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**Isam Fares Institutes**

**American University of Beirut (AUB)**

**Seminar on Climate Change and the Policy-Making Process in the  
Levant and North Africa**

**Climate Change: Impacts, Adaptations and Policy-Making  
Process: Palestine as a Case Study**

By

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## **Abstract**

Global climate change related to natural and anthropogenic processes has been the topic of concern and interest world-wide. One of the most significant impacts of the 'greenhouse effect' is anticipated to be on water resources. Thus, the impact of climate change appears to be an additional component on top of the large number of existing water-related problems. The present paper will identify key climate change actors, evaluate the potential impacts of climate change, review available literature on climate change, and assess the policy-making mechanisms and priorities for Palestine as a case study. Climate adaptation measures, adaptive capacity, gaps in policies, research and other country-specific issues and institutional limitations will be identified.

## **1.0 Introduction**

One of the major issues in the present century is global warming. Studies on global warming and its effect on climatic change are being pursued vigorously as a multi-disciplinary problem. Global warming due to enhanced greenhouse effect is expected to cause major changes in various climatic variables such as absolute humidity, precipitation and net terrestrial and global solar radiation etc. Atmospheric temperature is probably the most widely used indicator of climatic changes both on global and regional scales (Jones and Briffa, 1992).

Climate change will lead to an intensification of the global hydrological cycle and can have major impacts on water resources, affecting both ground and surface water supply for domestic and industrial uses, irrigation and in-stream ecosystems. Changes in the total amount of precipitation and in its frequency and intensity directly affect the magnitude and timing of runoff and the intensity of floods and droughts (IPCC, 2007).

The aim of this paper is to identify key climate change actors, evaluate the potential impacts of climate change, review available literature on climate change, and assess the policy-making mechanisms and priorities for Palestine as a case study.

The emerging Palestinian State is located in Southwest Asia on the Eastern shore of the Mediterranean. It is composed of two separate areas, Gaza Strip and the West Bank. There are two distinctive climatic seasons a wet winter and a dry summer. Annual average rainfall in the West Bank and Gaza is approximately 450 mm and 400 mm respectively. The Jordan River system is the only surface water resource in the West Bank. There are two aquifers shared by Palestine and Israel: the Mountain Aquifer underlying the West Bank and the Coastal Aquifer underlying Gaza.

The present problems that are related to water are many and varied. Palestine, Israel, Jordan, and most other mid-eastern countries, which are generally characterized by aridity have very limited water resources. They have experienced in the last three years a serious recurrent winter drought. The 2007/2008 winter has seen a drastic drop in rainfall for the entire Palestine (Ministry of Agriculture, 2008).

Palestine has one of the lowest per-capita water availability world-wide. Continuing population growth, Israeli control over shared water resources, predictions for climate change within the region and changes in rainfall amount and distribution will intensify

these problems. Palestine will experience serious deficit and the shortage was estimated to be  $271 \times 10^6 \text{ m}^3$  for the year 2020 (Mimi et al., 2003).

## **2.0 Key climate change actors and research at Palestine**

In the last years, several institutions and researchers conduct climate change studies. The following lists the key climate change actors and research at Palestine.

**1. Name of the Project:** Climate Change Adaptation Strategy and Program of Action for the Palestinian National Authority – The program was initiated by Environmental Quality Authority (EQA) and financed by UNDP/PAPP

**Main researchers/consultants:** Michael Mason, Ziad Mimi and Mark Zeitoun

### **Publications:**

Report of Consultants: Climate Change Adaptation Strategy and Program of Action for the Palestinian National Authority: Stakeholder Consultation and Scoping Meetings, January 2009.

Report of Consultants: Climate Change Adaptation Strategy and Program of Action for the Palestinian National Authority: Analysis of the Climate Change Situation in the Occupied Palestinian Territory, April 2009.

Report of Consultants: Climate Change Adaptation Strategy and Program of Action for the Palestinian National Authority: Climate Change Adaptation Strategy for the Occupied Palestinian Territory, July 2009.

**2. Name of the Project:** Rising Temperatures, Rising Tensions. The project was implemented by the International Institute for Sustainable Development (IISD).

**Main researchers:** Oli Brown and Alec Crawford

### **Publications:**

Brown, O. and Crawford, A. (2009) Rising Temperatures, Rising Tensions: Climate change and the risk of violent conflict in the Middle East. International Institute for Sustainable Development (IISD). Canada. Web site: <http://www.iisd.org>.

**3. Name of the Institution:** Al-Najah National University (Academic)

**Main researchers:** Numan Mizyed, Annan Jayossi and Sameer Shadeed

### **Publications:**

Mizyed, N. (2009) Impacts of Climate Change on Water Resources Availability and Agricultural Water Demand in the West Bank, Water Resources Management Journal, 23(10): 2015 – 2029.

**4. Name of the Institution:** Palestine Academy for Science & Technology (Governmental)

**Main researchers:** Imad Khatib and Ayman Haj-Daoud

**Publications:**

Khatib, I., Gerstengarbe, F.W. and Haj-Daoud, A. (2007) East Mediterranean climate change trends in the last century, Arab Water World 31(4): 96-100.

Khatib, I. (2009) GLOWA-Jordan River – Project 3 Final Report: Regional Climate Scenarios. Jerusalem: Palestine Academy for Science & Technology.

**5. Name of the Project:** GLOWA-Jordan River Project: It is financed by the German Federal Ministry of Education and Research (BMBF) as part of the GLOWA research initiative: Global Change in Hydrological Cycle. The project is coordinated by the Department of Plant Ecology of the University of Tübingen, Germany.

**Main researchers:** GLOWA Jordan River is an interdisciplinary and international project consisting of hydrologists, climatologists, ecologists, economists from Jordan, Palestine, Israel, and Germany.

**Publications:**

GLOWA-Jordan River Project (2008) Project 3: Climate Scenarios <http://www.glowa-jordan-river.de/ProjectP03/HomePage>

**6. Name of the Project:** SUSMAQ: The project was financed by the British Government and implemented by Palestinian National Authority.

**Main researchers:** SUSMAQ is an interdisciplinary and international project consisting of hydrologists, climatologists, ecologists, economists from England and Palestine.

**Publications:**

SUSMAQ (2003) Rainfall Variability and Change in the West Bank, , Ramallah: Palestinian National Authority/Palestinian Water Authority.

SUSMAQ (2005) Stochastic Space-Time Modeling of West Bank Rainfall for Present and Future Climates, Ramallah: Palestinian National Authority/Palestinian Water Authority.

SUSMAQ (2005) Development and Application of a Regional Climate Model for Assessing the Impacts of Land Use and Climate Changes, Ramallah: Palestinian National Authority/Palestinian Water Authority.

**7. Name of the Institution:** Friends of the Earth (NGO)

**Main researchers:** Ladeene Freimuth, Gidon Bromberg, Munqeth Mehyar, and Nader Al Khateeb

## Publications:

Friends of the Earth (2007) Climate Change: A New Threat to Middle East. Prepared for the United Nations Climate Change Conference, Bali, Indonesia

## 3. Analysis of the Climate Change Situation in Palestine

### 3.1 Current climate conditions

The climate of Palestine is traditionally described as 'Mediterranean', which is characterized by winter rain and summer drought. However, there is a great diversity in this climate, which is modified locally by latitude and altitude. This is especially apparent in the West Bank (Figure 1.1): climatic zones range from extremely arid to humid according to the De Martonne aridity index classification for arid areas (Land Research Centre 2007).

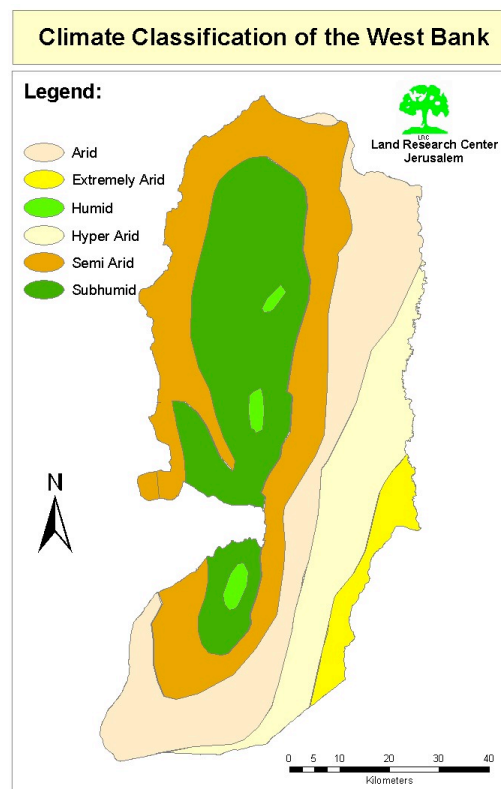


Figure 1 Climate classification of the West Bank

Annual rainfall in the West Bank is higher in the north (up to 700mm around Jenin) and lowest in the Dead sea area of the south (80-100mm): alongside this latitudinal variation is an orographic one – the western slopes receive 500-600mm, while the eastern slopes receive 150-45mm (Ministry of Agriculture 2008). Thus, the area suffering from greatest aridity (44%) is located at the south-eastern edge of the West Bank. This area, which is lightly populated, has been proposed as a strategic reserve of agricultural land for a future Palestinian state (Dudeen 2007).

Analysis of climate change situation in Palestine is based on a review of climate change scenarios for the eastern Mediterranean and on the available literature. The most

significant environmental effects of climate change for the people of Palestine, over the course of this century, are projected to be a decrease in precipitation (with significant seasonal variation) and significant warming. Climate change forecasts for the eastern Mediterranean from high-resolution regional climate models give clear scientific backing to the Intergovernmental Panel on Climate Change (IPCC) projections for the region. In its Fourth Assessment Report, the IPCC predicts that, for the southern and eastern Mediterranean, warming over the 21st century will be larger than global annual mean warming – between 2.2-5.1°C according to an optimistic emissions scenario (Scenario A1B). Annual precipitation rates are deemed likely to fall in the eastern Mediterranean – decreasing 10% by 2020 and 20% by 2050 – with an increased risk of summer drought (Mason et al. 2009).

Despite its small area (365km<sup>2</sup>) and generally flat terrain, there are also significant variations in Gaza's temperate climate: the average seasonal rainfall is 522mm in the northern Beit Lahiya governorate and 225mm in the southern Rafah governorate (Palestinian Water Authority 2007). Gaza experiences hot, dry summers and mild winters. There is already some evidence that global warming is affecting Gaza: an analysis of daily temperature data from 1976 to 1995 has shown an increase in mean temperature of 0.4C, which reflects above all an upward trend in minimum temperature values (El-Kadi 2005).

### **3.2 Current socio-economic conditions and Vulnerability**

Current socio-economic and political conditions in Palestine are increasing the vulnerability of those groups and sectors most exposed to the negative effects of present climate variability and future climate change. According to UNDP/Programme of Assistance to the Palestinian People (UNDP/PAPP), the ongoing Israeli occupation (with its restrictions on labour, trade and financial/investment flows) and prolonged economic contraction are undermining human development goals. 48% of Palestinians in the West Bank now live below the poverty line, which rises to 68% in southern Gaza and 72% in northern Gaza (UNDP/PAPP 2009).

The stakeholder consultations undertaken by the Project Team (Mason et al. 2009) in Palestine identified several forms of 'vulnerability' in Palestine. Apart from the expected impacts due to altered rainy seasons, temperature and humidity, physical infrastructures and livelihoods were also subject to the effects of the movement restrictions (especially in Gaza, but also between communities in the West Bank), the Separation Wall, settlement expansion, and weak governmental authorities.

The array of non-environmental sources of vulnerability led the team to employ the broad concept of climate vulnerability. It was clear also from these stakeholder consultations that the 'real' or 'net' impact of the combination of environmental and non-environmental risks was 'dampened' in a sense by the ways communities have responded to the risks – through such coping mechanisms as altering crop selection and cropping patterns, diversifying livelihoods and purchasing water from privately-run tanker trucks.

The hazards, which can lead to vulnerability, are identified as both environmental and socio-political in nature. In their report, climate vulnerability is defined as combined biophysical vulnerability and social vulnerability.

This Climate Change Adaptation Strategy which was developed by Mason and others (2009) adopts the concept of climate vulnerability, defined as combined biophysical vulnerability and social vulnerability. Input from stakeholders in the West Bank and Gaza shows that water and agricultural sectors in Palestine are most sensitive to climate hazards, both current and future.

Already under significant pressure from rapid demographic growth, economic development and restrictions on development from Israel, freshwater resources in Palestine are predicted to become more physically scarce as climate change causes decreases in annual participation. The expected increased scarcity means that the strategic planning of the agriculture sector by the Palestinian National Authority (PNA) needs to consider the potential impacts of climate change on food availability elsewhere in the world.

### **3.3 Vulnerability Pathways: West Bank**

The real physical scarcity of natural resources in West Bank is compounded by human-induced or conflict-induced scarcity. The effects are felt in compounding ways, all of which lead either to more precarious livelihoods or tensions between communities (or between Palestinian ministries, or at the inter-state level). Figure 2 suggests visually a number of these 'vulnerability paths' identified following consultations with stakeholders (Mason 2009). The figure demonstrates, for instance, that the vulnerability experienced from the Israeli occupation results in tensions between the communities and the water-service provider (PWA or Ministry of Agriculture), or between the communities themselves (in case of unlicensed Palestinian connections or wells drying up – around Wadi Fara' for example). The restrictions on well-drilling (according to the terms of the 1995 Oslo II Agreement), and the movement restrictions preventing farmers from regular access to their land or to markets, have a direct effect on yields, and thus on livelihoods.

Figure 2 also shows that the risk of reduced precipitation is a potential cause of a decrease in the resilience of livelihoods. Anticipated reductions in precipitation lead to reductions in freshwater (springs), in groundwater, and in soil moisture. The result again is reduced yields that either directly affect the livelihood of the farmers in question, or affect it even more substantially through an indirect method: loss of land ownership if it remains fallow for three years (under an old Ottoman land law invoked by the Israeli Government). Thus the political and physical aspects of climate vulnerability are intermixed.



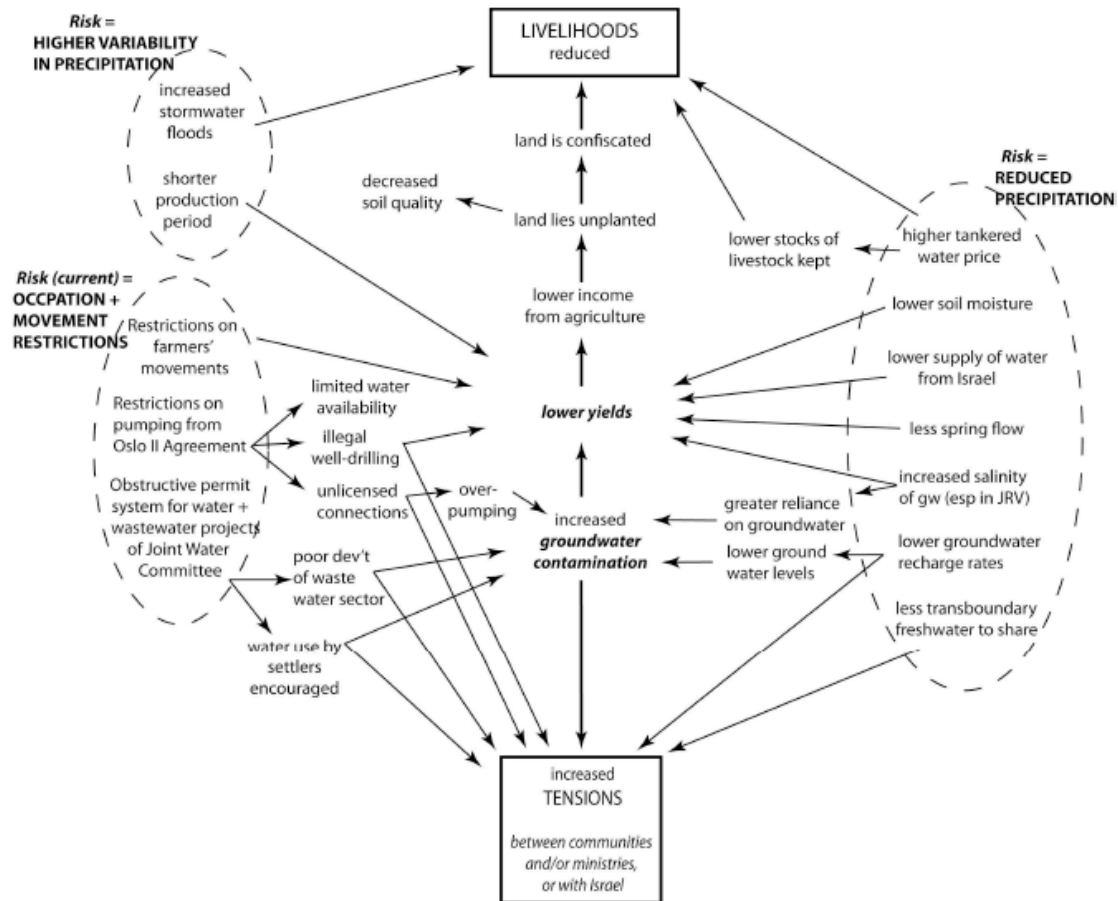


Fig. 2 Vulnerability Pathways: West Bank (Source: Mason et al)

### 3.4 Future Climate-Risks Assessment

The Fourth Assessment Report of the IPCC predicts that, for the southern and eastern Mediterranean, warming over the 21st century will be larger than global annual mean warming – between 2.2 and 5.1°C according to an optimistic emissions scenario (A1B) in which rapid economic growth and technological change have reduced reliance on fossil-intensive energy sources. Annual precipitation is deemed very likely to fall in the eastern Mediterranean – decreasing 10% by 2020 and 20% by 2050 – with an increased risk of summer drought (Christensen et al. 2007).

There is significant uncertainty regarding forecasted precipitation patterns for the eastern Mediterranean and the Middle East, in part because of insufficient observational data for Palestine. For example, in the mid-1990s Israeli researchers (Ben-Gai et al. 1994) reported increased annual rainfall for southern Israel of up to 30% in the preceding 30 years, with increases also on the western slopes of the West Bank mountains. In contrast, to the north of Tel Aviv, rainfall amounts had decreased (Stienberger and Gazit-Yaari 1996; SUSMAQ 2003). Figure 3 illustrates this mixed geographical pattern. Current predictions from the high-resolution climate models are for significant falls in annual rainfall over the eastern Mediterranean region by 2100, including decreasing winter participation by 2100 of up to 35% compared to late twentieth century timelines.

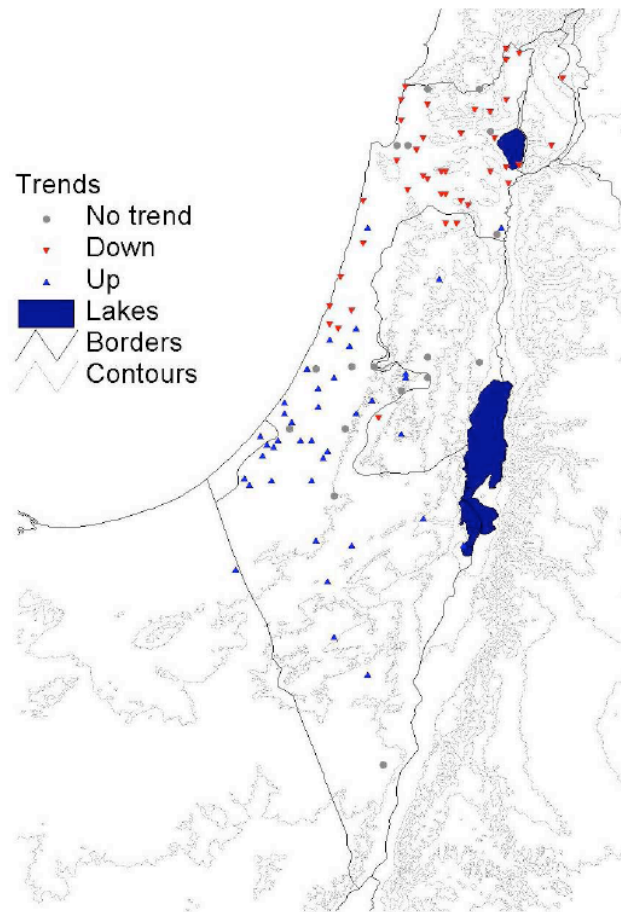


Fig 3. Annual rainfall trends from 1961 – 1990 (Source: Steinberger and Gazit-Yaari 1996)

However, the climate projections derived from high-resolution climate models applied to the eastern Mediterranean region also differ in some key respects from the lower resolution IPCC forecasts. The reported findings of three such models have been consulted to identify climate projections pertinent to Palestine (Mason et al. 2009):

1. The Japanese Meteorological Agency Atmosphere General Circulation Model (JMA-AGCM) with 20km grid squares. This climate model was run for the eastern Mediterranean according to three time-slices – present climate (1982-1993) and then two future runs (2080-2099) with moderate and high climate sensitivity. The future climate change scenarios were based on IPCC emissions scenario A1B (Kitoh et. Al 2008).

2. The GLOWA-Jordan River RCM, which uses an American nonhydrostatic meteorological model with nested steps at resolutions of 54km<sup>2</sup>, 18km<sup>2</sup> and 8km<sup>2</sup>

(MM5). This has downscaled climate data from two global circulation models – ECHAM4 and HadCM3 – running two 30-year time slices (1960-1990 and 2070-2099) for IPCC emissions scenarios A2 and B2. It has also run the A1B scenario for 1958-1996 (control run) and 2007-2045 (forecasts). The meteorological fields generated have also been coupled with a hydrological model WaSiM to provide the first estimates of hydrological responses of the Upper Jordan River to forecasted climate change (Plan Bleu 2008, GLOWA-Jordan River Project 2008; Khatib 2009).

3. The Sea Atmosphere Mediterranean Model (SAMM), which combines the French AGCM ARPEGE-Climate Model of 50 km<sup>2</sup> resolution with a regional Ocean General Circulation Model (OGCM) with 10km grid squares. Climate simulations for the Mediterranean were run from 1960-2100 using observed values up to 2000 and, beyond that year, projected values according to IPCC emissions scenario A2 (Somot et al. 2008).

However, caution is needed applying the projections from these models to Palestine because of the use of simplifying parameterizations, the different emission scenario runs and, given the small size of the territory (6020 km<sup>2</sup>), the generally coarse spatial resolution of the models. Even those with the highest resolution (grid sizes down to 8km for MM5 and 20km for JMA-AGCM) miss local orographic and environmental variations within the West Bank and Gaza. Above all, none of these models takes into account socio-economic impacts particular Palestine, which suggests the need for a regional downscaling model tailored to address Palestinian adaptation priorities in the face of future climate risks. More generally, a multi-model comparative approach is necessary to reduce uncertainty regarding the future impacts of climate change in the eastern Mediterranean (Mason 2009).

According to the greenhouse gas emissions scenario, sea levels are forecast by the IPCC to rise at least 18 to 38cm (emissions scenario B1) and as much as 26 to 59cm (emissions scenario A1F1) by 2100. More accurate predictions for the Mediterranean Sea are possible only through longer time-series data from satellite altimetry and a more comprehensive in-situ tide-gauge network. In any case, the estimates of existing climate models that the mean sea level for the Mediterranean Sea will rise by 35cm by 2100 still pose a serious threat to Gaza (Mason et al. 2009).

## **4.0 Impacts on priority policy sectors**

### **4.1 Agriculture**

Increases in seasonal temperature variability, storminess and frequency of temperature extremes may endanger cold- and heat-sensitive crops. Greater rain intensities and resulting floods may damage crops. Drought damages are also expected increase with the anticipated decrease in water availability, hotter temperatures and shorter winters. More pests and pathogens will not only increase crop diseases but also their sensitivity to drought and loss of biodiversity may reduce the natural control of agricultural pests. A delayed growing season will cause Palestine to lose its advantage over countries in colder climates in early exports of flowers, fruits and vegetables (Ministry of Agriculture, 2008).

Palestinian farmers both in the West Bank and Gaza will face challenges to mitigate decreased water availability predicted to be a result of climate change. Agricultural livelihoods, particularly within rural rainfed farming communities, are always directly affected by rainfall and drought incidence. However, their climate vulnerability is also attributable to: Israeli restrictions on movement and access to land, resources, and markets; a weak institutional framework; and an increase in farming production costs (including water supply) along with decreasing profits. The construction of the separation barrier, the expanding presence of settlements and settlers roads, and the imposition of restrictions on movement and access have jeopardized the watering and seasonal migration of herds, reduced grazing land and in many cases prevented access to closer filling points. This has forced herders to purchase water from more distant (but accessible) filling points, incurring higher transportation costs.

There have been few attempts to model the effects of climate change on the agricultural sector in Palestine. Abu-Jamous (2009), who used CROPWAT model to explore climate change impacts on the demand for irrigation water, focusing on agricultural data from the Jericho and Al-Aghwar Governorates. In view of the uncertainties associated with future projections of climate change, a number of climate scenarios were constructed for testing (Abu-Taleb 2000). The climate change scenarios applied relative precipitation (P) changes of P-20%, P-10%, P, P+10% and P+20%, and temperature (T)+ 1OC, T+ 2OC, and T+ 3OC to the monthly average series temperature and precipitation values respectively. For each climatic scenario, reference evapotranspiration (ET<sub>o</sub>), Crop Water Requirement (CWR) and Irrigation Water Requirement (IWR) for Jericho and Al-Aghwar Governorate were calculated. Table 1 presents irrigation water demand by applying relative temperature changes of T+ 1OC, T+ 2OC, and T+ 3OC to the monthly average series temperature and relative precipitation changes of (P) -20%, P-10%, P, P+10% and P+20% the monthly average series precipitation.

Table 1 Total Irrigation Water Requirement for Jericho and Al-Aghwar Governorate under different scenarios in MCM/year

	T	T+1	T+2	T+3
P-20%	21.05	21.63	22.23	22.83
P-10%	20.24	20.82	21.42	22.01
P	19.95	20.53	21.12	21.71
P+10%	19.66	20.24	20.83	21.42
P+20%	19.38	19.96	20.54	21.13

Source: Abu-Jamous (2009)

The results clearly show that the scenario of increasing temperature gets worse when combined with the scenario of decreasing precipitation; where (T+3, P-20%) scenario being the worst scenario resulted in additional 2.95 MCM required annually to overcome the water lost in evapotranspiration under the proposed scenario. It can be noticed that crops are highly affected by temperature change rather than precipitation change.

## **4.2 Energy**

The Palestinian Energy Authority (PEA) has not yet engaged in any climate change adaptation planning, so there are no policy statements on the potential energy impacts of climate change (e.g. demands from increased water pumping needs). However, the energy consequences of climate change impacts are most likely insignificant in relation to bulk power supply priorities in Palestine. There is continuing growth in energy demand across all sectors, but the PNA relies heavily on energy imports from Israel and is prevented from securing energy sources from other countries. In discussions with the Project Team, the PEA highlighted its strong interest in climate change mitigation and clean energy, notably the anticipated role for increased renewable sources and greater energy efficiency in an independent Palestinian energy system.

## **4.3 Public health**

Palestinians living in the affected areas are set to face health issues related to the lack of water such as diarrhea, cholera and dehydration. One main problem is the problem of mosquitoes which the population is already complaining about. The treatment of such a problem is expensive as the farmer/shepherd will be required to spray insecticide once every couple of weeks with an average of 1 liter per dunum.

The risk of parasitic disease may increase with climate change because increased annual and seasonal variability, elevated mean temperature, and extreme weather events may allow the spread of existing vectors and establishment of new invasive ones. Cold-sensitive vectors of human diseases, such as Leishmaniasis, tick-borne diseases etc., which proliferate in summer, are expected to increase in Palestine with the longer and hotter summers resulting from the projected delay of winter rains.

## **4.4 Coastal management**

Ministry of Environmental Affairs (2000) describes damages expected and observed to off-shore currents, sea bed fluctuations, seawater quality (from solid waste dumping and wastewater runoff) as a result of human activities: it also considers the impacts of sea level rise attributed to climate change. The combined impacts of human activities are forecast to be felt first and foremost by the fishing industry, which is already witnessing shifts from rocky to muddy or sandy habitats. Coastal erosion is also expected to increase as the sand in coastal areas is mined in quarries for use in construction.

## **5.0 Adaptation measures**

Adaptation practices may vary considerably among regions, countries and social groups: all of these may react to climatic variability and change in different forms. Effective adaptation practices are responsive to a wide variety of economic, social, political, geographic and environmental conditions, so criteria for success may be context specific. From this perspective, it may thus seem appropriate to provide here a framework of concepts, linked together in a flexible manner, e.g. in the form of a tool that helps policy makers and practitioners in the design, implementation or evaluation of the usefulness and chances for success of adaptation strategies and measures.

There are three types of adaptation options in the agriculture sector: technical (e.g. introduction of new cultivars), management (e.g. changes in cropping patterns, soil, landscape, water), or infrastructural (e.g. changes in drainage, irrigation systems, access, buildings). The type of measure will largely determine the extent to which farmers can adopt them without additional assistance. Farmers should be able to carry out some changes in management measures without support. This will also be true, to a large extent, for technical measures, while infrastructural measures are likely to require significant capital investment.

A Climate Change Adaptation Strategy for Palestine was a key output of a work programme for the Palestinian Environmental Quality Authority (EQA) funded by the United Nations Development Programme/Programme of Assistance to the Palestinian People (UNDP/PAPP). The Project Team adopted a vulnerability-based approach in developing the Strategy (Mason et al. 2009).

## **6.0 Adaptive Capacity-building**

There are major structural challenges internally facing the Palestinian National Authority (PNA) agencies critical to effective climate adaptation policy-making, which have been traced by observers to political differences, as well as resource and managerial weaknesses. In terms of internal PNA capacity-building, coordinated environmental information collection and use is an immediate priority. Adaptive capacity at the national level in Palestine is directly compromised by movement restrictions as well as insecure, insufficient water and land resources.

Effective climate risk management in Palestine requires the coordinated collection, analysis and dissemination of relevant information. There are many potential sources of information (both environmental and non-environmental), but data should be structured. Creating this information requires a focused approach where data is collected, stored, processed and analyzed and then disseminated according to priority issues and needs, as determined by dialogue among stakeholders. The challenge is to manage climate data in Palestine in such a way that it can be reliably generated and then readily converted for a variety of information uses by governmental and non-governmental actors.

### **6.1 National-level institutional capacity-building**

Already two national planning bodies have been highlighted as of strategic importance for mainstreaming climate change adaptation in the West Bank and Gaza (Mason et al. 2009):

- The integration of climate risk management with national disaster risk reduction under the responsibility of a revived *Higher Council of Civil Defense*;
- The strategic development of policies and measures relating to drought minimization and management under a *National Committee to Combat Desertification*.

It is recommended that the PNA should take responsibility for national climate change adaptation planning. National governmental institutions should serve to create the

conditions by which communities and individuals can improve their capacity to cope with climate stresses and hazards. Bearing in mind more pressing social, political and environmental priorities, the PNA is advised to consider adopting this Climate Change Adaptation Strategy (Mason et al 2009). This would imply: formalizing climate change adaptation planning within the PNA, with Environmental Quality Authority (EQA) confirmed as the line agency responsible for climate change adaptation planning, (in consultation with the Ministry of Agriculture, the PWA, and other ministries according to the forecasted sectoral impacts of climate change). The technical committee on climate change already established within EQA should continue in order to support this adaptation planning role.

## **6.2 Environmental Quality Authority (EQA)**

EQA is the lead agency on climate change for the PNA – a role that reflects the fact that EQA is the main Palestinian governmental body responsible for environmental protection. Its mission statement, which reflects Article 2 of the Palestinian Environmental Law No. 7/99, calls for EQA to “safeguard and protect the environment, control and limit the degradation of natural resources, prevent further pollution, enhance environmental awareness and ensure environmentally sustainable development.” EQA is the successor to the Ministry of Environmental Affairs, created by the PNA in 2000.

Capacity-building for climate change adaptation planning within EQA would need to include at least the following components (Mason et al. 2009):

- The formal designation of EQA as the line agency responsible for climate change adaptation planning within the PNA, in cooperation with the Ministry of Agriculture and the PWA (and in consultation with other ministries and specialised agencies according to agreed planning priorities);
- The continuation of the EQA technical committee on climate change to oversee the implementation of a national climate change adaptation strategy and to consider other climate change policy areas for development;
- The appointment of EQA as the lead agency within the PNA for coordinating the collection, analysis and dissemination of key information relating to climate variability and long-term change.
- The training of selected EQA and other PNA staff in climate change adaptation (and mitigation) planning and management, including technical training on the use of climate models. Such training should take advantage where possible of advanced professional development programs offered by external donors, but also be able to rely on a core training budget provided by the PNA;
- In cooperation with the Ministry of Agriculture and other agencies, the participation of EQA in the development of drought minimization and management guidelines for the *National Committee to Combat Desertification*;

### **6.3 Ministry of Agriculture**

Capacity-building within the Ministry of Agriculture to increase the resilience of farmers would include at least the following components (Mason et al. 2009):

- Routine monitoring of crop evapotranspiration rates, alongside rainfall and soil moisture;
- The incorporation of a climate risk management capacity in the proposed strengthening of the General Directorate for Planning and Policy;
- The development of drought minimization and management guidelines in support of the National Committee to Combat Desertification;
- Improved agricultural outreach and extension services;
- Strategic climate planning capacity (including modeling, in cooperation with EQA).

### **6.4 Palestinian Water Authority**

Capacity-building within the PWA to address climate variability and change would include at least the following components (Mason et al. 2009):

- Monitoring of groundwater quality and quantity;
- Monitoring of surface water (springs, wadis and the Jordan River);
- Incorporation of climate risk information in any new Fast-Track
- Approval process for new water infrastructure projects;
- Strategic climate change adaptation planning (including high-resolution hydrological modeling, in cooperation with EQA) in support of water policy-making.

## **7.0 Adaptation Integration into Policy and Planning**

Incorporating or integrating adaptation to climate change into planning processes is a necessary strategy for sustainable development over the long term. In many developing countries there are difficulties in integrating adaptation concerns into national policy due to low staff capacity for planning, monitoring and evaluation; poor data on adaptation options and lack of mechanisms for information sharing and management across sectors; and limited awareness of adaptation among stakeholders and the population. There are many factors that exacerbate the overall level of vulnerability in this region including political instability, widespread illiteracy and poverty of the rural population.

In order that real progress on adaptation can be made, key governmental departments (such as ministries of finance) need to be involved in the development of adaptation strategies. In the same way, national and local development planning agencies need to be informed by the relevant outputs of impact and vulnerability assessments, and environmental and sectoral institutions need to be strengthened in order to be able to address the complexities of addressing and coordinating the implementation of adaptation action. There are a number of actions that can help facilitate adaptation and integration of adaptation into policy, including actions at the local level (e.g. strengthening coping strategies and feedback to national policies), the national level (e.g. inter-agency coordination in the water sector and legal provisions for mainstreaming) and the regional level (e.g. incorporating climate change risks in projects of regional development agencies and the creation of intersectoral committees to be engaged in the formulation of adaptation plans).



Capacity-building at local, national and regional levels is vital to enable Palestine to adapt to climate change. It is important for stakeholders and funders to recognize the role of universities, tertiary centers and centers of excellence. Enhanced support is needed for institutional capacity-building, including establishing and strengthening centers of excellence and building up hydrometeorological networks. Training for stakeholders in all sectors would help the development of specialized tools for planning and implementing adaptation activities and thus promote action by local and national governments.

There is a need for capacity-building, training and increased public awareness as well as international support to build and strengthen environmental and sectoral institutions so that they can address the complexities of addressing and coordinating the planning and implementation of adaptation action.

Awareness on climate change risks and the need for adaptation should be raised among key sectors and mass media, including by using current events, such as economic, weather and health crises, as a basis to promote adaptation measures with co-benefits. Improving public awareness and developing overall communications strategies makes climate change science accessible to the average citizen and can reduce their vulnerability. Besides awareness-raising at local levels, it is also important to involve high-level policymakers to ensure integration of climate change risks into national development policies.

Given that many countries may experience similar effects from climate change, sharing experience can broaden knowledge on how to address the adaptation challenges. In this regard the cooperation on adaptation of the Levant countries is an effective tool for promoting the implementation of adaptation measures. There is still considerable scope and opportunity for regional and international collaboration.

## **8.0 Conclusions**

Current predictions from General Circulation Models (GCMs) are for significant decreases in annual rainfall over the region by the 2050s. This is combined with an increase in temperatures. A global-scale scenario cannot be reliably applied to Palestine, because of the small size of the country, the coarse resolution of current models and the great spatial inaccuracy of global models. The level of confidence in using GCM output directly is very low, so more sophisticated methods of “downscaling” GCM output for Palestine must be performed – primarily using dynamical methods, i.e. a high resolution regional model embedded within the GCM.

The comprehensive assessment of future climate risks requires in-depth domestic research capabilities. There is an identified need for the Palestinian National Authority (PNA) to acquire increased capacity for monitoring and modeling rainfall variability and long-term climate change in Palestine. Without such systematic analysis (which relies on expensive access to supercomputer capacity), there will remain significant uncertainties regarding future climate change impacts, and the policy prioritization of adaptation measures will rely more on expert judgment than the systematic quantitative reach of downscaled climate modeling.

Climate change is projected to have significant impacts on conditions affecting Palestinian water and agriculture sectors.

Adaptation practices should be implemented after careful evaluation. Effective adaptation practices are responsive to a wide variety of economic, social, political, geographic and environmental conditions, so criteria for success may be context specific. The process of identifying potential adaptation measures should involve two main stages: analysis of relevant literature and ongoing studies and a stakeholder consultation exercise to obtain practical information on adaptation measures

Of the adaptation options identified for Palestine, it is recommended that prioritisation is given to these no-regrets (low cost) and low-regrets (medium cost) measures which are judged to have the highest levels of adaptive capacity and technical feasibility.

There is a need for capacity-building, training and increased public awareness as well as international support to build and strengthen environmental and sectoral institutions so that they can address the complexities of addressing and coordinating the planning and implementation of adaptation action.

Cooperation on adaptation of the Levant countries is an effective tool for promoting the implementation of adaptation measures. There is still considerable scope and opportunity for regional and international collaboration.

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