

THE HASHEMITE KINGDOM OF JORDAN

**Adaptation to Climate Change
In the Zarqa River Basin**

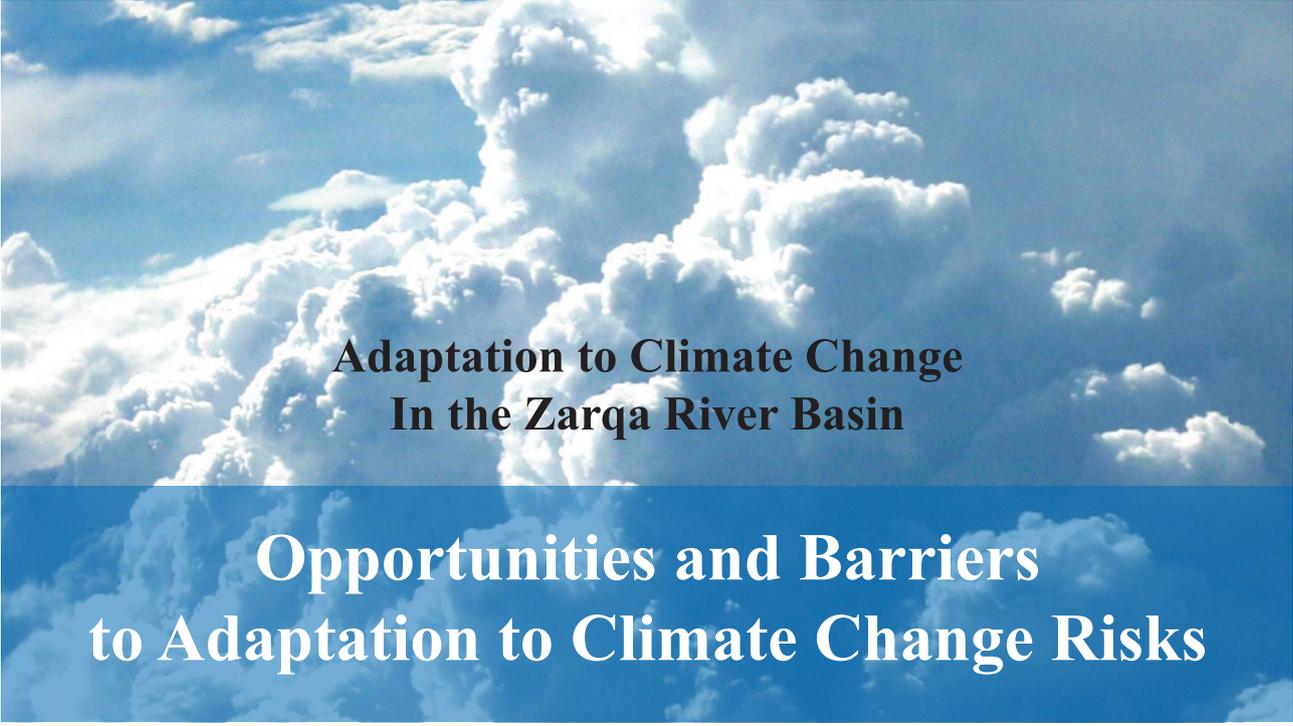
**Opportunities and Barriers
to Adaptation to Climate Change Risks**



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Foreword

Jordan is classified as one of the four most water scarce countries in the world. The National Agenda that sets Jordan's development vision till 2015, as well as the United Nations Development Assistance Framework (UNDAF) document (2008-2012), stress that Jordan's remarkable development achievements are under threat due to the crippling water scarcity, which is expected to be aggravated by Climate Change. The UNDAF (2008-2012) addresses four key related challenges to sustain progress towards the MDGs, which include: (i) water scarcity; (ii) drinking water supply security and quality; (iii) health, agriculture and food production vulnerability to Climate Change; and (iv) vulnerability of local biodiversity to Climate Change.

Jordan's Initial National Communication (INC) to the United Nations Framework Convention on Climate Change (UNFCCC) foresees that over the next three decades, Jordan will witness a rise in temperature, drop in rainfall, reduced ground cover, reduced water availability, heat-waves, and more frequent dust storms. The Second National Communication (SNC) to the UNFCCC identifies water as a priority area.

There are several barriers to water sector adaptation to Climate Change that threaten the sustainability of Jordan's achievement of the MDG targets, these include: (i) Climate Change risks not sufficiently taken into account within sectoral policies and investment frameworks; (ii) existing climate information, knowledge and tools are not directly relevant for supporting adaptation decisions and actions; and (iii) weak national capacity to develop sectoral adaptation responses. Jordan's success in adapting to increased water scarcity and related threats to health, food security, productivity, and human security induced by Climate Change is the key to sustaining its human development achievements and growth.

The government of Jordan represented by the Ministry of Planning and International Cooperation (MOPIC), the Ministry of Water and Irrigation (MWI), the Ministry of Health (MOH), the Ministry of Agriculture (MOA), and the Ministry of Environment (MoEnv) have been the implementing partner in carrying out the activities of the United Nations Country Team (UNCT) Joint programme (JP) on "Adaptation to Climate Change to Sustain Jordan's MDG Achievements" which is supported by a team of UN agencies in Jordan consisting of UNDP, UNESCO, WHO-CEHA, and FAO. The JP has worked on the identification of adaptation barriers and gaps have to be addressed, assessment of

the direct and indirect impacts of climate change on the health, nutrition, and livelihood security of people, screening and assessing potential adaptation strategies prior to wide scale application, and assessing and strengthening existing national adaptation capacities.

In addition to the key role of the JP to strengthen and develop the capacity of different institutions and communities in adaptation to Climate Change the JP is to disseminate the wealth of results, information, and studies accumulated during the period of its implementation to stakeholders, scientific and research community, and the public at large.

The component of the JP implemented by the MoEnv in cooperation with UNDP has been focusing on the Zarqa River Basin (ZRB) for its activities. The major activities of this component are: Identifying the direct and indirect impacts of Climate Change on the water sources of the ZRB, identifying barriers and opportunities for Climate Change adaptation in the basin, Developing a Climate Change adaptation programme for the basin, and pilot Climate Change intervention for groundwater protection on one local community in the basin.

This document is the result of a collaborative and joint efforts of many professionals from the government, private sectors, NGO's, and local community representatives to identify the appropriate adaptation measures, come up with tools for prioritization of adaptation to Climate Change interventions, and develop programmes to better adapt to Climate Change impacts for the ZRB towards strengthening the capacity of the basin to adapt with Climate Change impacts. It is hoped that this study will be a motivator for other studies in other basins of the country.

We at the MoEnv hope that this and other studies of the JP will provide a practical guide for the harmonization of the implementation of climate change adaptation and issues within the conceptual system of the strategic planning of all concerned parties.

Eng. Ahmad Al-Qatarneh



**Secretary General
Ministry of Environment**

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This study was part of a multi task project implemented by the MoEnv with support from UNDP. The project represents one component out of four with together form the UNCT joint programme titled “Adaptation to Climate Change to Sustain Jordan’s MDG Achievements” implemented by the MWI, MoEnv, MOA, MOH, and MOPIC, in cooperation with UNDP, WHO-CEHA, UNESCO, and FAO.

This component (MoEnv-UNDP project) was coordinated by a national participatory process that lasted for three and a half years and involved tens of national experts and organizations resulted in the preparation of this and many other studies. The project was funded by the Spanish MDG-F, administered by UNDP, and implemented by the Ministry of Environment.

The project was coordinated by:

- Dr. Munjed Al-Sharif – Joint Programme Co-ordinator and Chief Technical Advisor
- Ms. Rana Saleh - JP assistant

The project management team was supported by the influential efforts of the various counterparts in the Ministry of Environment with special thanks going to Eng. Ahmad Qatarnah, the SG of the MoEnv and head of the MoEnv task force, Eng. Hussein Shahin, Director of Nature Directorate and Eng. Hussein Badareen, Director of Monitoring and Assessment Directorate, the project counterparts at the MoEnv and members of the task force. Appreciation is also extended to the other members of the task force Eng. Abdel Majeed Khaboor, Director of Zarqa Environment Directorate, and Mr. Batir Wardam, Head of the Zarqa river rehabilitation project and unit at the MoEnv.

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The project outcomes and documents were the result of the innovative work of many Jordanian experts joining together a distinguished team representing the Science Triangle for Research, Training, and mangament (STRTM) consulting firm. The technical contribution was provided by:

- Dr. Ali El Naqa, Team Leader (Hashemite University, HU).
- Dr. Mohammad Al Qinneh (HU)
- Dr. Nizar Hammori (HU)
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The Ministry of Environment would like to express thanks for all the experts participating in the project reports and action plan development, partners in the Ministry of Water and Irrigation, Ministry of Planning and International Cooperation, UNDP and all organizations that were influential and positive in their support of the project.

ملخص

يهدف هذا التقرير إلى تجميع تدابير التكيف ذات الصلة بتوافر المياه ونوعية الموارد المائية في حوض نهر الزرقاء (ZRB) والتي يمكن إعتبارها من أفضل الممارسات للتكيف مع التغير المناخي. ومن خلال ذلك فإنها تهدف إلى دعم الجهود التي تبذلها الحكومة الأردنية من خلال وزارة البيئة لإدماج مفهوم إدارة مصادر المياه المتكاملة في سبل التكيف مع التغير المناخي. كما ويهدف التقرير إلى تعزيز النقاش حول الفرص المتاحة لمزيد من العمل والبحث عن استراتيجيات لزيادة الوعي والمعلومات ذات الصلة مع تدابير التكيف مع تغير المناخ في قطاعات التنمية في حوض نهر الزرقاء (ZRB).

هذا التقرير :

- يستعرض ما تم إجراره من تقدم من جانب الأردن في تعميم وادخال مفاهيم التكيف مع تغير المناخ في الخطط التنموية .
- يتناول العوائق والعقبات على التكيف مع تغير المناخ في نهر الزرقاء .
- تقدم توصيات بشأن الكيفية التي يمكن بها التغلب على هذه العقبات .

كما ويعرض هذا التقرير تفصيل العوائق والقيود التي تحتاج إلى تقييم للتغلب عليها عند تنفيذ أي من تدابير التكيف المقترحة. وقد تم تحليل وتقييم عوائق التكيف والعقبات التي قد تعترض تنفيذ تدابير التكيف وفقا لدرجة خطورتها.

وأخيرا هناك فرص عدة لتحقيق التكامل على نحو أكثر فعالية للتكيف مع تغير المناخ في النشاطات التنموية سواء كان هناك تأثير لتغير المناخ أم لا ، كما تم أيضا مناقشة مثل هذه الفرص.

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Abbreviations and Acronyms

Abbreviations	Acronyms
AR4	Fourth Assessment Report
CBD	Convention of Biodiversity
CC	Climate Change
CDM	Clean Development Mechanism
DNA	Designated National Authority
EU	European Union
GCMs	Global Circulation Models
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Green-House Gases
IPCC	Intergovernmental Panel on Climate Change
IWRM	Integrated Water Resources Management
JMD	Jordan Meteorological Department
JPRC	Jordan Petroleum Refinery Company
KAC	King Abdullah Canal
MoEnv	Ministry of Environment
MWI	Ministry of Water and Irrigation
NAPA	National Adaptation Program of Action
NCSA	National Capacity Self Assessment
NCARE	National Center for Agricultural Research and Extension
NEEDS	National Economic and Environmental Development Study
NGO	Non-Governmental Organization
OECD	Organization for Economic Co-operation and Development
PDD	Project Design Document
SNC	Second National Communication
SWOT	Strengths, Weaknesses, Opportunities, Threats analysis
STRTM	Science Triangle for Research, Training and Management
TAR	Third Assessment Report
UN	United Nations
UNCCD	United Nations Convention on Combating Desertification
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

WC	Water Conservation
WDM	Water Demand Management Strategy
WLRP	Water Loss Reduction Project
WRMP	Water Resources Management Program
WTO	World Trade Organization
ZCI	Zarqa Chamber of Industry
ZRB	Zerqa River Basin

1. Preface

According to Model Contract for Professional Consulting Services between UNDP and Science Triangle for Research, Training and Management No. (8/2010), This report summaries the results of the second task of the first objective of the project “Review opportunities and barriers to adaptation to climate change risks”.

2. Scope of the Report

This report’s main objective is to compile adaptation measures that are relevant to water availability and quality of water resources in ZRB that can be considered best-practice for adaptation to climate change. By doing this, it aims to support the efforts of the Government of Jordan through the Ministry of Environment to incorporate Integrated Water Resource management into climate change adaptation in water sector. The report intends to promote discussion on opportunities for further action research and on strategies for increasing awareness and information related to climate adaptation in development sectors in of ZRB.

This report:

- Reviews what progress has been made by Jordan in mainstreaming climate adaptation into development planning.
- Examines barriers and constrains to adaptation in ZRB.
- Provides recommendations on how these barriers can be overcome.

This report investigates the barriers and constrains that needs to be assessed to overcome when implementing any of the suggested adaptation measures. Based on a general classification of adaptation barriers, potential barriers to implementation of adaptation measures have been analysed and evaluated according to their degree of severity. Finally, several opportunities exist for more effective integration of climate change adaptation within development activities whether or not effects of climate change are realized; such opportunities have been also discussed.

3. Introduction

Jordan is classified as a lower – middle income country whose economy is constrained by limited arable land and scarce water mineral and energy resources. The 2006 budget does not exceed 3.45 billion JDs (43.7% of GDP) with a deficit of 480 million JDs. The deficit is a result of the escalating oil bill, growing debt service payment, diminishing foreign aid and an anticipated lower GDP growth. The government has liberalized the trade regime sufficiently to secure Jordan's membership in the World Trade Organization (WTO) in 2000, a free trade accord with the United States (US) in 2000, and an association agreement with the European Union (EU) in 2001. These measures have helped improve productivity and have put Jordan on the foreign investment map.

According to World Bank (2005), the cost of environmental degradation in Jordan was estimated to be 3.1% of GDP annually with a total of 205 million JDs estimated for five environmental sectors. The most significant negative impacts on health and quality of life was caused by water pollution at an estimated cost of 0.71 – 1.24 percent of GDP. Diarrhea illness and mortality which damage cost is estimated at JD 31 million per year, are caused by lack of access to safe potable water and sanitation, inadequate domestic, personal and food hygiene. Most of those impacted are children. The damage cost of air pollution associated with mortality and morbidity is estimated at around 0.69% of GDP, while the cost of land degradation comes predominantly from rangeland degradation (0.46% of GDP and soil salinity (0.14% of GDP). The damage cost from inadequate waste collection, associated with reduction in land prices is estimated at 0.11% of GDP.

Jordan as a country characterized with semi-arid climate, high dependence on rainfall and scarcity of water resources, Jordan is one of the countries to be highly affected with climate change impacts. Although Jordan's emissions of greenhouse gases are relatively very low, climate change is a big threat to Jordan since the ecosystem productivity and water resources are highly dependent on the hydrological cycle. Jordan has ratified the UNFCCC in 1994 and the MoEnv became the national focal point for climate change issues and UNFCCC. Jordan started its efforts within the framework of the UNFCCC in 1996 with a GEF-UNDP supported programme for national capacity building in documenting national emissions of greenhouse gases and preparing Jordan's national communication to the UNFCCC.

The first national communication was submitted in 1998 and it has been the first national communication to be prepared by a developing country party to UNFCCC. The national communication

included an inventory of greenhouse gases' emissions from all sectors; energy, industry, transport, agriculture, institutional and residential. The programme included developing national scenarios for greenhouse emissions for the upcoming 30 years based on various modelling systems. It has also included developing national mitigation measures for reducing the effects of climate change and a national action plan to reduce greenhouse emissions and turning into sustainable energy resources.

Based upon first national communication to be prepared by a developing country party to UNFCCC, a comprehensive assessment study was conducted in 1999 to anticipate the impacts of climate change on water resources in Jordan within the framework of vulnerability and adaptation to climate change. The study included four sectoral assessments on surface water, groundwater and wastewater in Zarqa basin and marine hydrological systems in the Gulf of Aqaba. Also, the Ministry of Environment have reported the Second National Communication (SNC) on greenhouse emissions that included suggested adaptation and mitigation measures for the first time in Jordan. The report sets the national priorities for climate change related actions and guide the country's future efforts to be part of the global efforts to combat climate change and ensure the achievement of sustainable development at the national level. The findings of the SNC show how serious and urgent are the challenges Jordan faces in the water sector, agriculture and health sectors.

Jordan also ratified the Kyoto Protocol in 2003 to become only the third Arab country party to the Protocol, thus, a national committee was formed to develop project proposals and initiatives for the Clean Development Mechanism (CDM) of the Kyoto Protocol. The Protocol entered into force in February 2005 and Jordan has started to mobilize resources under the CDM to implement the Protocol by developing three CDM projects and various projects are now within the CDM pipeline.

In accordance to the progress of achievements after the signature of the three Conventions on Biodiversity (CBD), Climate Change (UNFCCC) and Combating Desertification (UNCCD) by the Environment and Development Earth Summit, Agenda 21 and the Rio Declaration in 1992, Jordan has committed itself to the success of the global environmental management system. During the last decade or so, thousands of Jordanians were engaged in hands-on initiatives, policy- dialogues, and enabling activities to meet their obligations and ethical commitments to the Rio Conventions. Remarkable success was achieved in some cases, but some results were below expectations. In a process of trial and error the knowledge and lessons learned do accumulate and result in better approaches. However, developing countries cannot stand the consequences of not reaping the real benefits from the Rio

conventions, and thus a process of national prioritization should be used to place the high emphasis on direct and stressing constraints embedded in the proper implementation of the Rio Conventions.

According to the National Capacity Self Assessment report (NCSA, 2007), the major National Priority Capacity Constraints for implementing the UNFCCC and Kyoto Protocol in Jordan are the following:

1. Low capacity for developing National Vulnerability studies and Adaptation measures and guidelines
2. Lack of economic incentives for climate change mitigation and adaptation
3. Inadequate Institutional and technical capacity for the Climate Change focal point at the Ministry of Environment
4. Low Capacity for implementing the CDM
5. Weak linkages between research, systemic observation and policy making
6. Lack of a systemic approach to technology inventory and transfer
7. Lack of clear and systematic integration of the UNFCCC main concepts in the national policy formulation process
8. Weak systematic capacity development for energy efficiency
9. Weak capacity for practical education and training
10. Low capacity for Knowledge management and networking
11. Ineffective enabling environment for renewable energy
12. Low capacity for resource mobilization

The Hashemite Kingdom of Jordan stands at a critical juncture. The country has accumulated a wealth of knowledge and expertise in the climate domain. Through various initiatives the government of Jordan has attained a clear assessment of the challenges posed by climate change and has also identified the measures needed to address these challenges. However, implementation has been lagging partly due to lack of financial resources, technical capacity and weak linkages with national plans.

4. Barriers and Opportunities

The transfer of technologies and practices that have the potential to reduce or adapt greenhouse gas (GHG) emissions and Climate Change (CC) impacts is often hampered by various constraints called “barriers” (IPCC TAR, 2000). Thus, selecting best CC adaptation measure should be based on barriers-opportunities analyses to decrease the gap between the market potential of a technology or practice and the economic, socioeconomic, or technological potential (Box 1).

BOX 1: Definition of Barriers and Opportunities (IPCC AR4, 2007)

A barrier is any obstacle to reaching a potential that can be overcome by a policy, programme, or measure, while an opportunity is a situation or circumstance to decrease the gap between the market potential of a technology or practice and the economic, socioeconomic, or technological potential

According to Pierre Mukheibir report (2005), the common barriers to implementing water conservation and water demand management practices are related to financial, planning, institutional and technical capacity, and social aspects. Most common barrier for adapting a climate adaptation measure were focusing on either the lack of local capacity to implement the suggested strategies, and low financial resource base to cover the capital and running costs of most of the strategies. Local government competes for nationally allocated funds for capital expenditure. Running costs are mostly covered from local revenues, which for the smaller and remote local municipalities are insufficient to ensure water security at this level.

According to Department of Water Affairs and Forestry in South Africa (2004), the common constraints preventing or restricting the implementation of Water Conservation and Water Demand Management Strategy (WC/WDM) in the water services sector include:

- Financial constraints: Although the economic benefits in implementing various WC/WDM often financially constrained and may not have adequate financial resources to invest in such measures. As an example, low cost housing projects resort to the cheapest fittings (e.g. toilets and taps) without regard to operating and running costs.
- Planning constraints: Current planning practices in the Water Services sector are often focused on supply-side management and only consider infrastructure development as an option.
- Institutional constraints: There is sometimes a lack of co-ordination among the various role-players in the water supply chain during the planning process (including the Department, bulk water suppliers and local authorities). There has been inadequate clarity on institutional arrangements, roles and responsibilities.
- Capacity constraints: There is often limited technical and managerial capacity available to plan, implement and maintain WC/WDM measures.
- Technical constraints: There is a lack of appropriate WC/WDM planning tools and guidelines available and no adequate standards and enforcement for plumbing products.
- Social constraints: In certain areas, there is a low level of payment for services. Water wastage can be attributed to the lack of awareness of the benefits of water conservation and demand management. In other instances, WC/WDM measures are also only perceived as drought relief mechanisms.

According to Organization for Economic Co-operation and Development (OECD, 2006), the main barriers to mainstreaming adaptation to climate change are the lack of awareness of climate change within the development community and limitations on resources for implementation. These explanations may hold true in many situations, but there is also a more complex web of reasons underlying them: as barriers within governments and donor agencies and insufficient relevance of available climate information to development-related decisions. On the other hand, several opportunities exist for more effective integration of climate change adaptation within development activities. These include the following:

- Making climate information more relevant and usable
- Developing and applying climate risk screening tools
- Using appropriate “entry points” for climate information
- Shifting emphasis to implementation rather than developing new plans
- Encouraging meaningful co-ordination and the sharing of good practices

Kareiva et al., (2007) have summarized the barriers and opportunities to successful implementation of climate change adaptation strategies (Table 1). Barriers and opportunities may be categorized into policies and procedures, human and financial capital, institutional coordination and collaboration, and information and tools.

Table 1: Barriers and opportunities to successful implementation of climate change adaptation strategies. Adapted from Kareiva et al. (2007).

POLICIES AND PROCEDURES	
Barrier	Opportunity
Legislation and agency policies may be highly static, inhibit dynamic planning, impede flexible adaptive responses and force a fine-filter approach to management.	Re-evaluate capabilities of, or authorities under, existing legislation to determine how climate change can be addressed within the legislative boundaries.
Seasonal management activities may be affected by changes in timing and duration of seasons	Review timing of management activities and take advantage of seasonal changes that provide more opportunities to implement beneficial adaptation actions.
Agency policies do not recognize climatic change as a significant problem or stressor.	Take advantage of flexibility in the planning guidelines and processes to develop management actions that address climate change impacts.
HUMAN AND FINANCIAL CAPITAL	
Lack of incentive to take risks, develop creative projects; reward system focuses on achieving narrowly prescribed targets; funds allocated to achieve targets encourage routine, easily accomplished activities.	Shift from a culture of punishing failure to one that values creative thinking and supports incremental learning and gradual achievement of management goals.

Little to no climate expertise within many management units at the regional and local level; disconnect between science and management that impedes access to information	Use newly created positions or staff openings as opportunities to add climate change expertise; train resource managers and other personnel in climate change science
National and regional budget policies/processes constrain the potential for altering or supplementing current management practices to enable adaptation to climate change; general decline in staff resources and capacity	Look for creative ways to augment the workforce and stretch budgets to institute adaptation practices (e.g., individuals or parties with mutual interests in learning about or addressing climate change that may be engaged at no additional cost).
INSTITUTIONAL COORDINATION & COLLABORATION	
Political boundaries do not necessarily align with ecological processes; some resources cross boundaries; checkerboard ownership pattern of public and private lands at odds with landscape-scale management	Identify management authorities/agencies with similar goals and adjacent lands; share information and create coalitions and partnerships that extend beyond political boundaries to coordinate management; acquire property for system expansion.
INFORMATION AND TOOLS	
Often no inventory or baseline information on condition exists, and nothing is in place to detect climate change impacts.	Identify existing monitoring programs for management; develop a suite of climate change indicators and incorporate them into existing programs.
Historic conditions may no longer sufficiently inform future planning (e.g., “-100-year” flood events may occur more often and dams need to be constructed accordingly)	Evaluate policies that use historic conditions and determine how to better reflect accurate baselines in the face of climate change; modify design assumptions to account for changing climate conditions.
Lack of decision support tools and models, uncertainty in climate change science, and critical gaps in scientific information that limits assessment of risks and efficacy and sustainability of actions.	Identify and use all available tools/mechanisms currently in place to deal with existing problems to apply to climate-change related impacts.
Occurrence of extreme climate events outside historical experience.	Use disturbed landscapes as templates for “management experiments” that provide data to improve adaptive management of natural resources.
Stakeholders/public may have insufficient information to properly evaluate adaptation actions, and thus may oppose/prevent implementation of adaptive projects (e.g., such as those that have ground-disturbing elements like salvaging harvests after disturbance and using herbicides before revegetating). Appeals and litigation from external publics often results in the default of no action	Inform public and promote consensus-building on tough decisions; invite input from a broad range of sources to generate buy-in across stakeholder interests.

Similarly, Wilk and Wittgren (2009) concluded in their report for adapting water management to climate change in India and East Africa that the threat of climate change has greatly increased global awareness about the vulnerability of ecosystems and of large groups of people. Development programmes and strategies that encourage and enable stable livelihoods, that adequately ensure basic living standards and the ecosystems that support them, must top the priorities of national governments and international organizations. Many such strategies that aim to help people adapt to today’s climate are the same ones that must be promoted and more concretely implemented to meet the climate of tomorrow. Though capacity building and more education on the causes and effects of

climate change are needed in many parts of the world at all scales, even when people know what to do, other problems and circumstances hinder adaptation strategies from becoming reality. A long list of barriers exist, and the poorer the person the longer the list. The barriers include: lack of access to financial possibilities and markets, lack of cultural acceptance of change, gender bias, lack of acknowledgement and use of traditional knowledge, lack of cooperation between sectoral authorities and integration in policy plans, top-down or outsider interventions without local anchoring, weak institutions, lack of good governance, lack of trust, corruption, and lack of political linkage between the climate change processes and the water community. Overcoming the barriers could be achieved through the following:

1. Promoting Integrated Water Resources Management
2. Improving National Adaptation Programmes for Action and making them transboundary
3. Supporting the local level and participation
4. Managing uncertainty by adaptive planning
5. Finding fresh and flexible funding
6. Moving water to the forefront

Progress on adaptation in the water sector will require an understanding of why and how national-level authorities and policy may not be conducive to integrating adaptation within the water sector (Tearfund, 2010). Similarly, identifying and capitalizing upon existing opportunities will pave the way forward. To Strengthen national policy frameworks, five steps were proposed (Table 2); (1) Identify barriers and opportunities in relation to a good enabling environment for the integration of adaptation into the water sector, (2) Undertake a ‘Strengths, Weaknesses, Opportunities, Threats’ (SWOT) analysis (or similar) of the overall findings from Step 1, with the aim of identifying ways to overcome problems and capitalize on strengths and opportunities, (3) Identify any catalysts that could aid the creation of supportive or stronger enabling environments, as expressed in national policy, (4) Facilitate awareness-raising among national authorities regarding the links between climate risks and present-day conditions, (5) a) Identify political champions to help overcome any barriers (such as lack of political will for adaptation, and lack of budgetary support) and to create and maintain high-profile momentum amid changing priorities. b) Develop regular contact with such key individuals as part of the ongoing multi-stakeholder dialogue on adaptation within the water sector. c) Seek to influence national authorities and donors, drawing upon ‘champions’ for assistance to counteract and address clashes between sectors.

Table 2: Approaches to strengthen the national policy frameworks through Identify the opportunities and constraints created by national-level policy on climate change, and build on these opportunities while reducing the constraints (based on Tearfund 2010)

Step	Goal	Approach
1	Identify barriers and opportunities in relation to a good enabling environment for the integration of adaptation into the water sector	<p>Key questions to consider are:</p> <ul style="list-style-type: none"> • Are there any legislative constraints or gaps that could inhibit implementation of effective adaptation? For example: • Is there legal provision for increasing equity in water laws and their implementation? (Otherwise, any efforts to improve the management of water in response to climate change are likely to ensure that the share going to the most powerful groups does not change) Is there legislation regarding the management of trans-boundary water resources? • How may private sector, land ownership, national land use planning and natural resource management regulations impact opportunities for adaptation? • Is there availability of and access to data on climate risks? • What opportunities exist to enable local government and civil society to contribute to national decision-making processes? • How are cross-cutting themes, such as HIV or disaster risk reduction, coordinated across sectors? • How strong are partnerships with the international community, including donors? For example, what long-term agreements exist, and how has the water sector benefited from external aid? • Is climate change, and how it impacts on the water sector, reflected within national policy documents (eg national long-term visions, PRSP, national development plan, NAPA etc)? • Do policies in different sectors clash with the water policy? For example, are policies within the agricultural sector water-intensive and therefore possibly not conducive to facilitating adaptation in the water sector? • Develop a matrix to gauge an overall sense of the type of environment in which integration of adaptation within the water sector needs to occur.
2	Undertake a 'Strengths, Weaknesses, Opportunities, Threats' (SWOT) analysis (or similar) of the overall findings from Step 1, with the aim of identifying ways to overcome problems and capitalize on strengths and opportunities.	<p>In the matrix (opposite), it could be decided that levels 1 and 2 indicate areas of weakness and levels 3 and 4 indicate areas of strength. In which case, through dialogue, the SWOT analysis would form the basis of an attempt to seek ways of using the strengths to improve or overcome the weaknesses.</p> <p>As well as analyzing specific documents, plans and events, it is important to note that processes are also conducive to integration. For example, preparing National Communications and NAPAs, which involve the engagement of multiple stakeholders, particularly those at the national level, has been a good step forward for the integration agenda, despite the fact that NAPAs themselves are, arguably, currently too segregated from existing development planning.</p>

3	Identify any catalysts that could aid the creation of supportive or stronger enabling environments, as expressed in national policy.	<p>Key questions to consider are:</p> <ul style="list-style-type: none"> • Are there any lessons to be learned from the disaster management community's experience in raising the priority of risk reduction following disaster events? • What is public/the media's opinion on climate change impacts affecting the country? For example: how regularly is climate change mentioned in the press? Do NGOs or CBOs working among communities report an awareness or concern regarding climate risks? • Is there any recent or new scientific evidence or are there observable impacts of climate change for the region (eg. new patterns of migration indicating increased water stress)? • How and why were the priorities expressed in a NAPA or National Communication decided upon?
4	Facilitate awareness-raising among national authorities regarding the links between climate risks and present-day conditions.	<p>Awareness-raising can include activities such as:</p> <ul style="list-style-type: none"> • National media campaigns on climate impacts. • Internal government awareness-raising on the linkages between climate change, water and other sectors. • No regrets and low regrets approaches (which as well as supporting adaptation are effective in achieving development objectives regardless of climate change).
5	<p>a) Identify political champions to help overcome any barriers (such as lack of political will for adaptation, and lack of budgetary support) and to create and maintain high-profile momentum amid changing priorities.</p> <p>b) Develop regular contact with such key individuals as part of the ongoing multi-stakeholder dialogue on adaptation within the water sector. For example, key individuals could be asked to chair such meetings.</p> <p>c) Seek to influence national authorities and donors, drawing upon 'champions' for assistance to counteract and address clashes between sectors.</p>	<p>Key questions to consider are:</p> <ul style="list-style-type: none"> • Is there anyone who can help strengthen the link on adaptation between the water ministry and national authorities (such as the finance and planning ministries or prime minister/ president's office) to help secure political support and financing for capacity development and implementation, and aid coordination across sectors? • For example, who was instrumental in the NAPA process or in the writing of National Communications to UNFCCC? • Who is best placed to strengthen the links between the water ministry and the likely priority sub-national and local levels?

Another experience was initiated by the Yemen National Adaptation Program of Action (NAPA) giving efforts to address climate change and other important environmental issues. Their report identifies the synergies and barriers to adaptation. The report was based on a general classification of adaptation barriers, potential barriers to implementation of adaptation measures including analyses and evaluation of each barrier according to their degree of severity. Barriers were classified according to the level where they are influencing into: (1) Barriers at Multilateral Environmental Agreements level, (2) Barriers at national policy level, and (3) Barriers at program/project level. Also barriers were classified based on their nature/type into: (1) Institutional barriers, (2) Political barriers, (3) Cultural barriers, (4) Economic/financial barriers, (5) Technical barriers, and (6) Social barriers. A rough assessment for each barrier was achieved according to their degree of severity and classified into three levels; High severity barriers, Medium severity barriers, and Low severity barriers. A summary of their results are presented in table 3.

Table 3: Summary of potential barriers to implementation of adaptation measures in Yemen
(based on NAPA Team, 2006).

BARRIERS	Level	Type	Severity
Weak institutional structures and environmental legislations (weak inter-related, lack of executive bills, poor implementation of laws and bills, weak law enforcement)	2	1	H
The institutional arrangement for Vulnerability and assessment (V&A) studies is weak	2, 3	1	H
Lack of policies to facilitate the implementation of Yemen NAPA	2	1, 2	H
Uncertainty about effectiveness and appropriateness of adaptation options	1, 2	5	M
Lack of appropriate data (in terms of lack of adequate monitoring and collection, difficulties experienced in accessing databases, lack of technical capacity to analyze and manipulate data for V&A and lack of quality assurance)	1, 2, 3	5	H
Uncertainties in regional, local climate change scenarios, Socio-economic scenarios	1, 2, 3	4, 5	H
Public awareness for policy- and decision makers on the subject of V&A is inadequate (lack of knowledge on CC and V&A, lack of ability of technical personnel to convey clearer and concise information on CC and V&A issues to policy- and decision makers)	2	2, 3, 5	H
Financial support is limited (inadequate financial capacity to develop or modify existing models and methodologies, lack of financial sources to implement the adaptation measures)	3	4	H
Technical support is limited (lack of methodologies to identifying and collection of information, apply models and interpret results, inadequate technical capacity to develop or modify existing models and methodologies)	2, 3	5	H
Lack of coordination on cross-sectoral issues. Coordination and cooperation among national and technical cooperation programs/projects is very weak	3	1, 2, 5	M
Lack of awareness on vulnerability and climate change issues	1, 2, 3	4, 5	H
Little research work on the practical application of policy measures for adapting to climate change. National scientific community has not had an active role in addressing vulnerability and adaptation issues	1, 2, 3	4, 5	H
Poverty 1. Compounding problems of poor/worsening local conditions e.g. land degradation 2. Lack of community resources (financial, human, social) to enhance own resilience 3. Lack of local institutional capacity and resources to support community resilience building	1, 2, 3	4, 6	H
Low investment in environmental friendly technologies	2, 3	5	M

According to IPCC TAR (2001), adaptation and/or mitigation potentials are classified into the “market potential” that indicates the amount of GHG mitigation or adaptation benefit that might be achieved under forecast market conditions, with no changes in policy. The market potential can be close to zero as a result of extreme poverty, absence of markets, and remoteness of communities. The inability of the poor or isolated communities to access modern energy services reflects this situation (Figure 1). In addition to the market potential, there is also the economic potential and the socioeconomic potential to be considered. Eliminating imperfections of markets, public policies, and other institutions that inhibit the diffusion of technologies that are (or are projected to be) cost-effective for consumers (evaluated using consumers’ private rate of time discounting and prices) without reference to any GHG or adaptation benefits they may generate would increase GHG mitigation to the level defined as the “economic potential”. The “socioeconomic” potential consists of barriers derived from people’s individual habits, attitudes and social norms, and vested interests in the diffusion of new technology. This potential represents the level of GHG mitigation that would be achieved if technologies that are cost effective from a societal perspective are implemented.

Finally, some technologies might not be widely used simply because they are too expensive from a societal perspective. This leads to the level of the “technical potential”, which can be improved upon by solving scientific and technological problems. Policies to overcome this category of barriers must be aimed at fostering research and development (R&D). Technological and social innovation is a complex process of research, experimentation, learning, and development that can contribute to GHG mitigation and CC adaptation. Several theories and models have been developed to understand its features, drivers, and implications. New knowledge and human capital may result from R&D spending, through learning by doing, and/or in an evolutionary process. Most innovations require some social or behavioral change on the part of users.

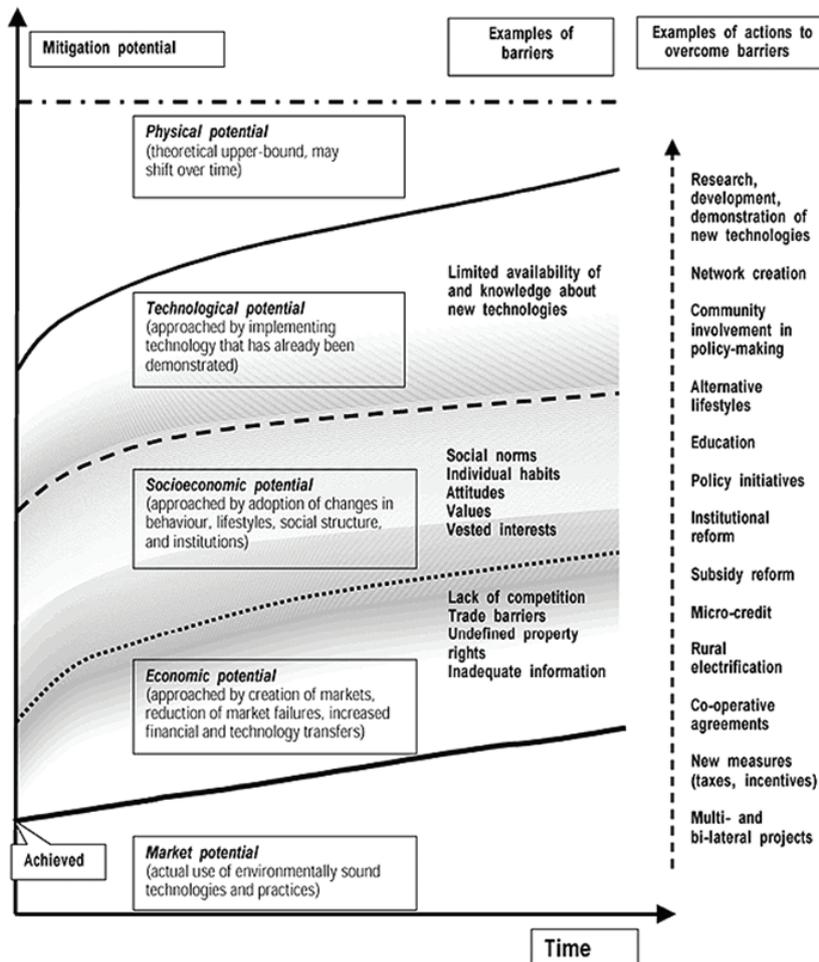


Figure 1: Penetration of Environmentally Sound Technologies: A Conceptual Framework: Various barriers prevent the different potentials from being realized. Opportunities exist to overcome barriers through innovative projects, programmes and financing arrangements. An action can address more than one barrier. Actions may be pursued to address barriers at all levels simultaneously. Their implementation may require public policies, measures and instruments. The socioeconomic potential may lie anywhere in the space between the economic and technological potential.

Emphasizing on socio-econ adaptation barriers, literature on climate adaptation refers to many social barriers to adaptation but not all of them are unique to climate change – many are inherently linked to complex decision making processes. These may include:

1. **Uncertainty:** Several scholars have argued that the development and implementation of adaptation strategies depends on the level of certainty of projected climate impacts and vulnerabilities. Despite the broad scientific consensus that the climate is changing and that this is very likely caused by human attribution, many uncertainties remain on how climate change will affect society. The uncertainties have become ‘cruel dilemmas’ for decision makers and they can pose significant barriers in the development and implementation of climate adaptation strategies. Uncertainty in the context of climate change refers to the lack of certain knowledge about current states and future events.
2. **Fragmentation:** Fragmentation is expected to be a main barrier to development and implementation of adaptation strategies. Fragmentation refers to the large number of different actors involved in coping with climate change at different levels of governance. Not only actors and scales, but also resources are often fragmented in adaptation policy processes. Resources can be subdivided in material aspects – financial, technological, physical – and social aspects –legal/ legislative, knowledge/ information, time. Not all resources are distributed equally throughout regions. Their accessibility is of particular importance in the context of adaptation. For example, tacit and explicit knowledge on the impacts and vulnerabilities to projected climate changes are highly valuable in long term planning for adaptive measures. Alongside the multilevel governance aspects, public administration literature on fragmentation refers to the different ways of governing, fragmented responsibilities and fragmented decision making processes.
3. **Institutional void:** In the relatively new policy domain of climate change adaptation, there are few commonly accepted rules and norms according to which policy processes are taking place. Public administration and policy sciences literature refers to this as an ‘institutional void’ and can be a major hindrance for the legitimacy and efficacy of policy processes. Even though the concept of ‘institutional void’ is not commonly used in climate adaptation literature, many of the institutional factors that are mentioned as barriers to adaptation result from the absence of climate adaptation institutions

4. Short time horizon of policies and politicians: Another characteristic of climate change that is being referred to as a barrier to decision making is the incongruence between long term processes of climate change and the short time horizon of politicians and policies.
5. Missing motives and willingness to start adapting: Adapting to climate change is largely a cognitive, attitudinal and behavioral challenge of individual and societal. However, when motives to start adapting are missing they can pose great barriers in the development and implementation of adaptation strategies at all levels of governance. Until now, little attention has been paid to the role of motives in the context of adaptation policy making, even though it has been mentioned as a major barrier to adaptation policies. Literature on climate change refers to two archetypes of motivational factors; the actor specific motives - intrinsic motives - and the institutional motives - external motives - to start adapting
6. The lack of sufficient and spatially detailed socioeconomic information in order to understand vulnerability at the sub national level: Moreover, downscaled socioeconomic data are still scarce and of doubtful quality. For instance, information on future GDP and population distribution, even when downscaled to the national level, does not suffice to address the multidimensional aspects of impacts and vulnerability to climate threats, which call for a multitude of socio-economic indicators on a more spatially detailed level.
7. The quality and breadth of estimates of costs and benefits used in impact and adaptation assessments.
8. The applicability and usefulness of socio-economic information in decision-making. Even when socio-economic information is available, it may not be in a form that can be readily understood by decision makers, and there is no guarantee that it will be taken into account in decision-making.
9. A lack of awareness among policy-makers and development practitioners about the risks posed by climate change, and how these relate to development priorities. This is seen as a constraint on the necessary foundations for mainstreaming. A major challenge for mainstreaming climate adaptation therefore is not in simply raising awareness per se, but in presenting issues in the context of the audience, paying attention to both content and manner of delivery. Tailoring infor-

mation in these contexts will require a more in-depth understanding of how targeted audiences consume information in different cultural and organizational contexts.

10. High proportion of people living in developing countries relies on ecosystems for their livelihoods. As a high proportion of people living in developing countries rely on ecosystems for their livelihoods, measures to protect their environments must form a core element of poverty reduction strategies.
11. Adaptive capacity is uneven across and within societies. There are individuals and groups within all societies that have insufficient capacity to adapt to climate change, and high adaptive capacity does not necessarily translate into actions that reduce vulnerability. For example, despite a high capacity to adapt to heat stress through relatively inexpensive adaptations, residents in urban areas in some parts of the world continue to experience high levels of mortality.
12. The ability of ecosystems to adapt to climate change is severely limited by the effects of urbanization, barriers to migration paths, and fragmentation of ecosystems, all of which have already critically stressed ecosystems independent of climate change itself.
13. Adequate financial and human public health resources, including training,
14. Lack of access to financial possibilities and markets

5. Review of Barriers and Opportunities to Adaptation in Jordan

Since the entry of the UNFCCC into force in 1994, Jordan started working to fulfill its obligations to the convention. The fulfillment of the national obligation to UNFCCC implies that Jordan should have the human, organizational, institutional and financial resources for developing the required tasks and functions on a permanent basis.

According to SNC to UNFCCC, the major constraints for CC adaptation exist In Jordan are related to financial, technical and capacity needs. The national needs could be summarized as mainly; capacity building needs to increase the local knowledge base; mobilize financial resources to conduct studies and implement adaptation and mitigation projects, and strengthen the legislative and institutional framework.

Most of the barriers focused upon the lack of institutional arrangements for data collection and data sharing. Data are often available in formats that suit government planning purposes, but do not cover all the information required by the IPCC methodology for inventory. Data availability, consistency and transparency was one of the main identified problems faced during the preparation of climatic scenarios and thematic vulnerability and adaptation studies, either missing or inconvenient. There is also a problem in water data availability. The quality of the available data is sometimes inappropriate. The existing climatic and water resources monitoring in the country are facing permanent problems in operation, slow modernization of equipment and reducing of the monitoring network.

In addition, the socioeconomic data are either unavailable or available in inappropriate form. In general, data of some socioeconomic variables are available at the governorate level and not at cities, towns and villages level. Also, lack of financial resources to address needs, conduct research and studies, and implement adaptation measures.

From technology transfer needs, the following constraints and gaps have been addressed:

- Lack of appropriate funding for technology transfer and research.
- Routine government procedures and lack of specialized staff in the public sector.
- Lack of incentives and high taxation and customs on modern technology.
- Insufficient information and training courses allocated to emphasize the effectiveness and the feasibilities of different technological options.
- Lack of legislative and institutional framework.
- Limited expertise in modern technology maintenance and spare parts availability.
- Special needs for foreign experts to transfer knowledge and experience of the new technologies.

The SNC report also suggested activities to overcome the barriers through:

- Conduct surveys, studies and scientific research aiming at developing disaggregated activity data and emission factors needed for the GHG inventory estimation with special focus on key emission sources and sectors with high uncertainty.
- Conduct studies with regional cooperation aiming at developing regional emission factors.
- Develop the local capacities in using the new guidelines, methodologies, tools and software.
- Secure and mobilize financial resources to address the above mentioned needs.
- Improve meteorological and water monitoring through modernization of equipment and extension of monitoring networks.

- Raising technical capacity for monitoring and data collection, data management and updating of basic data sets, and preparation of basic maps and databases.
- Capacity building is needed in the area of methodologies, tools and guidelines to conduct V&A studies.
- Conduct studies and research to assess adverse impacts and vulnerability to climate change in different sectors specially those that were not included in SNC, such as tourism and sea level rise sectors. In addition, studies are needed to geographically cover all potentially vulnerable areas of the kingdom.
- Secure and mobilize financial resources to conduct studies and implement adaptation measures.

According to the National Capacity Self Assessment (NCSA) report (2007), hard and honest assessment of past Jordanian achievements and options for improvement were investigated and reported as an action plan aiming at providing analysis of the priority capacity constraints facing Jordan while it strives to implement the three Rio Conventions on Biodiversity, Climate Change and Desertification. The NCSA process was conducted in a participatory way and facilitated a national dialogue that resulted in a robust package of suggested strategic capacity building activities in the form of the NCSA capacity building action plan. In a strategic planning methodology based on early prioritization of national needs, and relying in a backbone of synergies between the three conventions, the NCSA action plan was designed in the shape of actions responding to the integrated needs of the three conventions with clear local identity of priorities. The NCSA action plan is composed of 20 suggested projects that are based on six strategic programmes: Knowledge management and networking, technology transfer and technical training, linking research to policy development, sustainable coordination mechanisms, resource mobilization and empowerment of local communities (Table 4).

Table 4: Proposed action plans in response to climate change capacity constraints (based on NCSA, 2007)

No.	Constraint	Action No	Proposed action
CC 1	Low capacity for developing National vulnerability studies and adaptation measures and plans	CC 1.1 CC 1.2 CC 1.3 CC 1.4 CC 1.5	Potential adaptation measures identified in the fields of biodiversity and land management Awareness and training programmes for promoting the application of these studies by related sectors conducted Sectoral vulnerability assessment reports are developed Medium to long term adaptation options are identified and mainstreamed in national development planning Adaptation projects are developed and implemented
CC 2	Lack of economic incentives for climate change adaptation measures	CC 2.1 CC 2.2	Appropriate economic incentives for adaptation are identified Mobilization of financial resources to implement mitigation and adaptation options in related sectors through public-private sector partnerships
CC 3	Inadequate Institutional and technical capacity for the Climate Change focal point at the Ministry of Environment	CC 3.1 CC 3.2 CC 3.3	The technical capacity of the Designated National Authority (DNA) and the National Climate Change committee is evaluated and needs are assessed A capacity development programme based on the needs assessment is developed and conducted The negotiations skills of the national UNFCCC delegates are increased via a special capacity building programme
CC 4	Low capacity for implementation of the CDM	CC 4.1 CC 4.2 CC 4.3 CC 4.4 CC 4.5	CDM is promoted among stakeholders by technical capacity building Capacity building programme based on the needs of the DNA is developed Suitable, efficient and result-oriented procedures for CDM implementation developed CDM PDDs developed and approved by all related stakeholders Potential for the use of CDM projects in supporting development objectives and alleviating poverty is explored
CC 5	Weak linkages between research, systematic observation and policy making	CC 5.1 CC 5.2 CC 5.3 CC 5.4	Linkages mechanisms between research, systemic observation and policy making to implement the climate change convention are identified The linkages mechanisms are promoted Linkages mechanisms between research, systemic observation, and policy making to implement the climate change convention are adopted by stakeholders A system for integrated inventory of GHG emissions and adaptation measures within policy making developed
CC 6	Lack of a systemic approach to technology inventory and transfer	CC 6.1 CC 6.2 CC 6.3 CC 6.4 CC 6.5 CC 6.6	A comprehensive inventory of current applied technology is conducted. Technology needs assessment produced Environmentally sound technologies promoted A legal, regulatory and institutional framework that coordinates technology transfer, adaptation and enforcement developed Technology transfer projects based on financial opportunities developed Environmentally sound Climate Change technology adopted by stakeholders
CC 7	Lack of clear and systematic integration of the UNFCCC main concepts in the national policy formulation process	CC 7.1 CC 7.2 CC 7.3	Promoting the integration of UNFCCC concepts in sectoral policies Development of regulatory framework to implement future climate change options, including incentives and regulations and involve decision-makers from all relevant sectors Integration of identified adaptation measures into relevant sectoral policies.
CC 8	Weak asystematic Capacity Development for Energy Efficiency	CC 8.1 CC 8.2	Promoted and adopted energy efficiency programs in all sectors Guidelines for energy audit and energy efficiency programmes developed and implemented

CC 9	Weak Capacity for Practical Education and Training	CC 9.1 CC 9.2	Public awareness programs at different levels developed Climate change issues integrated in curricula of schools and other academic institutions
CC 10	Low Capacity for Knowledge management and networking	CC 10.1 CC 10.2 CC 10.3 CC 10.4	Operational procedures and a time frame networking at all levels are developed Better communications and sharing of experiences with regional and global partners are achieved A national plan on data and information management is developed and implemented. A unified climate change knowledge management system is developed, accessible and operational
CC 11	Ineffective enabling environment for renewable energy development	CC 11.1 CC 11.2 CC 11.3	Awareness programme for prompting the utilization of renewable energy resources is developed System of incentives for companies making investments in renewable energy is introduced Development of a national policy and legislation for the promotion of renewable energy
CC 12	Low Capacity for Resource Mobilization	CC 12.1 CC 12.2	An effective plan on resource mobilization capacity building is developed National training programme on resource mobilization is developed

As part of its commitment to international environmental conventions, Jordan initiated with the support of UNFCCC a National Economic and Environmental Development Study (NEEDS) for Climate Change. NEEDS initiative aims at identifying financing needs to implement adaptation and mitigation measures. Furthermore, the initiative will identify linkages with financial and regulatory instruments that will support the implementation of adaptation and mitigation measures. Eventually, the initiative should provide opportunity for inputs into the national development plan. Constraints, gaps and related financial, technical and capacity needs to incorporate the climate change mitigation and adaptation issues into national policies were identified. These included the low level of knowledge on the national level, lack of financial resources, as well as the absence of the national policies that address the climate change issues.

In terms of financial resources needed to integrate the climate change into national policies, it has been estimated that the total costs of adaptation project for water sectors was estimated to be 6.6 billions and the additional cost was estimated to be 2.64 billions up to the year 2020. Therefore, it is recommended to take actions to build the capacity and to seek financial resources to conduct studies and implement adaptation projects, and to strengthen the nation legal and institutional frameworks in such a way that they will reflect the climate change aspects. There are several funding windows that were identified which can be approached to fund the climate change initiatives and programs. Those are available mainly on the international and bilateral levels, while on the national and regional levels there are few financial instruments available.

According to NEEDS report to CC (2010), one of the main challenges identified was the low level

of knowledge and awareness of the climate change issues among the national stakeholders. This has led to the absence of climate change aspects from most of the national strategies and policies. Another challenge identified was the absence of financial resources to address the climate change.

However, the CC adaptation constrains can be summarized as follows:

- Data availability, consistency and transparency;
 - There are missing data in the daily and monthly climatological time series at the majority of national meteorological stations.
 - There is also a problem in water data availability. The quality of the available data is sometimes inappropriate.
 - The existing climatic and water resources monitoring in the country are facing permanent problems in operation, slow modernization of equipment and reducing of the monitoring network.
 - Health data on climate sensitive diseases are either limited or not readily available. Current records are based on disease groups, for example group one represents all infectious diseases while group nine represents digestive tract diseases.
 - Socioeconomic data are either unavailable or available in inappropriate form. In general, data of some socioeconomic variables are available at the governorate level and not at cities, towns and villages level.
- Coarse spatial and temporal resolution of climate scenarios do not match the requirements of policy oriented applications
- Lack of regional climatic prediction models and downscaling models, thus, Global Circulation Models (GCMs) were used with high spatial distribution. Precipitation modelling using these GCMs models gave poor results.
- Lack of well developed methodologies and tools worldwide for undertaking vulnerability and adaptation studies especially for health and socioeconomic sectors.
- Limited local and international vulnerability and adaptation studies to perform comparisons with the studies conducted during the SNC preparation and to verify the obtained results.
- Lack of financial resources to address needs, conduct research and studies, and implement adaptation measures.

Table 5: Proposed Adaptation projects for the water sector up to the year 2020 (based on NEEDS, 2010)

No.	Project/Program Name	Total cost (Million US\$)	Additional Cost (Million US\$) ^a	Implementing Agency
1	Disi Water Conveyance Project	1075	430	MWI
2	Red-Dead Project	5000	2000	MWI
3	Millennium challenge project MCC/service water tender to study the value of technical and environmental aspect for rebuilding and re habitation of the water system in Zarqa city p1-A and P1-B	4.23	1.69	MWI
4	Repair and rehabilitation project (RRF) for Water Supply network for Jeresh/Balela, Abu Eiat,Sakeb,Bani Obead,Alrmtha, and Bani Kenanah	42.09	16.84	MWI
5	Water loss reduction project (WLRP) for Northern Governorates	31.82	12.73	MWI
6	Rehabilitation of water conveyance system for northern governorates (Höfa-Alzatari conveyance)	45.12	18.05	MWI
7	Water resources management program WRMP (Water Loss Reduction in the middle and northern parts of Jordan, reuse of treatment waste water in Northern Jordan Valley, reduce water loss in Amman city	122.67	49.07	MWI
8	Water Loss reduction project for Karak city	42.24	16.90	MWI
9	Water loss reduction project in Northern governorates	31	12.41	MWI
10	Improvement of water supply in Zarqa city rnd stage	21.15	8.46	MWI
11	Improve the mechanical services to farmers	5.5	2.2	MWI
12	Wastewater system collection (sewer network) project	58.23	23.29 M	MWI
13	Enhancement of Monitoring systems	2.93	1.17	MWI
14	Irrigation improvement projects	13.1	5.24	JVA
15	Dam construction program: Ibn Hammad Dam, Khaled ibn Alwaleed dam, Al-whihdee Dam, Al-Karak Dam, Kufranja Dam etc.	86.74	34.7	JVA
16	Operation and Maintenance Program for King Abdullah Canal (KAC)	15.09	6.03	JVA
17	Early Warning System for Floods	6.0	6.0	JMD
Total		6.60 billions	2.64 billions	

^a Incremental cost is assumed to be 40% of the total cost.

6. Methodology

Willingness and ability to adapt are often affected by real and perceived barriers or constraints. This can lead to questioning the need for adaptation or may limit the effectiveness of a particular option. The study comprised a series of tasks representing a logical progression from an assessment of climate change impacts, through an analysis of risks and opportunities, and identification of adaptation options. First, the risks and opportunities were reviewed from literature in accordance to IPCC and to suggested adaptation measures for ZRB as pursued at the second report. Then categorized according to their direct effect into; institutional, political, financial, social, technical, and environmental constraints (Table 6).

A quantitative ratio-level approach was used to assess the magnitude and likelihood of risks and opportunities using the level of effectiveness and severity status. Three levels were adopted; national (N), local (L), and project (P). While the three severity magnitudes were assigned; low (L), medium (M), and high (H). The proposed risks and opportunities were evaluated according to multiple single-stakeholder meetings with related parties as Ministry of Environment, Ministry of Water and Irrigation, National Center for Agricultural Research and Extension, and Jordan Meteorological Department), local municipalities and communities (Zarqa Chamber of Industry), research and academic institutions, industries as Hussein Thermal Power Station (HTPP, CEGCO) and Jordan Petroleum Refinery Company (JPRC), and International Funding Agencies (UNDP). Most of the participants were at high level management (Annex 1).

The proposed barriers for CC adaptation measures implementation in ZRB can be summarized as follows:

- Weak of pertinent laws or regulations
- Insufficient and/or ineffective law enforcement
- Low empowerment of Effective Regulatory Agencies
- The incongruence between long term processes of climate change and the short time horizon of politicians and policies.
- Insufficient cooperation between sectoral authorities and integration in policy plans
- Presence of top-down interventions without local anchoring
- Little or no participation besides high-level government officials
- Adaptation initiatives are dependent upon external, donor funded expert intervention
- Absence of invisibility of model behavior by opinion leaders

- Failure of managers to provide needed social support
- Insufficient organization form obscuring negative externalities
- Little research work on the practical application of policy measures for adapting to climate change, National scientific community has not had an active role in addressing vulnerability and adaptation issues
- Financial support is limited (inadequate financial capacity to develop or modify existing models and methodologies, lack of financial sources to implement the adaptation measures)
- Lack of coordination on cross-sectoral issues.
- Weak coordination and cooperation among national and technical cooperation programs/projects
- Lack of policies to facilitate the implementation of national adaptation plans
- Little to no climate expertise within many management units at the regional and local level; disconnect between science and management that impedes access to information
- Long time and high transaction costs for small projects
- The ability of ecosystems to adapt to climate change is severely limited by the effects of urbanization, barriers to migration paths, and fragmentation of ecosystems
- Lack of trust between parties
- Presence of some corruptions
- Adaptive capacity is uneven across and within societies.
- Lack of cultural acceptance of change
- Poverty and compounding problems of poor/worsening local conditions
- Lack of community resources where high proportion of people rely on ecosystems for their livelihoods,
- Inability to feel responsibility for water sustainability
- Distorted or incomplete pricing policies
- Absence or inconsistency of financial incentives (rewards and punishments)
- Low financial resource base to cover the capital and running costs of most of the strategies.
- Low level of payment for services in certain areas or sectors.
- The quality and breadth of estimates of costs and benefits used in impact and adaptation assessments are weak
- Adequate financial and human public health resources, including training,
- Lack of finance instruments to cover adaptation costs
- Low investment in environmental friendly technologies

- Unstable Macroeconomic Conditions
- The lack of sufficient and spatially detailed socioeconomic information in order to understand vulnerability at the sub national level.
- Tacit and explicit knowledge on the impacts and vulnerabilities to projected climate changes are weak
- Lack or insufficiency of Data
- Uncertainties in regional, local climate change scenarios, Socio-economic scenarios
- Weak national human and institutional capacity
- Low Public awareness
- Low Data Reliability
- Lack of Stakeholders /public awareness and participation
- Uncertainty about effectiveness and appropriateness of adaptation options
- Inadequate or lack of technology transfer and technical capability
- Lack of credibility about setting project baselines, and monitoring of carbon stocks pose difficult challenges.
- Farm-level Adoption Constraints
- Lack of national standards for non- conventional water resources
- Political boundaries do not necessarily align with ecological processes
- Seasonal management activities may be affected by changes in timing and duration of seasons

7. Barriers classification and evaluation

According to the results of the categorization and evaluation by stakeholder's participation from related parties, most of the existed barriers to climate change adaptation measures at ZRB fall within the financial and technical aspects followed by social and institutional constrain (Table 6). It seems that the most feasible adaptation measure, as suggested before in the previous report, is the adaptation that doesn't require capital investment or running cost (or incremental costs) for implementation. Thus, selection and prioritization of adaptation measures in ZRB was based on multiple criteria's, by which the adaptation feasibility and urgency that had the largest weight. However, few political constrains were existed especially when related to adaptation measures implementation at the transboundary between ZRB and Syria.

On the other hand, the opportunities for the suggested implementations as suggested and reviewed by stakeholders can be summarized as follows:

- Revision of the governance arrangements and policy strategy are necessary.
- A multi-stakeholder coordination committee should be established to manage national adaptation strategies, chaired by a senior ministry.
- A risk-based approach to adaptation should be adopted, informed by bottom-up experiences of vulnerability and existing responses.
- Legislation and agency policies may be highly static, inhibit dynamic planning, impede flexible adaptive responses and force a fine-filter approach to management.
- Protecting and enhancing migration corridors to allow species to migrate as the climate changes
 - Identifying management practices that will ensure the successful attainment of conservation and management goals
 - Promoting management practices that confer resilience to the ecosystem.
- Awareness campaigns should be conducted.
- Solve the problem of corruption by implementing monitoring system.
- Equity in distribution of adaptive measures should be achieved.
- Governments should engage more actively with the scientific community, who in turn must be supported to provide easily accessible climate risk information.
- Capacity building campaigns at the policy makers and the stakeholders should be conducted.
- The capacity of existing poverty reduction and risk reduction mechanisms should be expanded to incorporate climate adaptation where possible.
- Gender issue should be taken into consideration in climate change adaptation measures.
- Collect useful and detailed socio-economic information.
- Detailed research on adaptation and mitigation cost estimated should be conducted
- Many diseases and health problems that may be exacerbated by climate change can be effectively prevented with adequate financial and human public health resources, including training.
 - Urban tree planting to moderate temperature increases
- Allocate adequate finance internally or externally to cover the adaptation costs.
- Arrange with the relevant institution, i.e. DOS and metrological department to provide high quality information.
- Arrange with the relevant institution, i.e. DOS and metrological department to provide needed information at sub-national levels.

- Raising awareness, developing and disseminating knowledge, developing instruments to facilitate implementation of future adaptation policies.
- Information needs of different actors should be considered and communications tailored more specifically to users, including the development community
- There is a need to adapt the new policies within the prevailing formal and informal rules, norms and values.
- Making climate change information more useful and easier to use, focusing more on implementing climate change and development strategies, and increasing co-ordination between development and climate change policies.
- Conduct focus group surveys to find the best ways to disseminate the needed information.
- Actions to address vulnerability to climate change should be pursued through social development, service provision and improved natural resource management practice
- Climate risk information should put current and future climate in the perspective of national development priorities
- Opportunities for intervention by the aforementioned stakeholders so that technologies can reach their full potential.

Table 6: Analysed set of possible barriers and opportunities for CC adaptation measures in ZRB.

Barrier	Institutional									Political									Financial									Social									Technical									Environment								
	N	L	M	H	N	L	M	H	P	N	L	M	H	P	N	L	M	H	P	N	L	M	H	P	N	L	M	H	P	N	L	M	H	P	N	L	M	H	P															
Severity	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H															
Week of pertinent laws or regulations		X																																																				
Insufficient and/or ineffective law enforcement		X																																																				
Lack of Effective Regulatory Agencies	X																																																					
The incongruence between long term processes of climate change and the short time horizon of politicians and policies.			X																																																			
Lack of cooperation between sectoral authorities and integration in policy plans			X																																																			
Top-down interventions without local anchoring		X																																																				
Little or no participation besides high-level government officials			X			X																																																
Adaptation initiatives are dependent upon external, donor funded expert intervention		X																																																				

Barrier	Institutional						Political						Financial						Social						Technical						Environment								
	N		L		P		N		L		P		N		L		P		N		L		P		N		L		P										
Severity	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H
Absence of invisibility of model behavior by opinion leaders			X			X									X			X			X																		
Failure of managers to provide needed social support			X			X			X						X			X			X																		
Organization form obscuring negative externalities						X									X			X			X																		
Little research work on the practical application of policy measures for adapting to climate change, National scientific community has not had an active role in addressing vulnerability and adaptation issues	X			X											X			X			X																		
Financial support is limited (inadequate financial capacity to develop or modify existing models and methodologies, lack of financial sources to implement the adaptation measures)															X			X			X																		
Lack of coordination on cross-sectoral issues.															X			X			X						X												

Barrier	Institutional									Political									Financial									Social									Technical									Environment								
	N			L			M			H			N			L			M			H			N			L			M			H			N			L			M			H								
Severity	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H						
Weak coordination and cooperation among national and technical cooperation programs/projects			X			X												X			X			X									X			X			X															
Lack of policies to facilitate the implementation of national adaptation plans			X			X												X			X			X																														
Little to no climate expertise within many management units at the regional and local level; disconnect between science and management that impedes access to information																		X			X			X									X																					
Long time and high transaction costs for small projects																		X			X			X									X																					
The ability of ecosystems to adapt to climate change is severely limited by the effects of urbanization, barriers to migration paths, and fragmentation of ecosystems																		X			X			X												X			X															
Lack of trust																		X			X			X			X						X																					
Corruption	X			X			X											X			X			X			X				X			X																				
Adaptive capacity is uneven across and within societies.																		X			X			X			X																											

Barrier	Institutional									Political									Financial									Social									Technical									Environment								
	N			L			P			N			L			P			N			L			P			N			L			P			N			L			P											
Severity	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H			
Stakeholders /public awareness and participation			X			X			X										X		X	X		X																														
Uncertainty about effectiveness and appropriateness of adaptation options																			X		X	X		X																														
Inadequate or lack of technology transfer and technical capability																			X		X	X		X																														
Lack of credibility about setting project baselines, and monitoring of carbon stocks pose difficult challenges.																			X		X	X		X																														
Farm-level Adoption Constraints																			X		X	X		X	X		X																											
Lack of national standards for non-conventional water resources			X																X		X	X		X																														
Political boundaries do not necessarily align with ecological processes									X			X							X		X	X		X																														
Seasonal management activities may be affected by changes in timing and duration of seasons																			X		X	X		X																														

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Annex (1): List of Participants to the Stakeholder Meeting held in Ministry of Environment, Amman November 10th, 2010

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