework. Local, private and foreign investments will be encouraged due to the stability in the region. In short, there will be an investment climate resulting from the reforms in general, and a conductive regulatory business environment that promotes sustainable development.

In 2050 the valley will house around 740,000 people, who will enjoy their living environment in terms of living, working and recreational conditions. They will live in a comfortable and sustainable urban setting with an average of about 3.5 people per household. There will be about 300,000 household units in the basin, compared to about 70,000 today. This will be the result of substantial investments in urban and infrastructure projects until 2050. Meanwhile the roads and infrastructure will be upgraded with adequate traffic safety measures, including efficient public transport, bypasses around urban centers, pedestrian and bicycle sideway capacities and more.

Due to investments in tourism, sustainable agriculture and agri-business, as well as in housing, infrastructure, higher education and public services the people in the basin will enjoy attractive job opportunities. The economy will become more service and high added value oriented, with a higher percentage of people being employed in the service sector. The average income will have risen substantially to about 14,000 USD per person or about 50,000 USD per household in Jordan.

By 2050, security related issues in the basin will be managed by a Security Coordination Body, representing key security officials of Israel, Palestine and Jordan. This body will assess and manage the security issues in the basin objectively and professionally, doing justice to the legitimate mobility rights of all people living in the basin, and the legitimate security rights of the people of Israel, Palestine and Jordan.

High numbers of regional and international tourists, up to 5 - 10 Million per year will visit the cities, nature parks, the cultural and religious sites and a wide variety of museums established in the valley. In additional, the expanded urban centers will provide wide variety of commercial services. This leads to an estimated 92,000 people being employed in the tourism and commerce sectors.

By 2050, agriculture in the valley will be developed into a sustainable and agri-business oriented sector, making efficient use of the valuable water resources and generating high economic revenues as result of efficient extension services, high quality agricultural products and good access to regional and international markets. Due to efficiency measures, about 5% of the working force will be directly employed in agriculture.

Finally, in 2050 the three riparian countries will have established in efficient transboundary River Basin Organization, which ensures coordinated water resources management between Jordan, Israel and Palestine on a shared Jordan River Basin, addressing the legitimate social and economic needs of each of the riparian states, to enable joint development and management of water resources infrastructure among the riparians. It will act as a coordinating water management body for the riparian countries of the LJR, fostering economic co-operation over water resources through a coordinated, transparent and democratic process. Projections of the main economic parameters for 2050 in the valley are presented in the table below.

**Table 32 – Economic Parameters in the Jordan River Valley by Year 2050**

| | Year 2050 |
|---|---|
| Average Household size (Person) | 3.5 |
| Average Income pppy (USD) | 14,000 |
| Employment Agriculture (%) | 5.0 |
| Employment Manufacturing/ Construction (%) | 17.0 |
| Employment Tourism/ Commerce (%) | 20.0 |
| Employment Transportation (%) | 3.8 |
| Employment Services/other (%) | 54.2 |
| GDP per person per year (USD) | 42,000 |
| Number of households | 130,842 |
| Total Income (Billion USD/ year) | 6.5 |
| Employees Agriculture | 22,897 |
| Employees Manufacturing/ Construction | 77,851 |
| Employees Tourism/ Commerce | 91,589 |
| Employees Transportation | 17,402 |
| Employees Services/other | 248,206 |
| GDP Jordan Valley (Billion USD/ year) | 21 |

## 5.2 Land Use in 2050

Particularly the foreseen economic developments and related growth in population requires that more land will be required for urban areas by 2050. At the same it has been assumed that the agricultural lands will remain as they are. It has been assumed that the nature reserves will remain untouched. The Jordan River will require a flood plain that accommodates for the increased baseflow and occasional floods that are foreseen by 2050. Furthermore it is assumed that an area of 1 km from both sides from the river remain protected, since this area is internationally significant for being home to birds migrating through the valley.

Based on above projections draft land use plans have been prepared for the Jordan River Valley in the year 2050. These plans are based on the existing topography, and projected areas required for agriculture, nature conservation, cultural heritage and urban expansion. The table below shows the current (2010) and future (2050) areas for different land use functions. These plans include expansion of secondary and primary roads, and linkage to national highway system and public transport requirements. The urban expansion in Jordan is in line with areas dedicated accordingly by the Jordan Valley Authority and the Ministry of Municipalities.

**Table 33 – Projected Land Use in the Jordan River Valley in 2050 compared to Land Use in 2010**

| | Area 2010 (ha) | Area 2050 (ha) |
|---|---|---|
| Uncultivated | 81,029 | 67,358 |
| Agriculture | 45,183 | 45,183 |
| Built Area | 4,462 | 9,133 |
| Fish Farming | 73 | 73 |
| Reservoirs | 555 | 555 |
| Wadis | 2,416 | 2,416 |
| Total | 133,718 | 133,718 |

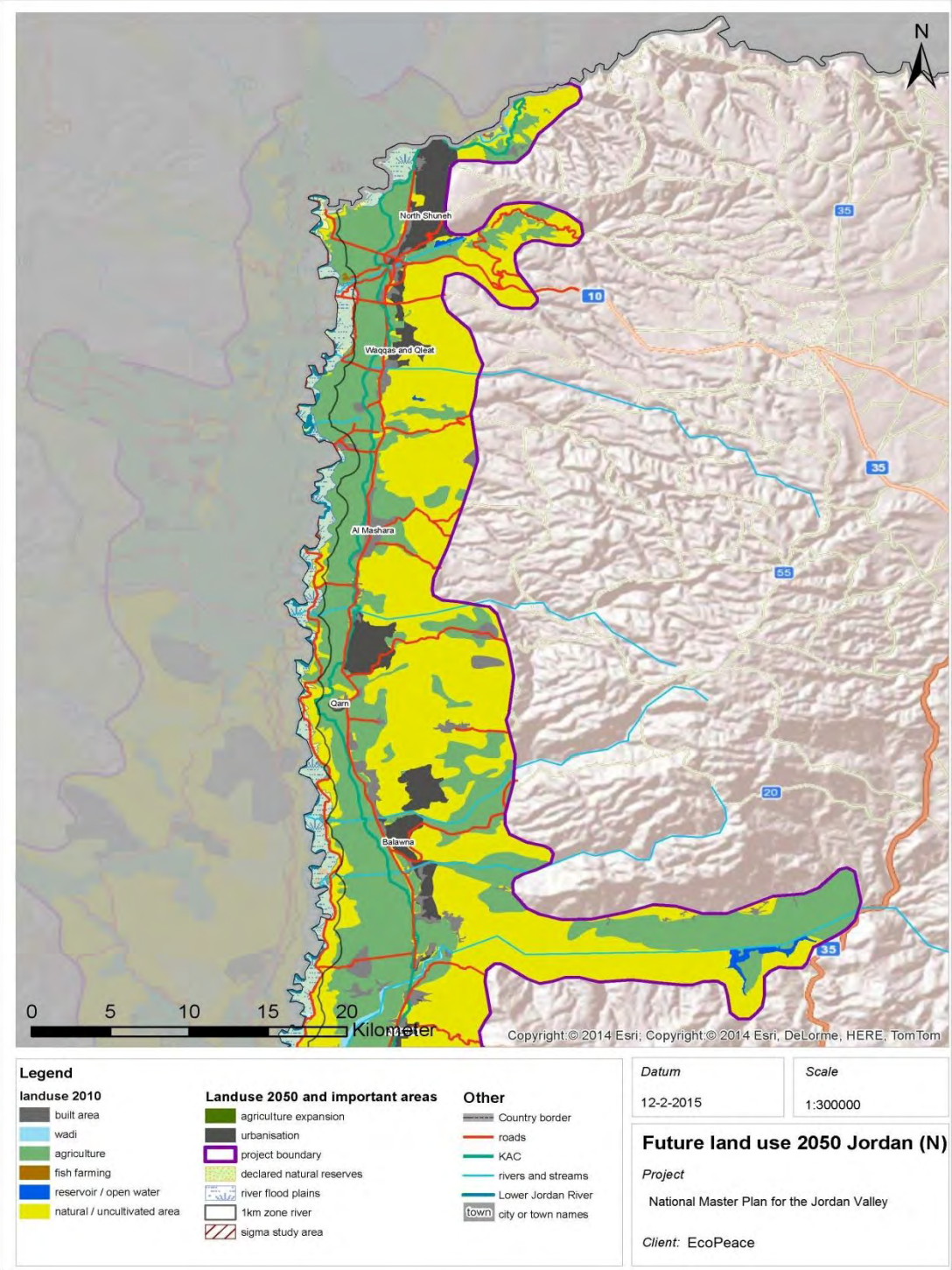



**Figure 39: Projected land use in the Jordan River Valley in 2050 – North Part**

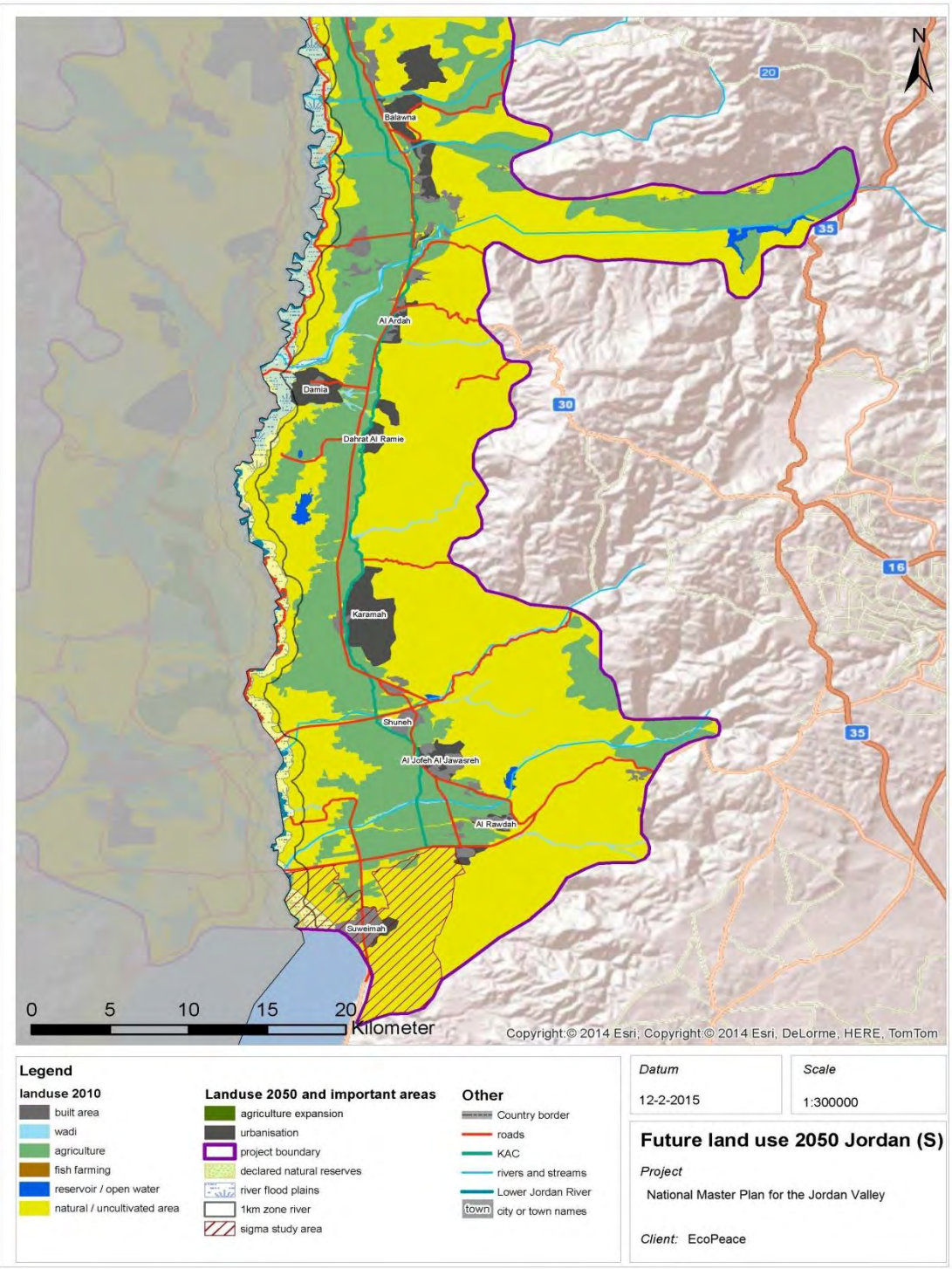
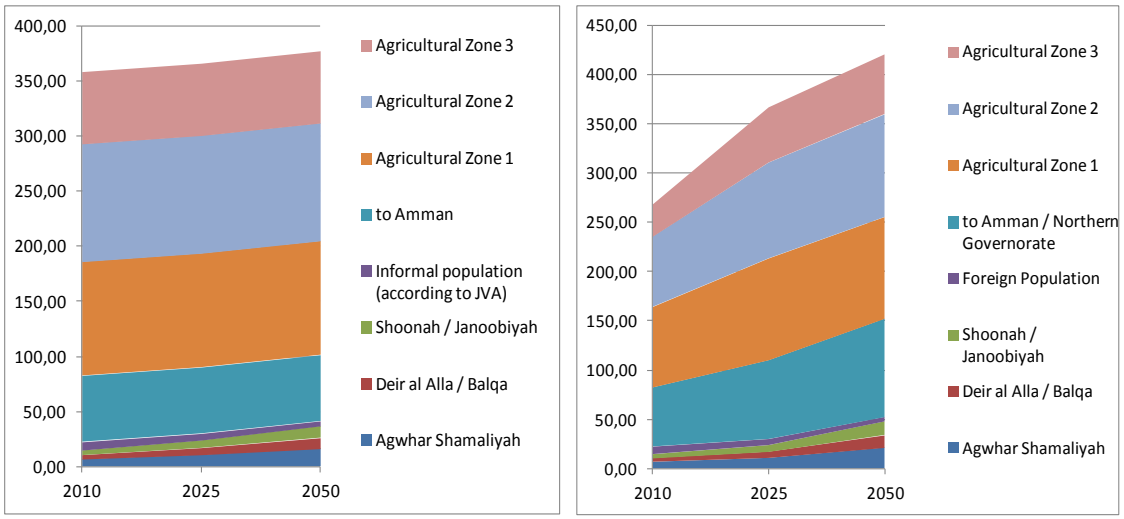



**Figure 40 – Projected land use in the Jordan River Valley in 2050 – South Part**

## 5.3 Water Balance in 2025 and 2050

The total projected water demands (figure 39, left) will grow from 358 MCM / yr in 2010 to about 386 MCM per year in 2025 and finally 428 MCM per year in 2050. This increase is largely related to the growing population and related domestic and urban water demands. It is assumed that the total agricultural water demands (left, zone 1, 2 and 3) will remain the same at a total of about 276 MCM per year.




*Water Demands (MCM / Yr)* *Water Supply (MCM / yr)*

**Figure 41 – Projected Water Balance in 2025 and 2050**

Meanwhile the available water resources in the basin will be impacted by three major developments:

1. It is assumed that the water provided by Israel to Jordan through the Tiberias Carrier Pipe will increase from 49 MCM / yr to 100 MCM per year
2. It is assumed that due to Climate Change the rainfall in the Jordan Valley region, and the related water resources associated with dams and groundwater will decrease annually with 0.2%. It should be noted that this will not influence the inflow from the Zarqa Carriers 1 and 2, since these are mainly fed by treated wastewater from Greater Amman, and do not correlate to rainfall.
3. It is assumed that gradually the locally generated wastewater will be treated and reused for agricultural purposes: for 50% in 2025 and for 80% in 2050. This leads to more than 33 MCM /yr of locally generated and treated wastewater being available for agriculture in 2050, and about 45 MCM / yr of wastewater from Amman and the Northern Governorates being returned to the Jordan Valley.

The total water resources available in the Jordan River Valley are 268 MCM in 2010. Due to the above three developments this will grow to a total of 366 MCM in 2025 and eventually 420 MCM in 2050. (see figure 40 below). It is assumed that these resources are allocated in terms of water supply in accordance with above figure 39 (right). As can be seen there, eventually in 2050 the gap between water demands and supply will almost be fully closed (deficit of 8 MCM / yr only). This implies for instance that, where agricultural zone 3 currently receives only about 50% of the actual agricultural water demands today, this will be more than 90% in the year 2050.

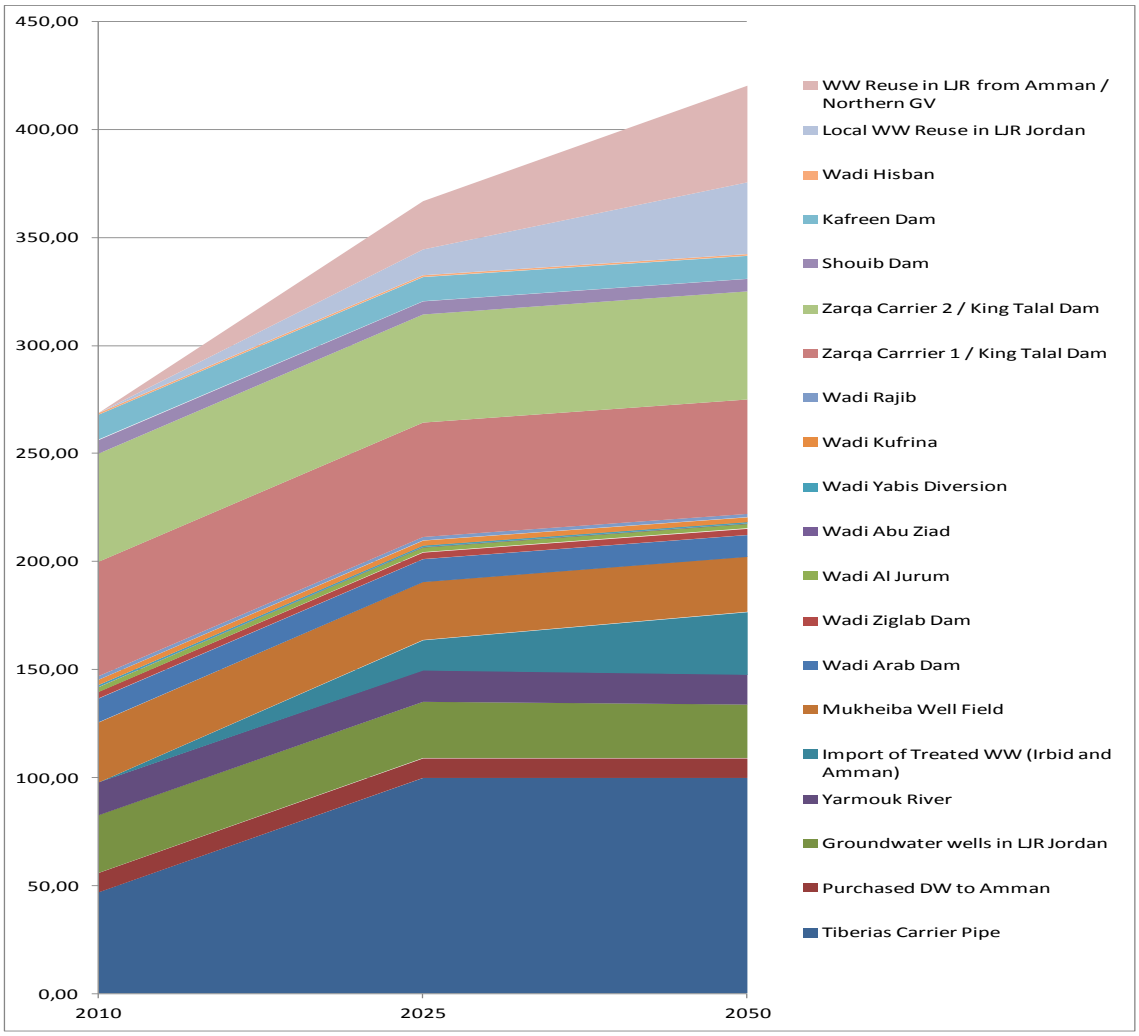



**Figure 42 –Water Resources in the Jordan River Valley 2010 – 2050 (MCM / yr)**

## 5.4 Jordan River Flow in 2050

The water flow through the Jordan River depends not only on the water regime in Jordan, but also directly by those of Israel and eventually Palestine. If the interventions suggested in this Master Plan will be implemented, and an addition 150 – 200 MCM of clean water will be released from Lake Tiberias through the Degania Dam, the impacts on the river flow will be as presented in figure 41. The overall impacts of the proposed interventions in the basin as a whole have been calculated with the WEAP model. Since in this Master Plan it is assumed that by 2050 all human pollution sources have been treated and controlled, including all generated solid waste and wastewater, as well as all saline water springs, the water in the Jordan River will be clean enough in 2050 to restore the aquatic ecosystems as presented in the interventions.

Under these conditions, the river flow will be largest at the confluent with Wadi Al Rayyan, and will grow from about 75 MCM / yr today to about 300 MCM in the year 2050. It is proposed to abstract this flow from the river again for water supply purposes before it will be finally discharged into the Dead Sea. As mentioned earlier, it is assumed that this contribution will come largely from additional release from Lake Tiberias. Eventually, assuming a full regional peace and co-operation scenario in the Jordan River Valley, the river stream flow might be even more augmented through by-passing into the river (some of) the water currently flowing through the King Abdulla Canal.

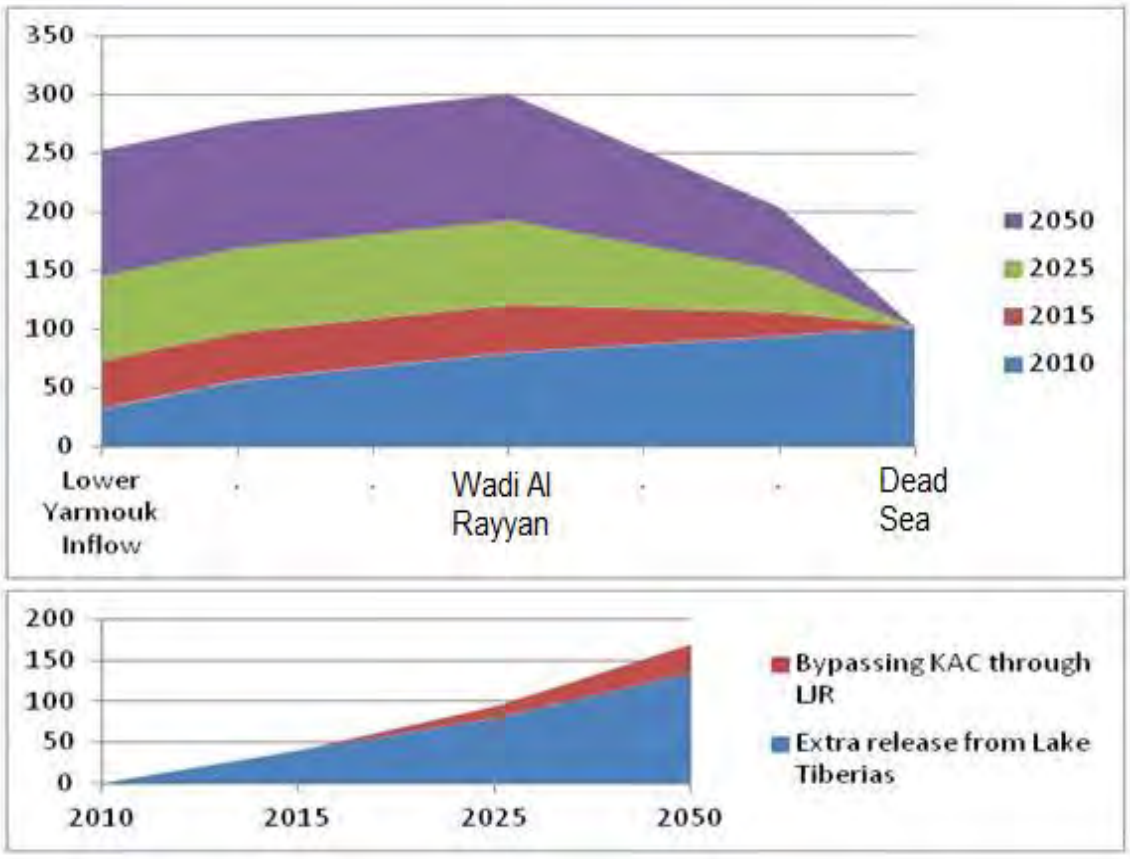



**Figure 43 – Anticipated Water Flows in the Jordan River (maximum 300 MCM / yr in 2050)**

## Assumptions

In the vision for 2050, the Jordan River will play a crucial and multi-functional role in terms of sustaining ecology, supporting tourism and related economic development, and conveying and supplying water throughout the basin, particularly for Jordanian and Palestinian supply purposes. However, the Jordan River is a dynamic natural water body, in which water flow and quality depend on a complex and time dependent interaction between inflow, abstractions, evaporation and groundwater flows.

To sustain the ecological conditions in the river, EcoPeace would ideally like to see a non-polluted flow in the Jordan River with a minimum of 400 MCM / yr, including the outflow into the Dead Sea.

In order to meet the water demands presented above, and to reach the flow targets in 2050, the following assumptions have been made:

- By 2050 some 238 MCM / yr of water will be released into the Jordan River from Tiberias Lake. This implies that Israel will reduce pumping water from Tiberias Lake into the National Water Carrier, and will have replaced this by other resources, such as desalinated seawater. However, it is assumed that Israel will maintain supplying its domestic and agricultural water needs in the basin from local water resources. The monthly sequence of this release shall be managed in line with the river annual flow predictions (see table 40) and the annual water demands

- Meanwhile Tiberias Lake will be kept on a medium water level between the top and bottom red lines (What is called now the "green line" by the IWA)

- All pollution flowing into the Jordan River will have ceased by 2025. This implies fully treatment of all wastewater, fully sanitary solid waste management in the Jordan, Israel and Palestine parts of the basin, and diverting salt water flows around the main part of the river. However, termination of all wastewater and waste pollution sources in the Israeli stretch from the Tiberias Lake to the Jordan River and Yarmouk River meeting point (Bakoura) is already foreseen by 2017 and in the stretch from Bakoura to Wadi Al Rayyan by 2020.

- By 2050 Jordan will use the Jordan River as a water conveyor for water supply purposes in addition to the current King Abdullah Canal. This implies that Jordan diverts water to the Jordan River to the possible extent.

- By 2050 Amman will not only receive 60 MCM / yr from the Jordan River Valley, as today, but will return an additional 60 MCM of treated wastewater back to the valley.

- The river has a natural tendency to become increasingly saline in southern direction, mainly due to brackish groundwater inflow near the Dead Sea. This implies that fresh water can only be supplied from the upper stretch of the river and more brackish water from the lower stretch of the river. Quality requirements for different types of consumption are the following:
    - Raw drinking water quality -<400 mg/l
    - Low Salinity / Semi Fresh irrigation water quality -<600 mg/l
    - Dates irrigation water quality -<1500 mg/l

- In 2050 Palestine will receive from the Jordan River a total of 50 MCM / yr.
- Climate change will result by 2050 in a linear decrease of 20% of all water sources and increase in evaporation by 8%.

### Salinity

In the current accounts calculation with the WEAP model, salinity is the only indicator of water quality. Designated salinity values of water sources are mentioned below and are documented in the model itself. The calculations of Chloride (Cl) concentrations in the different reaches are based on simple mass balance with no decay mechanisms: Salinity of all the water sources is fixed throughout the year:

- The salinity of Lake Tiberius does not change with water level and is fixed at 280 mg/L;
- Runoff salinity is 50 mg/L;
- Salinity of return flow from irrigation is 800 and 1500 mg/L for fresh and saline water respectively;
- Salinity of Israeli Sewage is 350 mg/L;
- Effect of evaporation on salinity in the Jordan River itself is neglected.

## Groundwater Contribution

*Groundwater North of Wadi Al Rayyan*

Direct contribution of groundwater to the LJR from Israel (north of *Wadi Al Rayyan*) was calculated in the current accounts according to Holtzman, who quantified groundwater. The model simulates the annual contribution of groundwater into the LJR to be 18 MCM, with an average salinity of 1150 mg/L.

*Groundwater South of Wadi Al Rayyan*

For the West Bank (south to *Wadi Al Rayyan*) the current WEAP model assumes under the current accounts that groundwater inflow is constant throughout the year and is about 5-6 MCM/month. The salinity levels have been assumed to be similar range as measured by Farber et. al.

In the southern part of East River Bank, the shallow groundwater system consists of Lacustrine sediments and Clastic fluvial components. The aquifer has been developed largely since the 1960s, and many shallow wells have been drilled, largely for irrigation purposes. Consequently, groundwater levels have dropped and salinity levels increased substantially. Where historically groundwater flow in the Eastern Jordanian valley area had a westwards direction, today more water is abstracted that recharged naturally. In this model it has therefore been assumed that there is no annual contribution of groundwater into the LJR from the southern Jordanian side.

## Water Supply Assumptions

Within WEAP model run for 2050 the LJR will be largely divided into the following 4 zones:

- Water of drinking quality within the basin will be supplied from the Tiberias Lake to upstream of the Sheikh Hussein Bridge.
- Water for fresh irrigation quality purposes will be provided from just upstream of the Sheikh Hussein Bridge to upstream of the confluence with Zarqa.
- Water for Dates irrigation quality purposes will be provided from the confluence with Zarqa to the confluence with Wadi Hisban
- From the Confluence with Wadi Hisban t to the Dead Sea the river water is naturally saline, and will receive brine from the north.

The brine water resources in the basin will be conveyed to the lower stretch of the Jordan River, at the confluence with Wadi Hisban downstream of the Baptism Site, and from here through the river into the Dead Sea. At this point the river will receive brine from two sources:

- Western Brine Carrier - A new conveyor west to the LJR that will carry water of the Salt Water Carrier, brine originating from desalination, and from fishponds discharges.
- Brine from the Abu Zeighan desalination plant

## Impacts on Flows in the Jordan River

In order to reach an outflow of 300 MCM / yr into the Dead Sea without the contribution of Syria, an additional 100 MCM / yr of inflow into the basin will be required to the data and assumptions presented above. Detailed assessment of these resources goes beyond the scope of this study. However, in line with earlier studies, including those of the World Bank Study on Alternatives related to the Red – Dead Sea Water Conveyance Project, it may be assumed that this water can be identified in 2050 as inflow of additional treated wastewater into the basin from the wider regions in Jordan, Israel and Palestine.

Such additional release of water into the Dead Sea will come at a certain cost, which may be directly compared to economic benefits of the Dead Sea economy by 2050. It should be noted though that flows required for stabilizing the Dead Sea Water levels are substantially higher than 300 MCM / yr, and may reach to more than 800 MCM / yr.

This leads to the following estimates in terms of flows and salinity levels in the Jordan River.

**Table 34 – Anticipated Flows in the Lower Jordan River by 2050**

| Location on the River | Avg mg/l Cl | MCM month min | MCM month max | Calculated* MCM/Yr (excl. additional 102 MCM reuse) | Estimated** MCM/Yr (incl. additional 102 MCM reuse) |
|---|---|---|---|---|---|
| Jordan River 6 km upstream the confluence with Yarmouk River | 280 | 16.9 | 27.1 | 238 | 238 |
| Yarmouk inflow | 270 | 16.9 | 32.8 | 269 | 269 |
| Before Withdrawal to KAC | 325 | 17.4 | 35 | 286 | 286 |
| Before Withdrawal to JAD2 Upstream Zarqa inflow | 530 | 6.2 | 33 | 205 | 230 |
| Baptism Site | 650[1] | 2.2 | 35.3 | 188 | 238 |
| After withdrawal to Pal. Dates | 1100 | 0 | 26.2 | 138 | 215 |
| After brine inflow | 1750 | 4.2 | 31.9 | 185 | 287 |
| Outflow into Dead Sea | 2265 | 5.2 | 33 | 198 | 300 |

[1] In November-May, when water is being pumped. In the summer Cl concentration could top 2000 mg/l

* Major inflows into the LJR Basin that are above 5 MCM/yr are the following:
- Tiberias Lake: 238 MCM / yr
- Yarmouk River: 34 MCM / yr
- Additional treated wastewater from Amman for irrigation: 60 MCM / yr
- Additional treated wastewater from West Bank / East Jerusalem for irrigation: 50 MCM / yr
- Groundwater inflow, spread along the entire river: 45 MCM / yr
- Western Brine Carrier (inflow into Jordan River near the confluence with Wadi Hisban): 40 MCM / yr
- Zarqa River: 29 MCM / yr
- Valley of Springs: 12 MCM / yr
- Harod Stream (just north of the Sheikh Hussein Bridge): 8 MCM / yr
- Wadi Al Arab: 8 MCM / yr

** Assuming additional 102 MCM / yr of treated wastewater diverted into the river from the wider regions in Jordan, Israel and Palestine, possibly generating hydropower at the same time
In addition, three major pumping points will be established as follows:
- Pumping to the KAC upstream of the Sheikh Hussein Bridge. The KAC will be used from this point on as a conveyor of drinking water quality to Jordan. it will convey 85 MCM/Yr from the LJR, of which 65 MCM will be supplied for irrigation.
- Pumping of 52 MCM / yr for irrigation water upstream to the confluence with Zarqa River.
- Pumping downstream of the Baptism Site (Upstream the brine discharge point) of 50 MCM/yr for the dates plantations in the west bank. The pumping will be concentrated in the winter so a network of reservoirs with a 35 MCM will have to be built. Such vast reservoirs are expected to lose some 10 MCM/Yr to evaporation. Hence, the 40 MCM/Yr that will be delivered could sustain about 27,000 dunums of grown date plantations.


YARMOUK

# 6 IMPLEMENTATION ASPECTS

## 6.1 Institutional and Governance Aspects

The aim of the proposed interventions in this Master Plan for the Jordan River Valley is to use it as an advocacy tool with national stakeholders, the EU, international financiers and various actors of the international community to increase political will for the adoption in full or in part of the proposed interventions.

The interventions have been described in section 4, and include a suggested institutional setting for each. Financing for the proposed interventions has yet to be secured, and will require additional preparation and design activities, including elaboration of the proposed institutional and governance aspects, also depending on the specific requirements of the financiers, either nationally or internationally.

However, it is foreseen that the Jordan Valley Authority will play a major role in implementation of most of the interventions, since its main task is the development, protection and improvement of the water and environment in the Jordan Valley. According to the 2001 Jordan Valley Development Law the JVA shall perform the necessary works to protect and improve the Jordan Valley, and it shall prepare related plans in co-operation with the municipalities and other stakeholders. The currently prepared Strategic Partnership with WATERNET, the water supply company and water board of Greater Amsterdam, might be very helpful in this respect,

The Municipalities also have to play an important role in the further preparation and implementation of the suggested interventions, since they represent the local population living in the basin, and they play a key role in providing services to these inhabitants in terms of water, wastewater collection and solid waste management.

Finally EcoPeace is foreseen to play a key role in most of the interventions as one of the major NGO‘s active in the Lower Jordan River Basin, particularly with regard to organizing grass root environmental protection activities, and engaging and managing the local stakeholders in the further preparation and implementation of the proposed interventions. Furthermore, EcoPeace is a unique organization at the forefront of the environmental peacemaking movement, and is therefore very well equipped to manage trans-boundary co-operation and dissemination components of the proposed interventions.

## 6.2 Planning

The below planning scheme below provides an overview of a suggested timing of the interventions proposed in this NGO Master Plan until the year 2050.

**Table 35 – Investment Planning Scheme (next page)**

| ID | | Project (JOD) | Subtotal (JOD) | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P01 | JOR | Solid Waste Management | 20.319.600 | | 2,1 | 42,5 | 41,8 | 38,9 | 38,9 | 38,9 | 0,0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| P02 | JOR | Environmental Management and Public Awareness Program | 3.115.200 | | 5,0 | 5,0 | 7,1 | 7,1 | 7,1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| P03 | JOR | Agricultural Pollution Control Project | 1.486.800 | | 3,5 | 2,8 | 2,8 | 2,8 | 2,8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| P04 | JOR | Separate waste collection and reuse pilots | 283.200 | | 2,8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | **TOTAL POLLUTION CONTROL** | **25.204.800** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **ID** | | **Project (JOD)** | **Subtotal (JOD)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| W01 | REG | Jordan Valley Water Demands Management Project | 1.062.000 | | | | | | | 5,3 | 5,3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| W01 | JOR | Improved Lower Jordan River Basin Management Project | 1.697.076 | | | | | 8,5 | 8,5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| W02 | JOR | Wastewater collection, treatment and reuse project | 29.740.956 | | | 2,0 | 70,8 | 74,9 | 74,9 | 74,9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| W03 | JOR | Emergency Wastewater Management Project | 16.072.308 | | | 1,0 | 39,9 | 49,9 | 49,9 | 20,0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| W04 | JOR | Waste water reuse pilot projects | 1.098.108 | | | | 1,0 | 5,0 | 5,0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | **TOTAL WATER MANAGEMENT** | **49.670.448** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **ID** | | **Project (JOD)** | **Subtotal (JOD)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A01 | REG | Jordan Valley Agricultural Water Efficiency | 1.062.000 | | | | | | | 5,3 | 5,3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A01 | JOR | Jordan Valley Greenhouses Expansion Project | 2.124.000 | | | | 1,4 | 5,0 | 5,0 | 5,0 | 5,0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A02 | JOR | Jordan Valley Extension Services Improvement Project | 1.537.351 | | | | 1,0 | 3,6 | 3,6 | 3,6 | 3,6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A03 | JOR | Jordan Valley Drip Irrigation Improvement Project | 8.984.520 | | | | 0,0 | 10,0 | 16,0 | 16,0 | 16,0 | 31,9 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A04 | JOR | Jordan Valley Post Harvesting Support Project | 1.647.162 | | | | 0,0 | 1,0 | 3,1 | 3,1 | 3,1 | 6,2 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A05 | JOR | Jordan Valley Irrigation Efficiency Improvement Project | 2.745.270 | | | | 0,0 | 0,0 | 5,0 | 4,5 | 4,5 | 13,5 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A06 | JOR | Jordan Valley Authority Support Project | 2.196.216 | | | | 1,0 | 10,5 | 10,5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | **TOTAL SUSTAINABLE AGRICULTURE** | **20.296.519** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **ID** | | **Project (JOD)** | **Subtotal (JOD)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| IC01 | REG | Jordan River Basin Organization (JORBO) | 531.000 | | | | | | | 1,1 | 1,4 | 1,4 | 1,4 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | **TOTAL LOWER JORDAN BASIN GOVERNANCE** | **531.000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **ID** | | **Project (JOD)** | **Subtotal (JOD)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E01 | REG | Jordan River Environmental Flows Project | 3.540.000 | | | | | | | 3,5 | 3,5 | 3,5 | 3,5 | 3,5 | 3,5 | 3,5 | 3,5 | 3,5 | 3,5 | | | | | | | | | | | | | | | | | | | | |
| E02 | REG | Jordan River Ecological Restoration Project - Regional | 21.594.000 | | | | | | | 3,5 | 21,2 | 21,2 | 21,2 | 21,2 | 21,2 | 21,2 | 21,2 | 21,2 | 21,2 | 21,2 | | | | | | | | | | | | | | | | | | | |
| E03 | REG | Jordan River Fish Stock Restoration Project | 3.894.000 | | | | | | | 3,5 | 7,1 | 7,1 | 7,1 | 7,1 | 7,1 | 7,1 | | | | | | | | | | | | | | | | | | | | | | | |
| E04 | REG | Nature Protection Areas and Management Plan | 3.894.000 | | | | | | | 3,5 | 7,1 | 7,1 | 7,1 | 7,1 | 7,1 | | | | | | | | | | | | | | | | | | | | | | | | |
| E05 | REG | International Accreditation of the Lower Jordan River Valley | 1.062.000 | | | | | 3,5 | 3,5 | 3,5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E01 | JOR | Ecological Corridors around Valleys and Dams | 3.894.000 | | 3,5 | 7,1 | 7,1 | 7,1 | 7,1 | 7,1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E02 | JOR | Wetlands and Aquatic Fauna Restoration Project | 1.062.000 | | | 3,5 | 3,5 | 3,5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E03 | JOR | Ecological Monitroing and Management Project | 1.770.000 | | 3,5 | 3,5 | 3,5 | 3,5 | 3,5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E04 | JOR | Jordanian Eco-parks and Projected Areas Project | 14.514.000 | | | | | | | 3,5 | 14,2 | 14,2 | 14,2 | 14,2 | 14,2 | 14,2 | 14,2 | 14,2 | 14,2 | 14,2 | | | | | | | | | | | | | | | | | | | |
| | | **TOTAL ECOLOGICAL REHABILITATION** | **55.224.000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| ID | | Project (JOD) | Subtotal (JOD) | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C01 | REG | Jordan River Mouth Tourism Information Center | 1.416.000 | | | | | | | 3,5 | 3,5 | 3,5 | 3,5 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C02 | REG | Jordan River Baptism Site Improvement Project | 2.832.000 | | | | | | | 7,1 | 7,1 | 7,1 | 7,1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C03 | REG | Jordan River Peace Park Improvement Project | 2.832.000 | | | | | | | 7,1 | 7,1 | 7,1 | 7,1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C04 | REG | Jordan River Regional Routes | 1.416.000 | | | | | | | 3,5 | 3,5 | 3,5 | 3,5 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C05 | REG | Cultural and Historic Museum for the Lower Jordan Valley | 2.124.000 | | | | | | | 5,3 | 5,3 | 5,3 | 5,3 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C01 | JOR | Pella Tabaqat Fahl Site Improvement Project | 2.196.216 | | | 2,0 | 10,0 | 10,0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C02 | JOR | Abu Ubaydah Tomb Improvement Project | 549.054 | | | 0,5 | 2,5 | 2,5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C03 | JOR | Cultural and Historic Museum for the Lower Jordan Valley | 2.181.242 | | | | | | | 0,2 | 0,1 | 21,5 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C04 | JOR | Archaeological Landmarks Development Project | 3.493.980 | | | | | | | 8,7 | 8,7 | 8,7 | 8,7 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | **TOTAL SUSTAINABLE TOURISM AND CH DEVELOPMENT** | **19.040.492** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **ID** | | **Project (JOD)** | **Subtotal (JOD)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| U01 | REG | Non-fossil, Renewable Energy Development Project | 2.124.000 | | | | | | | 4,2 | 4,2 | 4,2 | 4,2 | 4,2 | | | | | | | | | | | | | | | | | | | | | | | | | |
| U02 | REG | Adam / Damia Bridge Rehabilitation Project | 63.720.000 | | | | | | | | | | 7,1 | 99,1 | 106,2 | 212,4 | 141,6 | 70,8 | | | | | | | | | | | | | | | | | | | | |
| U03 | REG | King Abdullah Bridge Rehabilitation Project | 21.240.000 | | | | | | | | | | 7,1 | 99,1 | 106,2 | | | | | | | | | | | | | | | | | | | | | | | | |
| U04 | REG | Efficient Border Bridges Crossings | 7.080.000 | | | | | | | 2,1 | 33,3 | 35,4 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| U01 | JOR | Infrastructure Development Project | 189.673.200 | | | | | | | | | 21,2 | 48,9 | 141,6 | 141,6 | 141,6 | 141,6 | 141,6 | 141,6 | 141,6 | 141,6 | 141,6 | 141,6 | 141,6 | 141,6 | 127,4 | | | | | | | | | | | | | |
| U02 | JOR | Urban and Infrastructure development Master Plan | 1.008.262.800 | | | | | | | | | 7,1 | 424,8 | 424,8 | 531,0 | 531,0 | 411,3 | 389,4 | 389,4 | 389,4 | 389,4 | 389,4 | 389,4 | 389,4 | 389,4 | 389,4 | 389,4 | 389,4 | 389,4 | 389,4 | 389,4 | 389,4 | 389,4 | 389,4 | 368,2 | 339,8 | 247,8 | 177,0 | |
| U03 | JOR | Higher Education and Vocational Development Project | 21.240.000 | | | | | | | 7,1 | 63,7 | 70,8 | 70,8 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| U04 | JOR | Non-fossil, Renewable Energy Development Project | 201.780.000 | | | | | | | | | 10,6 | 10,6 | 212,4 | 212,4 | 148,7 | 148,7 | 148,7 | 148,7 | 141,6 | 141,6 | 141,6 | 141,6 | 141,6 | 141,6 | 63,7 | 49,6 | 14,2 | | | | | | | | | | | |
| | | **TOTAL URBAN AND INFRASTRUCTURE DEVELOPMENT** | **1.515.120.000** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | **GRAND TOTAL, all investments (JOD)** | **1.685.087.259** | 2015 | 2037 | 2087 | 2211 | 2266 | 2264 | 2276 | 2256 | 2335 | 2687 | 3059 | 3177 | 3100 | 2910 | 2818 | 2749 | 2739 | 2705 | 2706 | 2707 | 2708 | 2709 | 2618 | 2477 | 2443 | 2429 | 2430 | 2431 | 2432 | 2433 | 2434 | 2414 | 2387 | 2296 | 2226 | 2050 |

In above scheme the preparation related activities for each intervention are provided in green, each cell also providing the amount of preparation cost in Jordanian Dinars (x 10,000) required for that year; the pink cells represent the construction and/or implementation phase of the project, showing also the construction / implementation costs required in JD x 10,000 for that year; the blue cells represent the operational phase of the interventions, including the annual operations or maintenance costs required.

The starting dates of the projects have been selected on the basis of the dependence of a particular intervention on the completion of other interventions. For instance E01 Jordan River Ecological Restoration Project can only be initiated upon completion of most pollution control related projects. Furthermore the investment periods have been divided over time, in order to avoid that too many projects would have to be initiated in the same year, which would lead to an overstress of the local project implementation capacities.

The urban development and infrastructure related interventions consume by far the largest portion of the required investments in the Lower Jordan Valley (U01 to U04). Their initiation has been put in sequence starting from 2020, in order to facilitate the basin realizing the economic developments as projected in this Master Plan. Particularly in the years between 2027 and 2040 the annually required investments will reach about 80 Million JD per year. Nevertheless, these investment are required to increase the GDP in the Lower Jordan River Basin from around 1 Billion JD in 2010 to close to 14 Billion JD in the year 2050.

The agriculture; water, pollution control, ecology and cultural heritage / tourism related interventions will reach their maximum annual investments in the period 2018 to 2025, with about 12 to 17 Million JD per year, and will than drop to 6 to 7 Million JD per year until 2050.

The total costs and annual cash flow requirements are presented below.

## 6.3 Investment Costs and Finance

### 6.3.1 Disbursement Requirements

As presented in table below table, the totally required investments in the Jordanian part of the study area are 1.69 Billion Jordanian Dinars (JOD) until the year 2050, excluding operation costs. The annually required disbursement schedule is shown below.

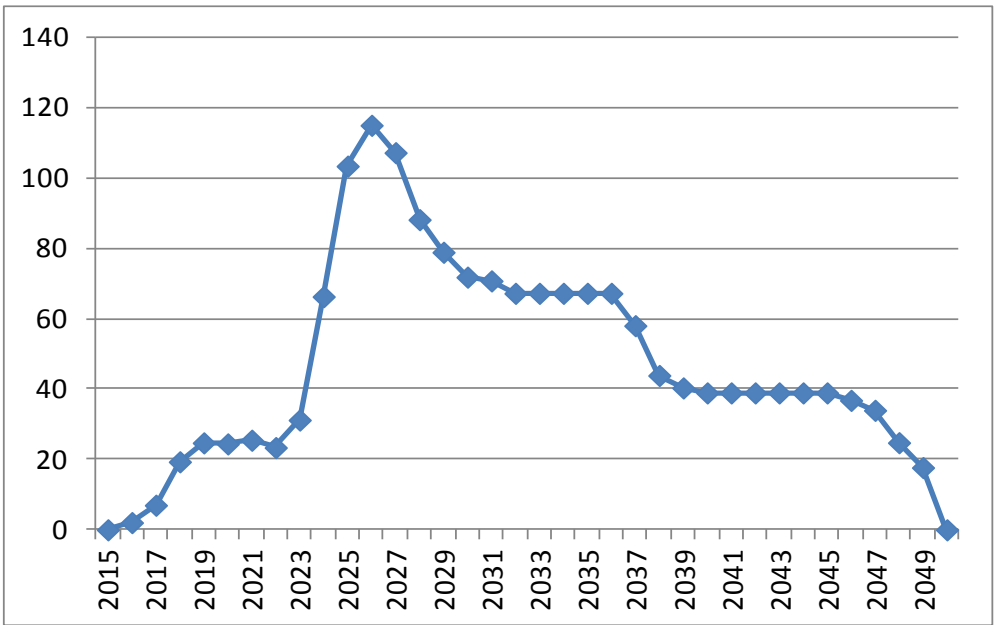



**Figure 44 – Investment Disbursement Requirements in Million JOD per year**

As shown above, the annual investment requirements gradually increase until the year 2027 to 107 Million JOD and then gradually decline until the end of the planning period in 2050. During the short term period until 2020 the investment are still relatively modest, and mainly focus on pollution control, water management, agriculture and the tourism sector. The bulk in the investment will be required in the Long Term from 2020 onwards and include urban and transportation development investments. The annual investments will reach its maximum in 2027, when about 107 M JOD of investments will be required, of which 90% relates to urban development and infrastructure investments.

This Master Plan for the Jordan Valley does not provide a detailed financing model for the required investments. The philosophy of this Master Plan predicts that the investments proposed here will gradually increase the economy of the region in a sustainable manner that will benefit the people, including related tax revenues, private savings, and eventually investment power; as well as the environment and the ecological status of the Lower Jordan River itself. This will particularly be the case if regional co-operation among the three riparian countries will flourish in a peaceful and safe living environment, which will also lead to higher number of international tourists visiting the region.

The type of financing required relates to the type of interventions, and will strongly depend, particularly during the initial 5 to 10 years of this Master Plan, on international donor funds. During this phase promotion and dissemination of this Master Plan and related investment plans will remain important to gain support from the international donor community.

It is expected that gradually the local and national Jordanian government will gain finance strength as a result of economic growth and higher tax revenues, leading to a higher public sector participation in the required investments. The private sector will likely become increasingly important as well in contributing to the required investments, particularly for those projects that lead to healthy revenues against acceptable internal rates of return (IRR). Examples may be the proposed water reuse projects; agricultural improvement projects, urban development projects and tourism – cultural heritage related investments. Also the farmers will be able to pay more "realistic" water prices once the basin economy grows and

agricultural outputs improve. Combination may also be possible, such as Public – Private Partnership in which the government and the private sector join forces in those cases where this leads to win-win situations for both

In this Master Plan it is assumed that the required investments will depend on international donor funds at least until 2030, reaching its peak by 2026 with about 46 M JOD donor investment requirements for that year. It is assumed that gradually national public investments and later on private investment will catch up due to increasing economic opportunities in the basin. This leads to the following investment scheme for the total package of interventions that have been proposed, separated for donor funds, public investments and private investments.

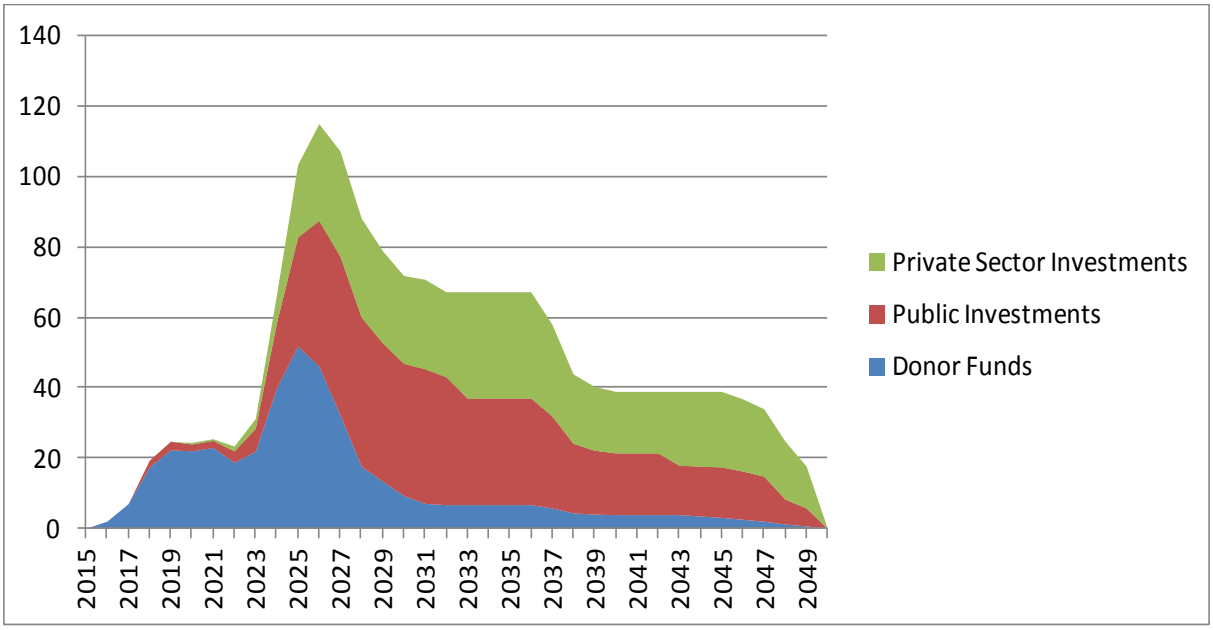



**Figure 45 – Funding Model for the Jordan Valley in Million JOD per year**

### 6.3.2 Financing

This Master Plan does not provide a detailed financing model for the required investments. The philosophy of this Master Plan predicts that the investments proposed here will gradually increase the economy of the region in a sustainable manner that will benefit the people, including related tax revenues, private savings, and eventually investment power; as well as the environment and the ecological status of the Lower Jordan River itself. This will particularly be the case if regional co-operation among the three riparian countries will flourish in a peaceful and safe living environment, which will also lead to higher number of international tourists visiting the region.

In this Master Plan it has been assumed that (partly) due to the proposed interventions the average number of people per household will decrease from 5 persons today to 3.5 persons per household in 2050, similar to economically more developed countries in the region; that the average income per person per year will increase from 1408 JD per year today, to about 10,000 JD in the year 2050; that the economy will become more service and high added value oriented, with a higher percentage of people being employed

in the service sector; that the GDP in the Lower Jordan Valley will increase from a level of 4,200 JD per person today to about 30,000 JD per person in 2050, and that the total GDP in the area will rise to 13.7 Billion JD in 2050, compared to 1 Billion JD today.

The type of required financing relates to the type of interventions, and may strongly depend, particularly during the initial 5 to 10 years of this Master Plan, on international donor funds. During this phase promotion and dissemination of this Master Plan and related investment plans will remain important to gain support from the international donor community. Particularly the NGO sector, including EcoPeace may play a key role during this period.

It is expected that gradually the local and national governments will gain finance strength as result to economic growth and higher tax revenues, leading to a higher public sector participation in the required investments. The private sector will also become increasingly important in contributing to the required investments, particularly for those projects that lead to healthy revenues against acceptable internal rates of return (IRR). Examples may be the proposed water reuse projects; agricultural improvement projects, urban development projects and tourism – cultural heritage related investments. Combination may also be possible, such as Public – Private Partnership in which the government and the private sector join forces in those cases where this leads to win-win situations for both.

# 7 FINAL CONCLUSIONS AND RECOMMENDATIONS

WEDO / EcoPeace Middle East (hereafter :EcoPeace) in partnership with the Stockholm International Water Institute (SIWI) and the Global Nature Fund (GNF) have assigned Royal HaskoningDHV in partnership with MASAR Centre in 2012 to develop the national Jordanian NGO Master Plan for the Lower Jordan River basin. The major challenge of the LJR Basin is to rehabilitate the Lower Jordan River in terms of water flows and quality and ecological values; and to develop a sustainable water management framework and a healthy economic development perspective for the Jordanian LJR Basin. The aim of the plan is to identify feasible interventions that will restore the basin's environmental and ecological values within a realistic financial and economic framework.

The NGO Master Plan presented in this report presents a series feasible interventions within the context of an integrated problem analysis of the region and an assessment and elaboration of the best possible solutions for these problems. This plan has been prepared in co-operation with a wide variety of Jordanian stakeholders. Specifically the contribution from the Jordan Valley Authority in preparing this plan was crucial and has been highly appreciated.

This national NGO Master Plan will next be used as an advocacy tool by EcoPeace and its partners towards Jordanian decision makers and the international community for the implementation of the proposed interventions. The authors of this Master Plan are also grateful to the excellent work and projects that have been done earlier in the basin, particularly the —Good Water Neighbors" (GWN) project, established by EcoPeace / EcoPeace in 2001. This proofed to be good example of how the challenges in the basin can be addressed from a regional perspective, based on the idea that identifying cross border communities and utilizing their mutual dependence on shared water resources is a good basis for developing dialogue and cooperation on sustainable water management across the national borders.

Finding international and national partners for implementing the current NGO Master Plan is the next challenge. We trust that the depth of the analysis presented here and the consistency in the applied planning approach will convince these future partners that it makes sense to embark on implementing this plan, including continued co-operation on basin level within the Lower Jordan River with both the Israeli and the Palestinian neighbors.

## List of Literature


1. *EcoPeace;* Take me Over the Jordan: Concept Document to Rehabilitate, Promote Prosperity, and Help Bring Peace to the Lower Jordan River Valley, September 2012
2. *EcoPeace (Michal Sagive, Mohammed Obidallah, Hana Al-Asad'd et al*); Cross-border —Priority Initiatives" of the Good Water Neighbors Project, September 2012
3. *Allan, J.A.:* Virtual Water: Tackling the Threat to Our Planet's Most Precious Resource, London: I.B. Tauris), 2011
4. *EcoPeace;* Lower Jordan River Rehabilitation Project: Advocacy strategic Action Plan for Jordan, 2010
5. *EcoPeace (Tatyana Gorskaya):* Lower Jordan River Rehabilitation Project: Trans-boundary Diagnostic Analysis (TDA), Jordan, December 2010
6. *EcoPeace (Dr. Taleb AL Harithi):* Lower Jordan River Rehabilitation Project: Trans-boundary Diagnostic Analysis (TDA), Palestine, December 2010
7. *EcoPeace (Yana Abu Taleb; Michael Lexander; Catherine-Emeline Robillard);* Why Cooperate Over Water? Cross-border crises and the need for trans-national solutions, Sept 2010
8. *EcoPeace (Dr. Sarig Gafny; Dr. Samer Talozi; Mr. Banan Al Sheikh; Mrs. Elizabeth Ya'ari)*; Towards a Living Jordan River: An Environmental Flows Report on the Rehabilitation of the Lower Jordan River, May 2010
9. *World Bank (ERM, BRL, EcoConsult)*: Red Sea – Dead Sea Water Conveyance Study Environmental and Social Assessment – Initial Assessment Report, March 2010
10. *EcoPeace ( Baha Afana);* Lower Jordan River Rehabilitation Project: Assessment of Barriers to the Rehabilitation of the Lower Jordan River as Regards Water Reform in the Hashemite Kingdom of Jordan, March 2009
11. *Tala Qtaishat;* Workbook Assignment for Rangeland Resources Watershed Management Course, 2008
12. *Chatham House (Zecharya Tagar):* Municipal Cooperation Across Conflict Divides: A Preliminary Study, Sept 2007
13. *International Water Management Institute (Rémy Courcier et al):* Historic Transformations of the Lower Jordan River Basin: Changes in Water Use and Projections (1950 – 2025), 2005
14. *Department of Statistics in Jordan, Khamis Raddad:* Water Use and Supply Statistics of Jordan, June 2005
15. *World Watch* – Water and Peace (Gidon Bromberg): For Clues to Resolving the Middle East Conflict consider the case of the Embattled Dead Sea, August 2004
16. *Ministry of Water and Irrigation (Sandra Chesrown);* Final Land Use Report - Jordan Valley Preliminary Land Use Master Plan Project (USAID); august 2004
17. *Dr. Anders Jägerskog;* Why States Cooperate over Shared Water: The water Negotiations in the Jordan River Basin (PhD Dissertation), Linköping Studies in Arts and Science (http://www.ep.liu.se/arts_science/2003/281/digest.pdf), 2003
18. *Dr. Shadda Attilli et al;* Historic Development Plans of the Jordan River Basin, 2003
19. *Allan, Tony (J.A.):* The Middle East Water Question: Hydro-politics and the Global Economy (London and New York: I.B. Tauris), 2001
20. *Chas T. Main;* The Unified Development of the Water Resources of the Jordan Valley Region, 1953
21. *Permaculture Research Institute of Australia (Geoff Lawton, Andrew Jones);* Jordan Valley Permaculture Project for the Report: —The Role of Environmental Management and Eco-Engineering in Disaster Risk Reduction and Climate Change Adaptation (ProAct Network), 2008

22. Farber, E., Vengosh, A., Gavrieli, I., Marie, A., Bullen, T.D. Mayer, B., Holtzman, R., Segal, M. and Shavit, U. 2005. Management scenarios for the Jordan River salinity crisis. Applied Geochemistry 20: 2138-2153.
23. Stevens, S.S., Organ, J.F., Serfass, T.L. 2011. Otters as Flagships: Social and Cultural Considerations. Proceedings of Xth International Otter Colloquium, IUCN Otter Spec. Group Bull. 28A: 150 -161.
24. Turner, M., Nassar, K., Khateeb, N. 2005. Crossing the Jordan: Concept document to rehabilitate, promote prosperity and help bring peace to the Lower Jordan River Valley. In Bromberg, G. (Ed.). Tel Aviv, Amman, Bethlehem, EcoPeace/EcoPeace.
25. Minutes of Meeting with mr. Majed Joudeh (WAJ), dd June 24th 2013
26. Minutes of Meeting with EcoPeace community coordinators (Mrs. Ghada Ateyat, Mr. Yousef Shammari, Mr. Mohammad tariff and Mr. Mohammad Nawsrah), dd June 25th 2013
27. Minutes of Meeting with mr. Haidar Malhas (MIRRA), dd June 23rd 2013
28. Minuted of Meeting with mr. Fuad Eijlat (JVA), dd June 23rd 2013
29. Minutes of Meeting with mrs. Amal Hwarat (Municipality of Deir Alla), dd June 26th 2013
30. Minutes of Meeting with mr. Nabeel Bani Hani (NCARE), dd June 23rd 2013
31. EcoPeace report op January 2006 —A Seeping Time Bomb: Pollution of the Mountain Aquifer by Solid Waste"
32. EcoPeace, pollution to groundwater project, 2013
33. Annual Report of the Department of Fish Breeding, 2012 , Ministry of Agriculture, Amman, Jordan. (Translated from Arabic)
34. Orthofer, Rudolf, ARC 2001, *A Harmonized Water Data Base for the Lower Jordan Valley*,
35. Loibl, Wolfgang and Elena Wendl, Austrian Research Centres Seibersdorf Research, November 2001
36. Loibl Wolfgang and Rudolf Orthofer ARC 2002, *Spatial Risk Modelling for Water Shortage and Nitrate Pollution in the Lower Jordan Valley*, Austrian Research Centres, Seibersdorf Research, Risk ARC--S-0162 February 2002,
37. Madanat H.J. 2010, Land Tenure in Jordan; *Land Tenure Journal*, No.1, 2010, FAO.
38. Petitguyot 2003 in *Irrigation water pricing: the gap between theory and practice* edited by Francois Molle and Jeremy Berkoff, Comprehensive assessment of water management in agriculture research report. www.GABI.org.
39. Venot J.P 2003, Farming systems in the Jordan River Basin in Jordan: agronomical and economic description. International Water Management Institute, November 2003.
40. Venot, J. P.; Molle, F.; Hassan, Y. 2007. Irrigated agriculture, water pricing and water savings in the Lower Jordan River Basin (in Jordan). Colombo, Sri Lanka: International Water Management Institute. 61p. (Comprehensive Assessment of Water Management in Agriculture Research Report 18).
41. AL-Eisawi, D. M. (1996). Vegetation of Jordan. Book Published By UNESCO (ROSTAS). Cairo.
42. Al-Eisawi, D. M. and Oran, S. 1995. Plant Diversity in Jordan. 3rd Scientific Week, HCST, Vol.V. Amman, Jordan.
43. ALOUF, N. J. (1998): Répartition de *Theodoxus jordani* (Mollusca Gastropoda) au Liban. Essai de Biogéographie. – Vie et Milieu 48: 133-138.
44. Bott, R. 1967. Potamidae (Crustacea, Decapoda) aus Afghanistan, Westasien und dem Mittelmeerranum (Eine Revision der Untergattung Potamon s str.)., Vidensk. Medd. Dansk. *Vidensk. Medd. dansk, nat. Foren*: 7-43.
45. Brandis, D., Storch, V. & Türkay, M. 2000. Taxonomy and zoogeography of the freshwater crabs of Europe, North Africa and the Middle East. *Senckenbergiana biologica* 1(2): 5-56.
46. CBD (2001): "Mainstreaming Biological Diversity: The role of communication, education and public awareness", CBD, UNESCO,

47. CBD (2003): "Interlinkages between Biological Diversity and Climate Change", CBD Technical Series no. 10, Secretariat of the Convention on Biological Diversity.
48. FORCART, L. (1972): Systematische Stellung und Unterteilung der Gattung *Sphincterochila* - Archiv für Molluskenkunde 102: 147-164.
49. GCEP (1998): "Jordan Country Study on Biological Diversity", General Corporation for Environmental protection & UNDP.
50. GCEP (2000): " National Agenda 21: National Strategy for Sustainable Development", General Corporation for Environmental
51. GCEP (2001): "Conservation and Sustainable use of Biodiversity in Jordan: 1st National Report to the CBD, General Corporation for Environmental Protection.
52. GCEP (2002): "Jordan Country Report on the Implementation of the UNCCD", General Corporation for Environmental Protection.
53. GCEP (2002): "National Country Report for the World Summit on Sustainable Development", General Corporation for Environmental Protection.
54. GEF SGP (2004): "101 Local Initiatives to protect the Global Environment", Jordan GEF Small Grants Programme.
55. GEF SGP (2005): " GEF Small Grants Programme Guide".
56. GERMAIN, L. (1921-1922): Mollusques terrestres et fluviatilis de Syrie. – Paris, Vol. 1 (1921): 523 pp.; Vol. 2 (1922): 243 pp.
57. Giavarini, I. 1934. Ricerche sui Potamon edule di alcune isole dell'Egeo, Arch. *zool. Torino* 20: 67-92.
58. GLÖER, P. & U. BÖßNECK (2007a): *Pseudobithynia kathrini* n. sp., *P. levantica* n. sp. und *P. amiqensis* n. sp. - drei neue Arten aus dem Libanon (Mollusca: Gastropoda: Bithyniidae). - Mollusca 25: 113- 120.
59. GLÖER, P. & U. BÖßNECK (2007b): Zur Identität von *Gyraulus piscinarum* (Bourguignat, 1852) mit der Beschreibung von *G. bekaensis* n. sp. (Gastropoda: Planorbidae). – Mollusca 25: 139-146.
60. HAUSDORF, B. (1996): Die Orculidae Asiens (Gastropoda: Stylommatophora). – Archiv für Molluskenkunde 125: 1-86.
61. HAUSDORF, B. (2000): The genus *Monacha* in Turkey (Gastropoda: Pulmonata: Hygromiidae) - Archiv für Molluskenkunde 128: 61-151.
62. IUCN (2000): "2000 IUCN Red List of Threatened Species", The World Conservation Union.
63. IUCN.DoS (2004): "Jordan Environmental Statistics Book 2003", National Department of Statistics.
64. JEWP (2001): "State of the Environment in Jordan 2000/2001", Jordanian Environmental Watch Programme.
65. KINZELBACH, R. (1986): Additional records of the River Limpet, *Ancylus fluviatilis*, from Krupp, F.,Schneider, W. (1989). "The fishes of the Jordan River Drainage Basin and Azraq Oasis" Fauna of Saudi Arabia 10 347-416.
66. Long, G. 1957. The Bioclimatolgoy and Vegetation of East Jordan. Rome, UNESCO/FAO.
67. MoA (2003): "National Strategy for Agricultural Development", Ministry of Agriculture.
68. MoEMR (2005): "National Energy Strategy", Ministry of Energy and Mineral Resources.
69. MoEnv (2003): "National Biodiversity Strategy and Action Plan", Ministry of Environment.
70. MoEnv (2005): "National Strategy and Action Plan to Combat Desertification", Ministry of Environment.
71. MoMRAE (1991): "National Environmental Strategy", Ministry of Municipal, Rural affairs and the Environment.
72. MoPIC (1995): "National Environmental Action Plan", Ministry of Planning.
73. MoPIC & UNDP (2004): "Jordan National MDGs report", Ministry of Planning and UNDP.

74. MoPIC (2002): "National Socio-Economic Development Plan 2004-2006", Ministry of Planning and International Cooperation.
75. MoSD (2003): "Poverty Alleviation Strategy", Ministry of Social Development.
76. MoTA (2004): "National Tourism Strategy", Ministry of Tourism and Antiquities.
77. MoWI (1998): "National Water Strategy", Ministry of Water and Irrigation.
78. NCARE (2005): "Conservation and Sustainable use of Dryland Agro-biodiversity in Jordan: Highlights of the Project Achievements".
79. Alfarra A. et al (2012): —Modeling Water Supply and Demand for Effective Water Management Allocation in the Jordan Valley", Journal of Agriculture and Applications JASA
80. GLOWA (2008): —An Integrated Approach to Sustainable Management of the Jordanian Water Resources under Global Change"
81. Toll M. et al (2008): —Groundwater Resources in the Jordan Valley: an integrated approach to the hydrogeological investigations of unconsolidated aquifers", IWRA congress 2008