



AUB  
American  
University  
of Beirut  
الجامعة الأميركية في بيروت



ISSAM FARES INSTITUTE  
FOR PUBLIC POLICY  
AND INTERNATIONAL AFFAIRS

The Research and Policy Forum on Climate Change and Environment in the Arab World

*at the*

Issam Fares Institute for Public Policy and International Affairs, AUB

*presents*

***"Climate Change, Water and the Policy-Making Process  
in the Levant and North Africa"***

*A closed workshop with leading water experts from the Levant*

*AUB, Tuesday, August 4, 2009*

**Issam Fares Institute for Public Policy & International Affairs | American University of Beirut**

408 Diana Tamari Sabbagh (DTS) Building | PO Box 11-0236, Riad el Solh | Beirut 1107 2020, Lebanon  
Tel: 961 – 1 – 350000 ext. 4510 | Fax: 961 – 1 – 737627 | Email: [ifi@aub.edu.lb](mailto:ifi@aub.edu.lb) | Web: [staff.aub.edu.lb/~webifi](http://staff.aub.edu.lb/~webifi)

**Current Status of Climate Change Research and Policy in the Levant**

**Issam Fares Institute**

**American University of Beirut**

**Jordan Case**

**By**

**Manar Fayyad**

**University of Jordan**

**Amman-Jordan**

**August, 2009**

## Table of Contents

I.	Introduction.....	2
II.	Methodology.....	2
III.	Findings.....	3
III.1	Situation Analysis.....	3
III.2	Climate Change Adaptation Policy in Jordan.....	6
III.3	Jordan ratification of climate change conventions .....	9
III.4	Enabling activities for the preparation of Jordan's..... second national communication to the UNFCCC	11
III.5	Vulnerability and Adaptation (V&A) Study.....	13
III.5.1	Vulnerability and adaptation in the water sector.....	15
III.5.2	Adaptation of the Agricultural Sector.....	20
III.5.3	Climate Change Effect on Socio-Economic .....	21
	Factors in Jordan	
III.5.4	Adaptation in the Health Sector.....	28
III.6	A Joint program On Adaptation to Climate Change..... to Sustain Jordan's MDG Achievements	32
III.7	Improvements as a Result of Mitigation Measures.....	38
III.8	Measures for Adaptation to Climate Change Issues .....	39
IV.	Mapping of Institutions and Researchers Acitve .....	42
	in Climate Change Issues	
V.	References.....	44

# **Current Status of Climate Change Research and Policy in Jordan**

## **I. Introduction**

This report comes in response to “The Issam Fares Institute at the American University of Beirut” to conduct country specific studies on climate change and the policy making process in the Levant. The aim of these studies is to identify the state of research and the key policy issues for Jordan, Lebanon, Palestine and Syria. This will be done by:

Identifying the current challenges of climate change, reviewing the literature on climate change and its impact on various sectors, identifying the key climate change actors, and assessing the policy –making mechanisms and priorities.

This report will cover the situation regarding the above mentioned issues in Jordan.

## **II. Methodology**

Data related to climate change issues was collected using different sources:

- Interviewing people active in this sector.
- Web sites of the Ministry of Environment, Ministry of Water and Irrigation, Ministry of Agriculture, funding agencies and the media.
- Reviewing reports of climate change projects conducted in Jordan and projects that are still on going and future projects.
- Interviewing researchers at different universities who are working in this field.
- Collecting scientific papers related to climate change issues published in scientific journals.

### III. Findings

#### III.1 Situation Analysis:

Jordan is located at the center of a complex political, social, and economic system. Regional conflicts have always affected the country decision taking processes. Jordan had a population of 5.35 millions in 2004 living in about 20% of the total area. The population growth rate is about 2.8%. About 80% of the population live in urban areas and about 3.5 millions are living in Amman, Irbid, and Zarqa governorates in the Amman-Zerqa and Yarmouk River basins. Jordan can be divided into three climatic regions :i) the Gohr area , ii) the highlands and marginal steps region, and iii) the Badia and desert region.



Figure 1: Map of Jordan

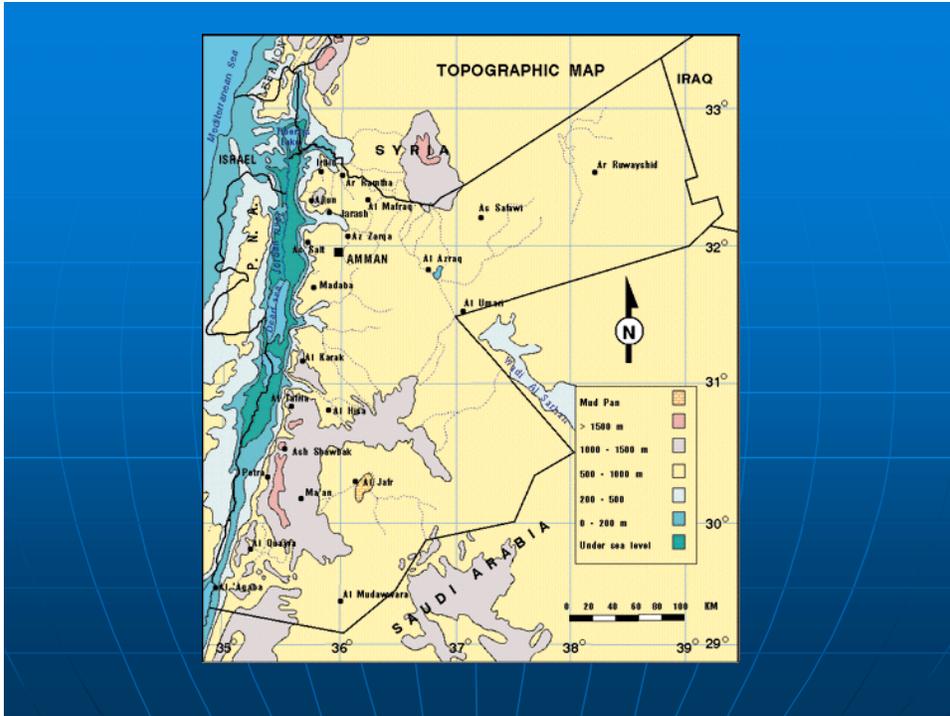


Figure 2: Jordan Topographic Map

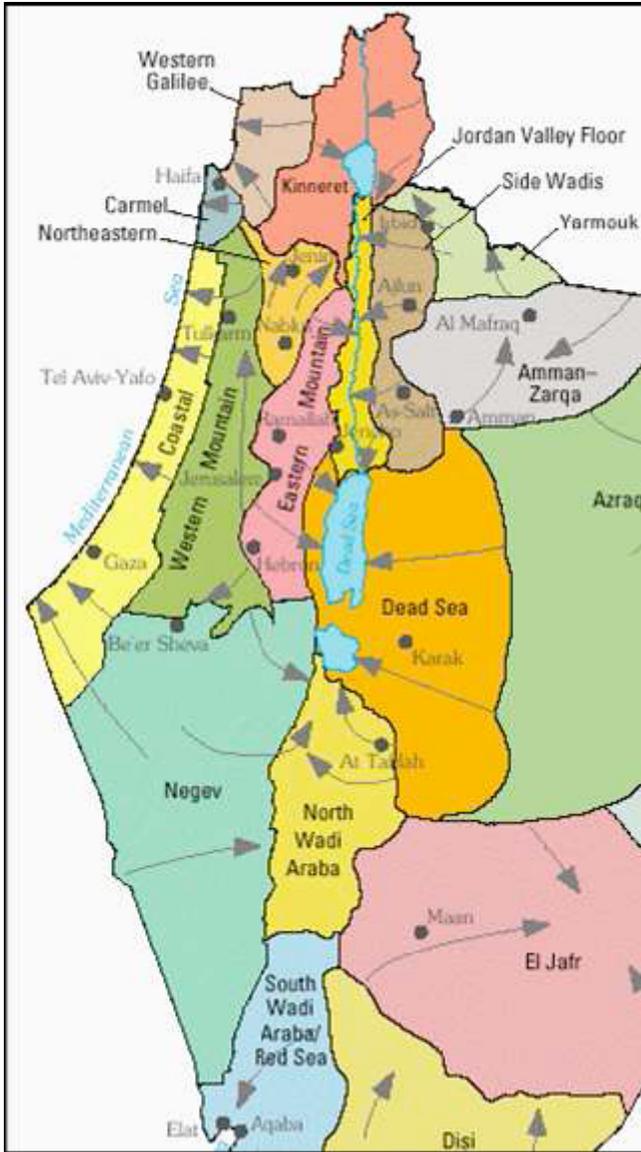


Figure 3: Water Basins in Jordan

Jordan GDP growth has increased to 3.8% and the composition of GDP by sector is ; agriculture (3.7%), industry (17.9%), and services (78.4%).

In 1995 , a comprehensive environmental law was adopted to regulate the various activities in the country in an environmentally safe manner . In 2003, the Ministry of Environment was first established by the Environmental

Protection Law # 1. The Government of Jordan considers environmental sustainability an integral component of all sectoral policies and programs. While striving for economic development, the protection and improvement of natural resources remain a priority.

### **III.2 Climate Change Adaptation Policy in Jordan**

No comprehensive national policy to address climate changes has been adopted to date.

The ministry of water and irrigation which is a major player in issues related to climate change in its latest strategy set for years 2008-2025 did not give climate change proper attention. In this strategy, climate change has been addressed once in the section related to future challenges. There it states that “Drought management and adaptation to climate change will need to be addressed through proper policies and regulations”.

In the last two decades a range of acts, regulations and measures, policies and strategies directly related to water scarcity and indirectly related to climate change are developed and even adopted.

There is a need to develop a climate change policy that is specifically geared towards more vulnerable sectors in the country and to establish a public policy, which encourages and supports adaptation at local or community level and in the private sector.

What helps in this development is sustainable economic growth, which, in return, allows for a greater allocation of resources to the development of adaptive technologies and innovations.

Climate change adaptation in Jordan as regards to water resources can be realized by

- demand management
- increasing water availability (“creation” of water):
- Desalinization
- Re-use of waste-water
- Water harvesting

#### **Important adaptation concepts**

The following are considered major concepts for adaptation to climate change:

- Mainstreaming: no stand-alone adaptation measures have to be taken, but embedding in existing policies and measures. First look at the sectoral level and then integrate (e.g. Integrated River basin Water Management)
- Stakeholder dialogues, to incorporate sectoral knowledge into the equation and to aim for broadly shared solutions.

### **Important directions of a national adaptation policy**

Several issues have to be considered to create a national adaptation policy to climate change, some of them are:

- In-depth research on climate change, its impacts on natural resources, national economy, public health and development of specific adaptation measures;
- Improvement of the systematic observation networks and environmental monitoring to revise and renew adaptation measures;
- Improvement of the system of data collection, interpretation and dissemination;
- Enhancement of weather forecasting, climate modeling and early warning systems for minimization of natural disasters risk and readiness to extreme incidents.
- Capacity building to strengthen institutional, technical and human resources to promote adaptation and research in fields of climate and hydrological investigations, geographical information systems, environmental impact assessment, protection and re-cultivation of lands, rational use of water resources, conservation of ecosystems, sustainable agriculture, infrastructure
- health protection;
- Implementation of specific projects on adaptation in priority areas related to rational use of natural resources, development of national economy and human health protection.

## **Expected outcomes of the National Adaptation Policy**

A national adaptation policy to climate change will help in combating the negative impacts on humans and on the environment caused by climate change. Some of the expected outcomes are:

- Reduction of vulnerability;
- Adaptation to expected climate changes;
- Promotion of sustainable development;
- Reduction of poverty;
- Protection of the environment;
- Institutional strengthening;
- Capacity building on climate change;
- Establishment of the legal framework to address climate change;
- Public awareness on climate change.

## **Potential Barriers to Implementation**

The main barriers to implementation of a national adaptation policy can be summarized as:

- Lack of financial resources to implement adaptation measures for climate change. As a developing country, Jordan's resources are over-stretched and limited to be able to implement adaptation programs.
- Lack of a clear and specific legal and policy framework for climate change issues in the country. There is no legal framework that has been directed to ensure that climate change issues at various levels are properly institutionalized in the planning process.
- Inadequate institutional, system and individual capacity in issues related to climate change.
- Lack of awareness of the extent of the problem as well as possible actions that could be taken, is the foremost amongst these barriers.
- Lack of incorporation of climate change impacts in developing policies, plans and programs in some of the most climate sensitive sectors (such integration is being slowly realized)

- Lack of adequate tools, knowledge and methodologies to provide guidance and advice to the decision makers . This is equally applicable at the technical level in different sectors, e.g. water management but also at the grassroots levels for the vulnerable communities themselves.
- Inadequate human resources with skills to translate strategies into action at the community level where the impacts of climate change are the greatest. This also follows coping strategies by the communities although useful they lack adaptive planning tools which are needed to empower communities to deal with new threats and risks.
- Weak private sector involvement in issues related to climate change.
- Limited understanding of best practices/ activities of what constitute to be adaptation to climate change;
- Monitoring and evaluation plans including environmental impact assessments are weak and lack practices that consider climate change implications and climate as a non-static element. Current deliberate efforts to address the problem of climate change are more reactive than futuristic.

### **III.3. Jordan ratification of climate change conventions**

1. Jordan has ratified the UN Framework Convention on Climate Change (UNFCCC) in 1994 and the ministry of environment (MOE) became the national focal point for climate change issues . Jordan started its efforts in 1996 with a program supported by the Global Environmental Facility (GEF) and UNDP for national capacity building in documenting national emissions of greenhouse gases and Jordan was able to submit its Initial National Communication (INC) in 1998.

2. Jordan ratified the Kyoto protocol in 2003 and a national committee was formed to develop project proposals and initiatives for the Clean Development Mechanism (CDM) of the Kyoto protocol.

3. The World Bank published in 2004 a report on the cost of environmental degradation in Jordan which was estimated to be 3.1 % of the GDP with a total of 205 million JDs estimated for five environmental sectors. The most significant negative impact on health and quality of life were caused by water pollution at an estimated cost of 0.71-1.24 % of the GDP. Diarrhea and mortality damages were estimated at 31 million JDs annually are caused by lack of safe drinking water and proper sanitation and inadequate domestic, personal and food hygiene.

4. The damage due to air pollution is estimated at 0.69 % of the GDP, while the cost of range land degradation is estimated at 0.46% of GDP and soil salinity at 0.14% of GDP . The cost of inadequate waste collection and coastal degradation in Aqaba is estimated at about 0.11% and 0.09% of GDP ,respectively.

5. UNDP through its global environmental facility (GEF) program is helping Jordan to enhance capacity to incorporate environmental conventions into national policies. GEF has supported the construction of a biogas reactor at Russeifa waste disposal site to reduce methane emissions and use it to produce electricity. Other projects related to minimizing GHG by reducing energy losses were also implemented . A list of projects related to adaptation to climate change is shown in Figure 4.

6. The initial national communication project (INC) project aimed at strengthening the MOE in achieving environmental commitments to international conventions and to integrate the environmental dimension into the planning processes. The project succeeded in getting funds for Jordan to prepare the Second National Communication (SCN) to the UNFCCC. It started with a preparatory phase, a self assessment exercise was performed. The main objective of this phase was to undertake a consultative process of needs assessment, and to identify and validate the critical priorities for UNFCCC implementation in the country. In August 2006, the project "Enabling Activities for the Preparation of Jordan's Second National

Communication to the UNFCCC” was started in order to prepare Jordan’s second national communication .

7. In February 2009 a work shop was held to present the results obtained by experts appointed for preparation of the project titled “Enabling Activities for the Preparation of Jordan’s Second National Communication to the UNFCCC”.

The SNC project will develop and enhance national capacities to fulfill Jordan’s commitments to conventions on a continuous basis. Also it aims at making the decision makers aware of climate change challenges to mobilize additional resources for adaptation projects.

#### **III.4. Enabling activities for the preparation of Jordan’s second national communication to the UNFCCC:**

In August 2006, the project "Enabling Activities for the Preparation of Jordan's Second National Communication to the UNFCCC” was started in order to prepare Jordan’s second national communication .

The project consists of the following main components:

(a) An inventory of greenhouse gases for the year 2000 and time series 1994- 2000;

(b) An analysis of potential measures to mitigate the increase in greenhouse gas emissions in Jordan;

(c) An assessment of potential impacts of climate change in Jordan and adaptation measures;

(d) Preparation of the SNC of Jordan .

(e) In addition to public awareness activities and stakeholder consultations that will be cross-cutting issues along the overall course of this project

A workshop was held in February 2009 ,its objectives were to publish the preliminary outcomes of the project, focusing on the following main issues:

- The National Green House Gas Inventory , including:
  - Energy including Transport
  - Industrial Processes
  - Solvent and Other Product use
  - Agriculture
  - Land-use, Land-use Change and Forestry Waste
- Measures to mitigate Green House Gas emissions
  - Primary Energy
  - Energy Conservation and Efficiency .
  - Renewable Energy.
  - Waste .
  - Agriculture .
- Measures to adapt to climate change :
  - Climatic Scenarios
  - Water recourses
  - Agriculture
  - Socio-economic
  - Health

### **III.5 Vulnerability and Adaptation (V&A) Study:**

#### **Overview**

Jordan like other developing countries has low adaptive capacity to withstand the adverse impacts of climate change due to the high dependence of a majority of the population on climate-sensitive sectors, such as agriculture and water resources sectors, coupled with poor infrastructure facilities, weak institutional mechanisms and lack of financial resources.

The following can be considered as possible impacts of climate change:

- Water stress and reduction in the availability of fresh water due to potential decline in rainfall
- Threats to agriculture and food security, since most of the agricultural activities are rainfed agriculture in most governorates
- Adverse impact on natural ecosystems, such as Jordan Valley, and coral reefs in Gulf of Aqaba, grasslands and mountain ecosystems.
- Impact on human health due to the increase in vector and water-borne diseases
- Increased energy requirements and impact on climate-sensitive industry and infrastructure.

### **V&A Study Objective**

The V& A study aims at determining potential implication of climate change on the water resources, agricultural, health sectors and socio-economic factors to be incorporated into related policies and strategies.

This study has several components , the first is to identify areas of potential vulnerability to climate change; the second is to develop a baseline and climate change scenarios; the third is to characterize potential impacts; and last but not least is to identify future strategies for adaptation to climate change including feasibility assessment .

### **The sectors covered in the V&A study are:**

- Water Resources sector
- Agriculture sector
- Health sector
- Socio-economic impacts

## **Temporal and spatial scales :**

Temporal and spatial scales have been taken into consideration:

As for temporal scale , climatic data including daily temperature, daily precipitation and other climatic factors for about 45 years are available.

Also monthly stream flow is available for the same period. While for the spatial scale, river watersheds , such as Zarqa River basin and the Yarmouk River basin which has the highest population density in Jordan are considered.

The horizon of this study might be extended till 2050.

## **DELIVERABLES OF V&A STUDY**

This study should come up with an adaptation policy to the climate change impacts occurring in the country.

Adaptation to changing conditions in water availability and demand has always been at the core of water management. Water managers have long dealt with the changing availability of water resources and changing demand ,assuming that the natural resource base is, on average, constant and, therefore, that past hydrological experience provides a good guide to future conditions.

Climate change, however, challenges these assumptions and may alter the reliability of water management systems and water-related infrastructure.

Therefore we have to deal with uncertainty and risk, due to climate variability and extreme conditions. This requires a shift in thinking if we want to keep a good health and a prosperous economy.

This shift will not happen automatically. The tasks are complex, the solutions are often far to reach and it is unclear to what extent and how quickly the climate is changing. The public authorities, the business communities, NGO's and all citizens must work hand in hand to be able to adopt. A national adaptation strategy has to provide a frame work and an integrated area oriented approach must be followed. Also adaptation in the international context among regions, countries, and socioeconomic situations should be considered.

### **III.5.1. Vulnerability and adaptation in the water sector:**

Adaptation consists of initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects.

Jordan is one of the first world's poorest countries in terms of water, with an annual per capita share of water for all purposes standing at about 110-150 m<sup>3</sup>, compared to the international water poverty line of 1,000 m<sup>3</sup> of water per person annually. The available water from existing renewable sources is projected to fall from (150) m<sup>3</sup>/capita/year in 2003 to less than 90 m<sup>3</sup>/capita/year by the year (2025).

Climate change (CC) is expected to increase the water scarcity which will reduce the per capita water share for Jordanians. There is now considerable evidence of a discernible anthropogenic influence on global climate associated with greenhouse gas (GHG) emissions.

Furthermore, it is highly likely that GHG emissions will increase over the coming decades, and that the human impact on climate is likely to continue. Nevertheless, climate change is projected to cause significant changes in the spatial and temporal distribution of precipitation. This can be expected to cause a wide range of health effects, particularly in communities either within or at the edge of deserts, where water is scarce, highly polluted or salinated, and there are competing demands from household consumption, agriculture and other industrial sectors. The quality and quantity of water supply have direct effects on health - poor water and sanitation, and malnutrition. A more flexible, qualitative, stakeholder driven approach would help to develop an integrated policy to balance competing demands on water supplies.

#### **The main objectives of the current study are:**

- To evaluate the hydrological characteristics of the two major Amman-Zarqa and Yarmouk basins.
- To investigate the impact of climate change on water resources of in these two basins.

- Identification of possible adaptation measures (Policies, Strategies, Action Plans and Sustainable Water Resources) in response to potential climate change.

The methodology followed was based on data collection in order to have a meteorological data base. This data was used for hydrological modeling, which will be used for scenarios for assessment of climate change impact in order to suggest mitigation and adaptation measures.

The main obstacle that was faced during the implementation of this work was the data availability. More specifically during the calibration phase of the work; where observed data was not easy to obtain. Furthermore the quality of the obtained observations in some records was highly suspicious. Therefore, some records with unreliable reading was deleted from the analysis. This process was done by referring to some official reports and statistics from Ministry of Water and Irrigation. Some technical problems were also faced during the work with software.

### **Amman-Zarqa River Basin**

Amman Zerqa basin is the second main tributary to River Jordan after Yarmouk River, and thus one of the most significant basins in the Country. It is located in the central part of Jordan ( Figure 3and 4) It covers an area of 3567 km<sup>2</sup> from the upper northern point to its outlet near King Talal Dam (KTD), and is part of five governorates, namely; Amman, Balqa, Jarash, Mafraq and Zarqa. It is also considered as one of the major productive ground water basins in Jordan.

### **Yarmouk River Basin**

The Yarmouk River is the second largest river in the region in terms of annual discharge and its waters are a vital resource for municipal, agricultural, and industrial needs. The watershed lies principally in the Jordan Highland, with its eastern headwaters extending to an area about 1,800 m above sea level, average annual rainfall is about 250 mm.

The area belongs to the Yarmouk River is about 6790 km<sup>2</sup> of which 1384 km<sup>2</sup> lie within Jordan. Land use in the Yarmouk watershed is primarily agricultural, with some industrial and residential use in the cities. In general, the water quality of the Yarmouk River is good.

Modeling results using different soft wares indicated that:

Runoff is expected to increase by about 5% when precipitation increased up to 10% and mean temperature increased not more than two degrees. It also increased more than 30% and 22% when precipitation increased by about 20% and mean temperature increased one degree and four degrees respectively.

Runoff is decreased more than 20% when mean temperature values increased up to four degrees and precipitation remains unchanged.

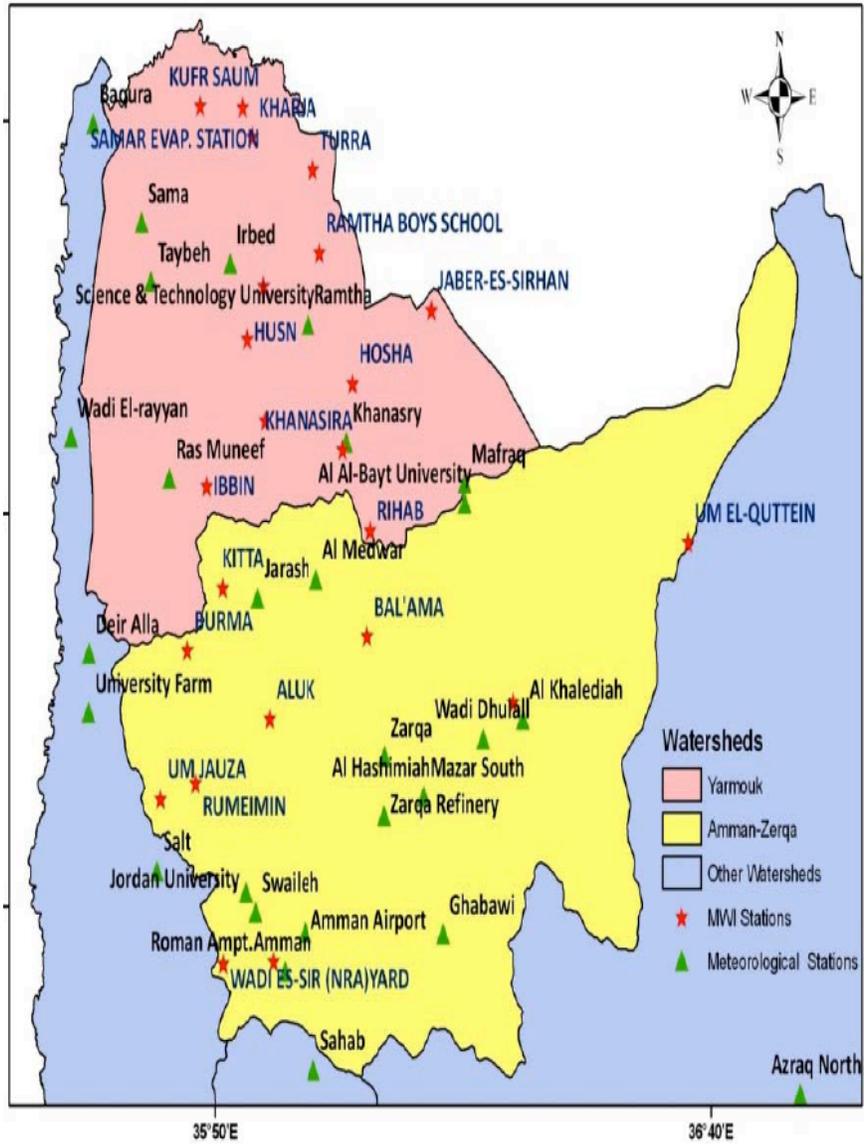


Figure 4: Ammann Zerqa an yarmouk river Basins

## **Adaptation and Mitigation Measures**

Water vulnerability and adaptation to climate change should be part of sustainable water resources management. Development policies should:

- Build on the existing policies to protect water resources, the environment and economic development against current climate (the adaptation baseline)
- Make incremental changes to the adaptation baseline to mitigate effects from the direct and indirect climate change

### **Existing Mitigation Measures:**

In its efforts to adapt and to mitigate to climate change that has been affecting water scarcity problem, the Jordanian Ministry of Water and Irrigation (MWI) issued a recent water master plan and related strategy and several policies to conserve water and seek alternative supplies. In addition to increasing water use efficiency, water harvesting systems, wastewater reuse, virtual water, and desalination were identified as potential adaptive measures to water scarcity affected indirectly by climate change.

### **Suggested Projects for Climate Change mitigation:**

Several projects were suggested to help in mitigating the climate change effects:

1. Establishing the National Center for Climate Change, Desertification and Drought Studies (NCCCDDS)
2. Identification of desertification-prone areas in Jordan based on the analysis of factors and processes causing desertification.
3. Water harvesting and treatment of house hold wastewater (Grey Water)for irrigation of house yards.
4. Supporting the Sustainable Monitoring of Environmental Degradation in Jordan .

### **Climate change scenarios study conclusions:**

- The majority of the stations exhibit slight decreasing trends in precipitation time series. While some other stations exhibit insignificant increasing precipitation trends.
- Temperatures reveal significant warming trends at 99% confidence level in most of the stations.
- The significant warming trends of minimum temperature are too much greater than that of maximum temperature.
- All the future scenarios for the period 2005 -2050 show an increase in temperature of less than 2°C. The warming was found to be stronger during the warm months of the year while less warming is projected to occur in the cold months of the year.
- The climate change scenarios for precipitation are highly variable.

### **III.5.2. Adaptation of the Agricultural Sector:**

Adaptation in the agricultural sector can be active or proactive and can take place at the farm level (autonomous) or the decision maker level (planned).

The barriers to adaptation can be attributed to lack of knowledge and communication and to economic factors.

General adaptation measures in the agricultural sector can be summarized as:

- Modification of cropping pattern.
- Modification of crop calendar including planting and harvesting dates.
- Implementation of supplemental irrigation and water harvesting techniques.
- Change in land topography and use of artificial system.

- Improve water use efficiency and use of treated waste water for irrigation.
- Use of different crops varieties
- Modification of policies and implementation of action plans
- Strengthening the capacity of local communities to implement plant breeding programs and develop locally-adapted crops

The first six points are considered autonomous adaptation , while the last two are planned adaptation activities.

## 2.2. Planned adaptation:

**Program 1:** Climate change legislation and policy.

Project 1:Review and update of policies

Project 2:Capacity building for mitigation and adaptation

**Program 2:** Assessment and monitoring of vulnerability

Project 1:Mapping and assessment of agro ecological zones.

Project 2:Early warning and risk management systems

**Program 3:** Knowledge management and technology transfer

**Program 4:** Rehabilitation of livestock systems and rural livelihoods.

### **III.5.3.Climate Change Effect on Socio-Economic Factors in Jordan**

A study on the effect of climate change on the socioeconomic factors was carried out with the following objectives:

- To review social and economic scenarios relevant to climate assessments (mitigation and adaptation) in Jordan;

- To assess the needs of different communities of users for socio-economic scenarios in climate change assessment and decision-making;
- To tailor existing social and economic scenarios for climate assessment and decision-making;
- To propose further research on social and economic scenarios in climate research and policymaking.

### **The role of Socio economic variables in climate impact assessment:**

Two socioeconomic indicators can be used in climate impact assessment:

- One is as an indicator of economic and social conditions that might be influenced by climate. Climate impacts on society can be described by changes in such indicators.
- The second is an indicator of socioeconomic drivers that directly or indirectly influence sensitivity and vulnerability to climate change. For example, population and income growth increase the demand for water and water quality, which has implications for the assessment of impacts of climate change on water quantity and quality .

The main problem facing this part of research is the un-availability of data in proper forms. Required time series data are mainly available at the Governorate level, the Available time series data are only for population, income, consumption and GDP from Agriculture, and governorate data could not be used in evaluation of climate change on socio-economic aspects due to large differences in these aspects within the governorate.

Models were built to describe the effect of the climate change on the socio-economic factors. Time series data for some parts of the studied areas were collected used to run different types of models, but unfortunately, no significant results could be achieved .

Due to problems that were faced in data and information collection, it was decided to conduct a limited field survey, and conduct qualitative and descriptive analysis. The field survey was conducted according to the following methodology:

Three groups were met and interviewed in the three related governorates, Irbid, Jarash and Mafraq, since these governorates are located in the two study areas.

The first group is the policy makers: the governor, head of the development department of the governorate, head of government departments in Irbid and Mafraq Governorates.

The second group is composed of farmers in Irbid and Mafraq Governorates, who were divided into two subgroups: Plant production and livestock production. The focus group technique, with a pre-structured questionnaire was used and implemented for the first two groups.

The third group was households: for this group: a 61 households sample from the community was selected, i.e. Irbid 30 households, Jarash 13 households, and Mafraq 18 households. They were selected randomly from a list of poor people who receive aid from the National Aid Fund. A questionnaire was prepared for this purpose .

Analysis trials were conducted relating the precipitation with two socio-economic factors in Mafraq governorate, i.e. annual household income, annual household consumption .Mafraq Governorate was chosen because all of its cities and villages are included in the two project areas, i.e. Zarqa River Basin and Yamouk River Basin. Moreover, the level of Precipitation in this governorate is fluctuating and generally low.

The field survey showed that the highest income, according to its source, in Jarash and Ajlune, which are parts of Yarmouk River Basin, was the government salaries, in Mafraq, the highest was through foreign remittances, while in Irbid they got the highest income from selling field crops. The largest part of the income goes to buying clothes then for social activities in all the governorates.

The government of Jordan partially compensates the farmers who are hit with frost by paying money according to the reports prepared by the assessment committees. Moreover, it partially compensates livestock owners by providing them with small quantities of barley, at subsidized prices. The Government does not compensate for other climate hazards such as drought, snow or floods, except when general severe drought condition is declared by the Cabinet.

The main effect of climate change factors on the respondents in the urban areas is shortage of water which affects the sanitary conditions in the households, thus increases some kinds of diseases such as diarrhea, and the increase of costs of living.

The impact of climate change on public health could be summarized as follows: 1) The results of the study showed that climate change causes the emergence of many diseases, especially due to high temperature. 2) There was considerable impact of the climate change on water availability for sanitary purposes in the houses, 3) To address the problem of lack of clean water, caused by low level of rain, the urban dwellers buy water from tankers, while some of them increased the periods between cleaning the house, which may cause some health hazards .

As the income decreases, or the purchasing power of income decreased, some of the urban people start reducing spending on health and education to cope with rising commodity prices caused by the climatic changes .

Influence on the exploitation of home gardens could be summarized as follows:

- 1) Low level of rain causes low level of water distribution to the houses, which causes decreasing the level of producing in the home gardens,
- 2) The Water Department in the Municipalities in drought years reduces the quantities of water delivered to houses.

Some of the farmers interviewed indicated that they do not receive contemporary climate information. The majority of those who receive information do not use it in their farm decision process. The reason they

gave was that contemporary information is too general and not specific in time and space ■

The effect of climate change on the livestock sector could be summarized as follows: 1) It has impact on the price of fodder availability, since poor rains leads to higher prices of feed and low available quantities of water which cause rising in production costs, 2) Lack of water for producing fodder and feed crops causes high prices for these products, 3) Some farmers who own livestock continued cultivation the land to feed their animals in low-rain seasons, 4) The lack of wild grasses in drought years increases reliance on purchased fodder, which makes some herders sell part of their animals at low price to buy feed for the rest of the flock, 5) In drought years the livestock owners feed their animals on the vegetable farms roughages.

The farmers and livestock owners suggested the following solution for climate change adaptation: 1) Securing affordable fodder for livestock breeders, 2) The formation of associations for cultivating fodder in areas with available water to secure fodder for the rest of the Kingdom, 3) Allowed to dig boreholes to provide water for agriculture and livestock, 4) Encourage the cultivation of fodder in the adjacent land to the Zarqa River which is mixed with treated wastewater, 5) Support the farmer to encourage using drip irrigation to decrease irrigation water quantities, 6) Provide support to the farmers in drought years to encourage them to stay .

### **Recommendations:**

1– Establishing a Climate Information System (CIS): this will be the main regional mechanism for providing seasonal climate forecasts to policy makers and for disseminating climate information to users, including farmers.

The system should bring together climate scientists, operational forecasters and end-users. Climate outlook guidance will be agreed and the implications

for climate-sensitive sectors should be discussed. The guidance should be presented in terms of probabilities of rainfall being in the ranges of previous dry or wet years. The System will help to develop links and mutual understanding between meteorologists and end-users of seasonal forecasts and will stimulate the development of national seasonal predictive capacity in Jordan. They will also raise awareness of the issues of inter-annual climate variability and climate change and provide advice for adaptation activities.

Climate information can generate substantial benefits in other areas as well, including water management, planning and delivery of health services, and improved warning for extreme weather events.

2. Enhance the knowledge of the poor and adaptation methods to face the climate change through training people of different ages and social status on water saving and sanitation methods.

3. Given the centrality of growth to poverty eradication, there is a need for measures aimed at minimizing climate's negative impacts on a country's growth strategy. This could be achieved through: Governments can attempt to increase the resilience of their growth strategies through implementing effective adaptation policies to both short-term and long-term impacts of climate on their economies; climate issues should be mainstreamed into national economic planning and budgetary processes; climate adaptation activities should be integrated in the budget framework of the development projects; effective adaptation strategies are facilitated by responsive and accountable public institutions;

4. Follow up some adaptation measures in Agriculture and food Security, such as dam construction, soil fertility maintenance, and educational and outreach programs on conservation and management of soil and water.

5. Provide the necessary resources to establish a "Climate Change Watch and Early Warning System" for the timely alert and preparedness of the country.
6. Accord due attention and consideration to the socio-economic dimension of drought within the framework of the "Preparedness and Mitigation Plans", which should be comprehensive and integrated to address rehabilitation and development, including rangeland, livestock, forestry and crop production
7. Establish a "National Disaster Fund" to farmers and introduce policy measures to ensure the equity in access to water .
8. Institutional capacity needs boosting through provision of better equipment and more personnel training. Moreover, there is a need to improve networking among the institutions that deal with climate and drought forecasting and management.

The socio-economic study suggested three related programs, they are:

1. Conduct detailed analysis of the effect of climate change on the socio-economic factors, a comprehensive field survey should be conducted in areas that are vulnerable to climate change. In this case, cross sectional data analysis could be conducted comparing the different socio-economic factors in different areas in the Governorate with different levels of precipitation. The cost of the program depends on the size of the study area.
2. Vulnerability and Adaptation to Climate Change workshop (A Training of Trainers)

The purpose of this workshop is to increase the participants understanding of climate change issues, such as mitigation and adaptation, as well as their understanding of the impacts that climate change will have on development goals .

### 3. Strengthen National Capacity to Manage Drought Efficiently

#### **III.5.4. Adaptation in the health sector:**

The actual disease burden attributable to climate change in Jordan is not known.

Environmental and health data sets are poorly matched and methods for analyzing the relationships between them have not been applied locally. The overall susceptibility of the Jordanian population to environmental health concerns had been decreased in recent years , this might be attributed to:

- improvement in health facilities access
- improvements in the environmental conditions,

Climate change ( change in precipitation patterns, temperature, humidity, wind , solar) can have many impacts on health, some of these are:

- physiological disorders,
- Dermatological disorders
- Dehydration,
- Damage of public health infrastructure,
- Changing in Mortality rates deaths and injuries.
- Increasing water borne diseases such as cholera, Typhoid, Hepatitis A
- Increasing of endemic vector borne diseases leshmaniasis
- Emerging or reemerging of infectious diseases Such as Malaria, West Nile Fever, Rift Valley changes in climatic conditions
- Changing in the rates of Respiratory, Cardiovascular and Digestive system diseases .

#### **Study Design:**

##### **1. Ecological study:**

Study the available data, to identify the relationships between climate variables and actual health outcome.

## **2. Population Study:**

Usually ecological studies are performed on a national or regional scale, the whole population was assumed to be exposed to climate change because of the small size of the country, and the relatively small population who are clustering in the middle and northeast of the country.

### **The objectives of this component were:**

- To identify secular trends
- To characterize the complex associations between exposure to climate variables and public health outcomes from the available data
- To correlate health outcomes with Monthly maximum temperature (MMT).
- To quantify effects of climate change on health.
- To determine the attributable burden of weather and climate change on health.

### **Methodology:**

Time series were analyzed retrospectively on monthly bases and correlated retrospectively to monthly maximum temperature. Linear regressions were performed, to quantify effects of climate change on health and to determine the attributable burden of climate change on health.

In spite of the temperature increase, the incidence rate of diarrhea decreases. This could be due to sanitation improvement, and more coverage of areas served with the sewage system, chlorination of drinking water and development of primary health .The incidence rate for diseases under the study “diarrhea, Hepatitis A, Typhoid Fever and Leshmaniasis” reveal decreasing in secular trend through the period 1988-2007.

The most important effect of climate change in Jordan is shortage of water, due to increasing temperature and decreasing rainfall.

One of the adaptation measures to cope with shortage of water is reuse of grey or treated wastewater in growing some trees or vegetables that are not consumed without cooking. This adaptation measure increases the

opportunity for transmission of several pathogens through contamination of crops and could cause outbreaks like Typhoid fever, Amibiiasis, Giardiasis, or Hepatitis A.

To verify the impact of using the grey water or treated waste water on health , two specific zones from Zarqa health directorate were chosen:

-Sukhneh which is close to As-samra wastewater treatment plant and could use the effluent in irrigation

-Dhuleil which is far away from the treatment plant.

Although of the approximately equal incidence of Diarrhea 16/1000 at Sukhnehand 18/1000 at Dhuleil, the results obtained prove that there is no correlation between digestive tract diseases and the MMT at Sukhneh, that could be due to ongoing contamination of water from the nearby wastewater treatment plant and using the treated waste water to cope with shortage of water as a result of rainfall decrease.

### **Limitations:**

- Most of health outcomes have multi factorial causes, which may limit the predictability of the health outcome.
- No known base line data, studies or models to verify the results and perform comparisons are available
- “improvement of environmental sanitation” which masks the incidents that might be attributed to climate change
- Ecological studies indicate association but couldn’t prove the causality between exposure and disease.
- Reliability of data health registry system in Jordanian uses records that are based on disease groups, which do not have detailed information.
- Time and financial issues limit the study to one climate variable and one age group.

### **Recommendations:**

- Expand the analysis to other climate variables.
- Conduct in depth analysis to explore the trend and correlate it to environmental health determinants.
- Conduct a retro –prospective study at hospitals to collect the necessary data on weekly bases; also at eight sentinel health centers to collect detailed data on diagnosis, age group, to study the effect of climate variables.
- Evaluate the recording health system in MOH and create new one using separate code for each disease to replace the existing one based on disease groups .

### **Adaptation Measures in the Health Sector:**

No specific guidelines for adaptation measures are available. The health issue is cross cutting with all other sectors. Therefore, there is need for integrated multidisciplinary approach.

Health impacts depends on impacts of climate change on water resources, water management and water transport in addition to the infrastructure in the country. The following issues should be addressed:

- Coping the impacts of climate change on human health.
- Improvements in environmental practices,
- preparing disaster management plans
- improving the public health infrastructure
- Strengthening disease surveillance
- Enhancement of emergency response capabilities.

### **Adaptation Strategies:**

The following are suggested to be able to adapt the health sector to climate change:

1. Strengthen surveillance and establishment of highly sensitive alert and any other climate sensitive diseases system by developing of health forecast system for acute respiratory diseases.
2. Prevention and control of emerging and reemerging vector-borne

diseases(Malaria, Hemorrhagic fever)

3. Strengthen existing emergency plans and disaster management for national surveillance monitoring system,
4. Formulation and implementation of policies for disasters
5. Support and strengthen preventative health programs and projects within public health divisions that emphasize on community involvement projects
6. Improve monitoring systems such as permanent monitoring of the drinking water quality; permanent monitoring of water supply and sewage systems,
7. Establishment of data base using geographical information system (GIS) for creating multi layers maps (host, vectors, reservoirs, surface water ...) to facilitate monitoring.
8. Ongoing environmental care through sustaining and improving sanitary conditions and encourage development of proper waste disposal to minimize existence of vector breeding habitats
9. Capacity building and increasing awareness through regular training workshops on sanitary education for the population.
10. Undertake research at population and individual levels to provide a solid data basis for formulation of adaptation strategies.

### **III.6 A Joint program On Adaptation to Climate Change to Sustain Jordan's MDG Achievements**

As a result of the project related to “Enabling activities for the preparation of Jordan’s second national communication to the UNFCCC V&A to climate change studies”, several projects have been suggested in the second national communication (SCN) . The above mentioned program: “**A Joint program On Adaptation to Climate Change to Sustain Jordan’s MDG Achievements**” was suggested to adapt to climate changes in the water , health, and agricultural sectors.

The Proposed Joint Program is funded by the Spanish Government and is conducted jointly by UNDP, FAO, WHO, and UNESCO for a total of 4.2 million dollars.

This joint project includes two overall objectives to achieve the outcomes identified by the program stakeholders; The first objective aims to secure reliable sources of water supply in spite of potential pressure due to climate change through adopting water resource management plans that ensure more water supply to health and food production; while the second objective focuses on adopting suitable mechanisms for adaptation to climate change in food production and health. To achieve its objectives, the program will adopt the following modalities:

- a) It will adopt a participatory approach in implementing the different program activities. This joint project will be implemented in partnership among the four UN agencies and with their governmental partners. In addition to creating and enhancing partnerships with the NGO's and local community institutions working in the target area. Stakeholders will be involved in all project stages from planning throughout the final impact assessment stage.
- b) Public awareness campaigns and outreach will be conducted to promote the project concepts, generate knowledge and capture lessons learnt from the implementation of different activities.
- c) The program includes an extensive training and capacity building scheme for the local community and governmental partners to ensure sustainability and long term impact.
- d) Development of policy and legal frameworks to support the implementation and institutionalization of the adaptation strategies.

The program objectives will address the root causes of water scarcity through sustaining access to water supply and strengthen adaptive capacity of food production and health sectors to climate change. The joint program includes six outputs which will be achieved through implementing 27 activities, over three years. The six outputs will be implemented by the following institutions: Ministry of Health, Ministry of Water and irrigation, Ministry of Agriculture, Ministry of Environment , local municipalities and NGOs.

## **Summary of Results Framework:**

This JP will develop Jordan's key government and civil society counterparts' capacity to adapt to climate change threats to health, food security, productivity, and human security under the conditions of severe water scarcity that is expected to be compounded by climate change. This joint program seeks to enhance capacity to adapt to climate change by addressing Jordan's long-term adaptation needs through the following outcomes and outputs :

### **Outcome 1: Sustained access to improved water supply sources despite increased water scarcity induced by climate change**

- Output 1.1: National drinking water quality management system at central and periphery level is strengthened: The activities will concentrate on upgrading the national drinking water management systems, increasing the capacity of the national partner staff and improving the working environment for water quality monitoring system.
- Output 1.2: Sustainable and reliable supply of minimum water requirements for health protection is provided to all citizens. The activities under this output will include inventories to identify the minimum water requirements and the development of policy instruments for securing the supply of these requirements.

### **Outcome 2: Strengthened adaptive capacity for health protection and food security to climate change under water scarcity conditions**

- Output 2.1: Rural sector adaptive capacity for climate variability and change is improved: The activities include the

risk assessment of climate change and water scarcity and identification of the adaptation measures to reduce climate change impacts on food (land and water) productivity and control of desertification. In addition to a public awareness campaigns for local community to promote these measures on the target areas.

- Output 2.2: National institutional and community capacity in integrated water resources management is improved: The activities will include development of awareness in available economic incentives to farmers and agricultural policy frameworks that support and realize carbon benefits in Good Agricultural Practices. The activities will also concentrate on the capabilities of the local community institutions and the introduction of water resource management concepts into the school and University curriculum.
- Output 2.3: Adaptation measures, by health sector and other sectors, to protect health from climate change are institutionalized: Activities to achieve this output will focus on assessing the direct and indirect risks of climate change on health sector. Adaptation strategies will be developed and early warning system will be established to protect health from the negative effect of climate change.
- Output 2.4: Adaptation capacity of Zarqa River Basin to climate change is piloted and strengthened: The activities will include the assessment of direct and indirect effects of climate change on water availability and quality in Zarqa River Basin; identify opportunities and barriers to adaptation to climate change; review and deliver reform strategies for legal and institutional frameworks and national water policies and action plans; build local and national capacities for adaptation to climate change using participatory approach; and document and share knowledge generated from the Zarqa River Basin and establish linkages to regional and global experiences.

The following table lists the past and ongoing projects related to climate change, duration of each project , the funding sources, and the aim of each project are also listed.

**Table 1:Past and Ongoing Projects Related to Climate Change**

<b>Name of Project</b>	<b>Duration</b>	<b>Funding Sources</b>	<b>Aim</b>
<b>Initial National Communication</b>	<b>1996-1998</b>	<b>GEF,MOE</b>	<b>Prepare the first national communication on climate change</b>
<b>Top-up enabling activity</b>	<b>2004-2005</b>	<b>GEF,MOE</b>	<b>Develop technology needs assessment and technology transfer</b>
<b>Vulnerability study</b>	<b>1999-2001</b>	<b>GEF, MOE</b>	<b>Prepare a study on vulnerability and adaptation of selected sectors to</b>

			<b>climate change</b>
<b>Renewable energy</b>	<b>2005/15months</b>	<b>Japanese grant/World Bank</b>	<b>Barriers removal through resource assessment and regulation of renewable energy in Jordan</b>
<b>National capacity self-assessment</b>	<b>2004-2006</b>	<b>GEF, MOE</b>	<b>Capacity needs in three areas of the convention(climate change, biodiversity, and desertification)</b>
<b>Energy conservation</b>	<b>2005/12 months</b>	<b>Japanese fund, World Bank</b>	<b>Study of energy audits in selected industrial and commercial enterprises in Jordan</b>
<b>Geothermal energy</b>	<b>2005/8 months</b>	<b>Japanese grant/World Bank</b>	<b>Technical and economic evaluation of geothermal drilling data for energy application in Jordan</b>
<b>Wind energy</b>	<b>2005/9 months</b>	<b>Japanese grant/World Bank</b>	<b>Feasibility study of commercial wind energy in Jordan</b>
<b>Enabling Activities for the Preparation of Jordan's Second National Communication to the UNFCCC</b>	<b>2006-2008</b>	<b>UNDP</b>	<b>Preparation of Jordan's second national communication</b>
<b>Adaptation to climate change to sustain Jordan's MDG achievement</b>	<b>2009-2013</b>	<b>UNDP, UNESCO, FAO, WHO, MOE, MWI, MOH</b>	<b>Secure reliable water resources in spite of pressure due to climate change and adopting suitable mechanisms for adaptation to climate change in food production and health.</b>

### **III.7. Improvements as a result of mitigation measures:**

Environmental issues have become a priority for Jordan, especially since the establishment of environmental NGOs and of the Royal Society for the Conservation of Nature in 1966. Moreover, an independent Ministry of Environment was established in 2003 to tackle Jordan's environmental

challenges. Jordan has also drafted and issued a number of laws and regulations in various environmental fields which includes articles dealing with environmental issues.

Environmental indicators show that the percentage of wooded areas in Jordan has increased from 0.44% in 1990 to 0.84% in 2002 and that protected areas for biodiversity cover 0.44% of Jordan's total land surface area. The proportion of the population with access to safe drinking water through a public network reached 97% in 2002, while the proportion of households connected to sewage networks reached 60.1% for that same year. Jordan's consumption of ozone depleting substances has dropped from 835 tons in 1990 to about 251 tons in 2001. Some studies carried out on air quality in certain areas show that overall lead concentration during 2002 reached an average of 0.23 micrograms per cubic meter of air compared to the 0.50 level permitted by international standards.

Despite such progress, the complexity of Jordan's environmental problems calls for a stronger commitment especially regarding the institutional legislative framework, the amount of resources allocated to ensure environmental protection, the coordination between policies and strategies and the availability of a comprehensive environmental database. Water will continue to be a major challenge given the very limited water resources in Jordan. Also of concern is that a significant area of land, approximately 60 million squared meters, is known or is suspected to be mined. In a country starved of arable land and water, the development challenges posed by the presence of these landmines are significant.

### **III.8. Measures to be taken for adaptation to climate change issues**

In its development report, the UNDP describes climate change as the "defining development challenge of the 21st century". Although some people

are questioning that, climate change is occurring , it is the gradual (or even abrupt) change, by human interference, of natural processes that together determine the climate . It is a complex problem, with many stakeholders and it has to be approached as a risk problem. Adaptation measures have to be incorporated now to drinking water supply, irrigation, river basin management, transboundary water management, coastal zone management, etc . We have to encourage implementation of Integrated Water Resources Management approach that takes adaptation to climate change into consideration.

Jordan has endorsed the 2008-2022 national water strategy . This strategy plans for water which is the most crucial issue for the development of all sectors in the country. The preparation of the water strategy did not follow a participatory approach which could have guaranteed a better national ownership of the outcome. It is hoped that the development of implementation phase will take all stake holders into consideration.

Impacts of climate change have already been documented in many parts including fragile economies and ecosystems of developing countries like Jordan. The first steps towards combating climate change effects were conducted through the “Second National Communication to Climate Change Convention”, which was prepared by the Ministry of Environment relying on the accumulated knowledge of Jordanian experts. Trend analysis of the impact of climate change on the water sector, the agricultural sector, health sector and socioeconomic issues has been performed in this study. The main findings about the water sector’s vulnerability to climate change is worrying.

Climate change trends in Jordan have been studied in Amman Zerqa basin and Yarmouk basin because these two basins are the most highly populated basins and they contain many of the important water resources in the country. The trends show an increase of two degrees in the coming 40 years. In addition, a decline in rainfall in Jordan has been projected by modelling analysis .. The results indicate a significant change in spatial and temporal distribution of precipitation by about 20 per cent. However, the inconsistency of historical data has not allowed to develop a comprehensive future scenario.

The way in which Jordan responds to the challenges of climate change in the water sector is crucial. The expected water situation in the Kingdom is alarming. This is a known fact, but the impact of climate change on these fragile water resources is not receiving the necessary attention in a poor water country like Jordan. For example in the new adopted water strategy, adaptation to climate change was mentioned but not stressed, and no plans for mitigation measures have been described. To be able to adapt to climate impacts, the following barriers have to be overcome:

- Lack of financial resources to implement adaptation measures for climate change. As a developing country, Jordan's resources are overstretched and limited to be able to implement adaptation programs.
- Lack of a clear and specific legal and policy framework for climate change issues in the country. There is no legal framework that has been directed to ensure that climate change issues at various levels are properly institutionalized in the planning process.
- Inadequate institutional, system and individual capacity in issues related to climate change.
- Lack of awareness of the extent of the problem as well as possible actions that could be taken, is the foremost amongst these barriers.
- Lack of incorporation of climate change impacts in developing policies, plans and programs in some of the most climate sensitive sectors (such integration is being slowly realized)
- Lack of adequate tools, knowledge and methodologies to provide guidance and advice to the decision makers. This is equally applicable at the technical level in different sectors, e.g. water management but also at the grassroots levels for the vulnerable communities themselves.
- Inadequate human resources with skills to translate strategies into action at the community level where the impacts of climate change are the greatest. This also follows coping strategies by the communities although useful they lack adaptive planning tools which are needed to empower communities to deal with new threats and risks.
- Weak private sector involvement in issues related to climate change.
- Limited understanding of best practices/ activities of what constitute to be adaptation to climate change;

- Monitoring and evaluation plans including environmental impact assessments are weak and lack practices that consider climate change implications and climate as a non-static element. Current deliberate efforts to address the problem of climate change are more reactive than futuristic.

To do so, Jordan must first identify all potential impacts on the water sector in different parts of the country and not just two basins. Adaptation measures that respond to the real, scientifically-based challenges have to be defined. The assessment study by the Ministry of Environment identified a few adaptation measures: reduction of water loss in distribution pipes; introduction of water saving technologies, water harvesting; and the reuse of treated wastewater as a resource for irrigation.

Jordan started taking its first steps in adaptation measures with the new program “Adaptation to Climate Change to Sustain Jordan’s Millennium Development Goal Achievements”. This program is funded by the Spanish government and implemented by UNDP, UNESCO, WHO, and FAO working together with the ministry of environment, the ministry of water and irrigation, ministry of health, and the ministry of agriculture. The program focuses on the water sector aiming to sustain access to improved supply sources despite increased water scarcity induced by climate change and enhancing adaptive capacity for health protection and food security to climate change under water scarcity conditions. This program will be the first integrated effort in the Kingdom to incorporate climate change adaptation in natural resource management and is expected to set the standards and norms for future action. It is hoped that through such programs, genuine scientific data about climate change impacts will be available for decision makers to incorporate adaptation measures in an integrated manner into their plans and decisions.

Involvement of all stakeholders in development of and implementation related to climate change adaptation has to be encouraged. NGOs and media can play a vital role in the awareness programs and dissemination of information related to this issue.

Transboundary water management on the basin level based on benefit sharing could help eradicate climate change impacts in the shared water basins.

Researchers at universities should be encouraged to conduct researches related to climate change. Submitting of proposals to funding agencies that support projects related to climate change has to be encouraged. For example, this year and in its PF7 initiative, the European Community requested proposals related to climate change.

Scientists from the LEVANT should cooperate in submitting joint proposals to funding agencies. Such cooperation projects have better chances of getting funded.

Capacity building in the area of climate change is highly needed on a regional level. Regional training courses and specialized work shops would help in changing experiences in the mitigation measures used to adapt to climate change.

#### **IV. Mapping of institutions and Researchers working on climate change issues:**

The following institutions are involved one way or another in climate change issues:

1. Ministry of Environment : The focal point on climate change issues in the country .
2. Ministry of water and Irrigation.
3. Ministry of Planning.
4. Ministry of Health
5. Ministry of Agriculture

## 6. Universities:

- Jordan university of Science and Technology
- University of Jordan
- Hashemite University
- Balqa University

## 7. Funding agencies :

UNDP, USAID, EU, UNESCO, FAO, WHO, SIDA

## 8. NGO's: Royal society of conservation of nature (RSCN),

Mercy Corp, Friends of the Earth.

The following researchers worked on producing the vulnerability and adaptation to climate change as a preparation for the second national communication report (scn):

**V & A Team Leader Dr. Fayez Abdulla** [fabdulla@just.edu.jo](mailto:fabdulla@just.edu.jo)

**Dr. Muwffaq Freiwan** Jordan's Meteorological Department

[mfreiwan@yahoo.com](mailto:mfreiwan@yahoo.com) 07-77971408 ( meteorology)

**Eng. Muawia Samara** Water Authority of Jordan [muawia\\_samarah @mwi.gov.jo](mailto:muawia_samarah@mwi.gov.jo) 07-88273331 ( water resources)

**Dr. Nezar Atalla Hammouri** The Hashemite University [nezar@hu.edu.jo](mailto:nezar@hu.edu.jo)  
[nezarh@gmail.com](mailto:nezarh@gmail.com) 7 85799061 ( water resources)

**Dr. Jawad Al-Bakri** University of Jordan [jbakri@ju.edu.jo](mailto:jbakri@ju.edu.jo) 07-77484466  
4.(agriculture)

**Dr. Sami Sheikh Ali** Ministry of Health [saadshali@hotmail.com](mailto:saadshali@hotmail.com) 07-77741648 5. (Health

**Dr. Samir Al-Habab** University of Jordan [samirhabbab2000@yahoo.com](mailto:samirhabbab2000@yahoo.com)  
07-95657017 (socio economy).

There are other people who are active in this area either directly or indirectly, the following is a list of some of them:

Raafat Asi: Ministry of Environment

Munjed Al-Sharif ; JUST and is the director of the new project : “  
Adaptation to climate change to sustain Jordan’s MDG achievements

Ziad Al-Gzawi: JUST

Adnan Al-Salihi: University of Jordan

Muhammad Shatanawi: University of Jordan

Abdel-Aziz Al-Weshah : private sector

Batir Wardaman: environmental researcher and communicator, can be reached at [batir@nets.jo](mailto:batir@nets.jo).

## V. References

1. Impact of climate change on the monthly runoff of a semi-arid catchment: Case study Zarqa River Basin (Jordan), Faye A. ABDULLA and Abbas S. AL-OMARI, Journal of Applied Biological Sciences 2 (1): 43-50, 2008

2. The Hashemite Kingdom of Jordan ,The General Corporation for the Environment Protection(GCEP), Initial Communication Report under the UN Framework Convention on the Climate Change , Volumes 1, and 2 ,January 1997

3. Mitigation of methane emissions from sanitary landfills and sewage treatment plants in Jordan, Ziad D. Al-Ghazawi & Faye A. Abdulla, Clean Techn Environ Policy, DOI 10.1007/s10098-008-0145-8

4. Water strategy of Jordan 2008-2022

5. Jordan Times, a Jordanian daily news paper, July, 2009

6. Ministry of Environment. Home Page:

<http://www.moenv.gov.jo>

7. Ministry of Planning and International Cooperation:  
<http://www.mop.gov.jo/>
8. Ministry of Energy and Mineral Resources :  
<http://www.memr.gov.jo/>
9. Ministry of Water and Irrigation :  
[http:// www.mwi.gov.jo](http://www.mwi.gov.jo)
10. Global Environment Facility GEF:  
<http://www.gefweb.org/>
11. United Nations Development Program- Jordan Country Office :  
<http://www.undp-jordan.org>
12. United Nations Framework Convention on Climate Change  
UNFCCC: <http://www.unfccc.int>
13. The Intergovernmental Panel on Climate Change IPCC:  
<http://www.ipcc.ch/>
14. National Communication Support Program NCSP:  
<http://ncsp.undp.org/>
15. United Nations Environment Program - UNEP :  
<http://www.unep.org/>
16. National Communication Support Program NCSP Guidance  
handbooks: <http://ncsp.undp.org/reports.cfm?projectId=3>

17. Second National Communication web site :  
<http://www.snc.gov.jo>

18. UNDP Human Development Report 2007.