Climate Change Adaptation Strategy and Programme of Action for the Palestinian Authority

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Annex I:

Questionnaire on the impacts of climate change on water resources and on potential adaptation strategies in the occupied Palestinian territory

Acronyms and Abbreviations

AHLC	Ad Hoc Liaison Committee
CAP	Consolidated Appeal Process
CMWU	Coastal Municipalities Water Utility
DWQ	drinking water quality
ECHO	European Commission Humanitarian Aid Office
DRR	Disaster Risk Reduction
EQA	Environmental Quality Authority
FAO	Food and Agriculture Organization
FTAP	Fast-Track Approval Process
GCM	General Circulation Model
GDP	Gross Domestic Product
GEF	Global Environment Facility
HCCD	Higher Council of Civil Defence
ICRC	International Committee of the Red Cross
IDF	Israeli Defense Forces
IPCC	Intergovernmental Panel on Climate Change
MCM	million cubic metres
MDG	Millennium Development Goal
NAPA	National Adaptation Programme of Action
NGO	Non Governmental Organisation
OCHA	(UN) Office for the Coordination of Humanitarian Affairs
oPt	occupied Palestinian territory
PAPA	Palestinian Adaptation Programme of Action
PEA	Palestinian Energy Authority
PA	Palestinian Authority
PLO	Palestinian Liberation Organisation
PNPA	Palestinian National Policy Agenda
PRDP	Palestinian Reform and Development Plan
PWA	Palestinian Water Authority
RCM	Regional Climate Model
SIDA	Swedish International Development Cooperation Agency
UCODEP	Unity and Cooperation for the Development of People
UNDP	United Nations Development Programme
UNDP/PAPP	United Nations Development Programme/Programme of Assistance to the Palestinian People
UNFCC	United Nations Framework Convention on Climate Change
UNRWA	United Nations Relief and Works Agency for Palestine Refugees
USAID	United States Agency for International Development
WFP	World Food Programme
WHO	World Health Organisation

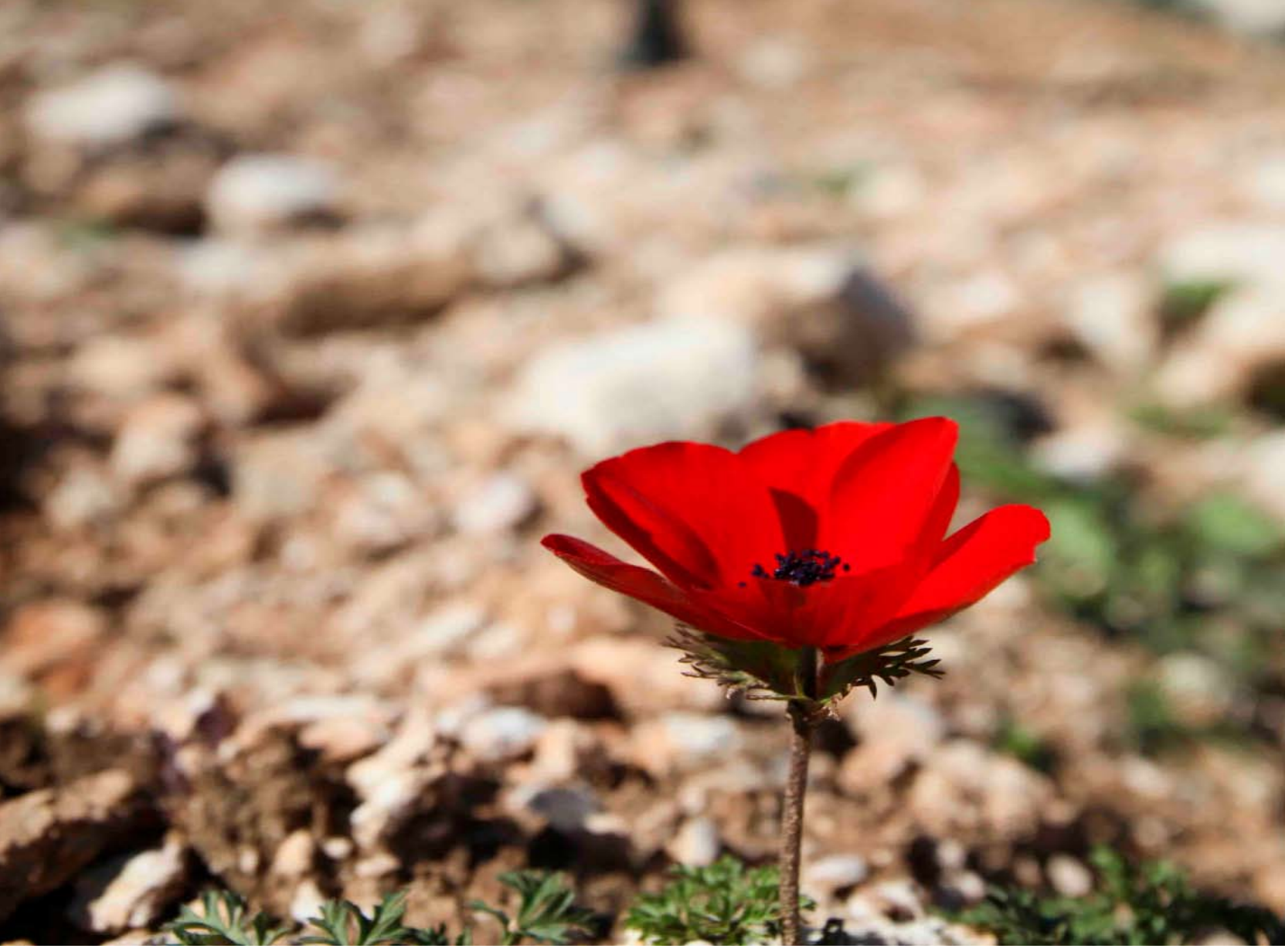
Preface

Climate Change is no more an illusion. Its impact is globally witnessed and interventions must be highly addressed at international, regional and national levels. Recognizing this reality, governments and communities have to actively respond to this phenomena aiming at minimizing the rate of this change and raising the resilience of local communities to cope with its impact.

The occupied Palestinian territory, as part of the Eastern Mediterranean, is subject to many serious changes in annual rainfall, mean temperature, extreme weather events and sea level rise as stated in the fourth assessment report by IPCC. The Palestinian National Authority, represented by the Environment Quality Authority (EQA), took the lead in developing the "National Climate Change Adaptation Strategy" with support from UNDP/PAPP. Stakeholders representing all scrotal groups, including officials, researchers, representatives of NGOs, CBOs and local communities, were actively involved in preparation of this national strategy. A National Committee for Climate Change is already active and working towards highlighting the impact of climate change on different sectors aiming at developing the National Action Plan for Adaptation. We are looking forward to cooperating with the international community to actively and properly adapt to the impact of climate change to protect our planet.

On behalf of H.E. Dr. Yousef Abu Safieh, Chairman of EQA and all EQA staff I would like to thank UNDP/PAPP for funding the development and publication of this strategy. Thanks are extended to the team of experts who made every possible effort to develop the strategy based on extensive stakeholders' consultations. Finally thanks to all stakeholders who actively participated in this effort.

Jameel Mtour
Deputy Chairman of EQA



Palestinian Adaptation Programme of Action

Executive Summary

1. There is clear support for climate change adaptation planning from the Palestinian Authority (PA), which includes all ministries consulted by the Project Team – Environmental Quality Authority (as lead agency), Palestinian Energy Authority, Palestinian Water Authority, Ministry of Agriculture, Ministry of Planning, and Ministry of Transport. Support from leading Palestinian environmental NGOs is more qualified, relating to a perception that climate change vulnerability needs to be understood in the political context of the Israeli occupation. However, all parties have endorsed the stakeholder-driven determination of adaptation priorities supported by UNDP/PAPP, including the need to ensure that climate adaptation planning supports the humanitarian and development needs facing governing authorities in both the Gaza Strip and the West Bank.

2. The *Palestinian Adaptation Programme of Action* (PAPA) – and its companion document, the *Climate Change Adaptation Strategy for the Occupied Palestinian Territory* – both adopt the concept of climate vulnerability, defined here as *the propensity of people or systems to be harmed by climate hazards in the context of other domains of vulnerability, as well as in relation to response capabilities in both the short-term (coping) and the long-term (adaptation)*. Input from stakeholders in the West Bank and the Gaza Strip corroborated the initial premise of the Project Team that the water sector in the oPt justifies priority focus in terms of climate change impacts, and that agriculture is the Palestinian economic sector most sensitive to climate hazards, both current and future. This led to a *strategic adaptation focus on reducing water insecurity and food insecurity.* Within the oPt, the Project Team identified three regions (case studies) as having particularly high levels of climate vulnerability – *Massafer Yatta* (West Bank), the easternmost oPt areas of the *Jordan River Valley* (West Bank) and *the Gaza Strip*.

3. The most significant environmental effects of climate change for the people of the occupied Palestinian territory (oPt), 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 a realistic emissions scenario (Scenario A1B). Annual precipitation rates are likely to fall in the eastern Mediterranean – decreasing 10% by 2020 and 20% by 2050 – with an increased risk of summer drought.

4. There remain significant uncertainties about the precise impacts of climate change in the region. Indeed, *it is not possible at the moment, with high scientific confidence, to differentiate climate hazards in the oPt on the basis of natural climate variability or long-term climate change*. A precautionary approach is adopted in which improving adaptive capacity in the oPt – both for institutions and communities – delivers 'no-regrets' and 'low- regrets' benefits in terms of disaster risk reduction and human development even if long-term climate trends are less harmful than predicted. Furthermore, *there is a need for climate modelling and research capacity-building in the oPt tailored to Palestinian adaptation priorities in the face of future climate risks*.

5. Already under significant pressure from rapid demographic growth, economic development and restrictions on development from Israel, *freshwater resources in the oPt are predicted to become scarcer as climate change causes decreases in annual participation*. If the major asymmetries in water availability between the oPt and Israel remain, the political tensions that exist will be exacerbated. Water scarcity is not a robust predictor of violent conflict as 'virtual water' (water imported in the form of food) can ease local water or food shortages. But virtual water imports can only serve as an effective means of climate change adaptation for the Palestinians if there is sustainable economic growth. The expected increased scarcity also means that the strategic planning of the agriculture sector by the PA needs to consider the potential impacts of climate change on food availability elsewhere in the world.

6. *Historic forms of household and community coping by Palestinians in the face of climate and other hazards offer potential templates for adaptation to climate change in the oPt.* However, the ongoing effects of the Israeli occupation undermine the conditions necessary to their operation, both *economic* – the free movement of goods and people – and *political* – national self-determination and democratic governance. Indeed, the continuing Israeli occupation fosters a wide range of maladaptive policies and practices (e.g. subsidised water-intensive livestock farming by settlers and the destruction of Palestinian olive groves) that frustrate the development of Palestinian resilience to climate hazards. In both the West Bank (and especially the Gaza Strip), the enforced *coping strategies* of Palestinians as a result of access and movement restrictions are incompatible with the effective delivery of human development goals.

7. Disaster risk reduction (DRR) – the development and implementation of policies and practices that minimise risks from disasters – is the first line of institutional defence against serious climate change impacts. Development of the DRR capacity within the PA is critical to effective climate change adaptation within the oPt. It is recommended, based on stakeholder feedback, that *a revived Higher Council of Civil Defence would be an effective vehicle for mainstreaming climate risk reduction at a strategic level within the PA*. This will require more systematic information on climate-related risks in order to provide an integrated understanding of the role of climate hazards in relation to other civil defence challenges facing Palestinians. It is recommended, therefore, that *the Environmental Quality Authority serves as the lead agency within the PA for co-coordinating the collection, analysis and dissemination of information relating to the risks created by climate variability and long-term climate change*.

8. There is enough agricultural information and meteorological evidence to justify priority risk management by the PA to address the impacts of drought and desertification in the oPt. *The National Committee to Combat Desertification is the appropriate Palestinian strategic body to take lead responsibility for developing policies and measures relating to drought minimisation and management*. This body needs to be actively supported by a technical committee comprising relevant PA ministries (especially the Palestinian Water Authority, the Ministry of Agriculture, and the Environmental Quality Authority). A drought early-warning system for the oPt is already under development. This will improve data collection on rainfall and **soil** moisture, providing a more scientific basis for minimising the risk of drought and desertification.

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

No-regrets adaptation (in no order of priority)

1. Development of flood contingency plans
2. Local increases in rainfall interception capacity
3. Establishment of clear water use priorities
4. Introduction of more efficient irrigation techniques
5. Review of drinking water quality management systems to
6. incorporate climate risks
7. Increased (sustainable) production of freshwater
8. Increased use of brackish and treated wastewater re-use
9. Equitable and reasonable utilisation of transboundary water resources between the Israelis and the Palestinians (involving a fairer allocation of groundwater and freshwater)

Low-regrets adaptation (in no order of priority)

1. Prioritisation of irrigation for highest value crops
2. Increased use of water harvesting
3. Protection of coastal sand dunes in the Gaza Strip
4. Diversification of rural livelihoods
5. Incorporation of climate adaptation in land use planning
6. Increased use of precision agriculture for improved soil and crop management
7. Selection of crop and ruminant selections for more tolerance to heat and drought

8. Consideration of no-regrets and low-regrets options does not mean that high cost adaptation measures should be ignored. Those judged to have both high adaptive capacity and technical feasibility include:

   - Increased water use efficiency from infrastructure investment
   - Development of 'new water' sources, including new major (150 MCM/year) desalination capacity for the Gaza Strip
   - New coastal protection structures for the Gaza Strip (e.g. wave breaks and offshore protection structures)

   These are the types of sector-wide options that may be considered by PA donors, especially for investment programmes planned already for human and economic development reasons.

9. Helping the PA mobilise sources of funding for climate change adaptation actions will require targeted communications work with potential donors. The PA has no direct access to any of the climate change adaptation financing available to Parties under the United Nations Framework Convention for Climate Change (UNFCCC) and Kyoto Protocol. International recognition of the legitimacy and urgency of Palestinian climate change adaptation needs is key to securing necessary financial assistance for vulnerable sectors and communities. There are strong legal grounds for allowing Palestinian participation in UNFCCC. Adaptation funding should be additional to existing official development and humanitarian assistance to the oPt.

Palestinian Adaptation Programme of Action

1. Introduction

According to the Intergovernmental Panel on Climate Change, global warming is already altering the world's climate. Its impacts are felt in all sectors of society, through changes in temperature and precipitation as well as through changes in the frequency and intensity of climatic extreme events. The impacts of climate change are likely negatively to affect progress toward development in the occupied Palestinian territory (oPt) in a number of key areas including agriculture and food security, water resources, coastal zones, public health, climate-related disaster risk management and natural resources management. Climate change will thus constrain the ability of the Palestinian Authority (PA) to reach poverty reduction and sustainable development objectives consistent with the United Nations (UN) Millennium Development Goals (MDGs).

In 2007, in consultations with the UNDP/PAPP (United Nations Development Programme/Programme of Assistance for the Palestinian People), the Environmental Quality Authority (EQA) – the lead environmental agency for the PA – identified the need to develop Palestinian decision-making capacity for climate change adaptation. UNDP/PAPP and EQA jointly agreed the terms of reference for the appointment of consultancy support for the initiative, and in October 2008 appointed a consultancy team to draft an adaptation strategy and programme for the oPt. It was agreed that this work should be guided by extensive stakeholder consultations.

The consultancy team (the 'Project Team') consisted of three environmental experts from leading universities addressing climate change adaptation, together with UNDP/PAPP and EQA. The Project Leader was Dr. Michael Mason of the Grantham Research Institute on Climate Change and the Environment, London School of Economics and Political Science (LSE). Co-consultants were Dr. Ziad Mimi, Director of the Institute of Environmental and Water Studies (IEWS) Birzeit University, and Dr. Mark Zeitoun, LSE (and, from January 2009, the University of East Anglia). Their combined expertise covered the specialist knowledge required for the development of a *Climate Change Adaptation Strategy for the Occupied Palestinian Territory and a Palestinian Adaptation Programme of Action*.

The initial premise of the Climate Change Adaptation Project Team, based on a review of climate change scenarios for the eastern Mediterranean, was that the most important environmental effects of climate change for the oPt, over the course of this century, are likely to be a decrease in precipitation (with significant seasonal variation) and significant warming. This premise, which favours an adaptation focus on *water insecurity* – the lack of access of individuals to sufficient safe water for heath and well-being – was confirmed in consultations with stakeholders in the Gaza Strip and the West Bank during November 2008-January 2009. Water insecurity is above all about the absence of control and effective management of scarce water resources. This can apply locally, nationally and across borders: if water is not equitably allocated for agriculture and other food production, as in the case of transboundary water resources straddling Israel and the oPt, water insecurity can directly impact on *food security*. Therefore this report considers also food insecurity – defined for the oPt as households with income and consumption below $1.6 US per capita per day and households showing a decrease in total food and non-food expenditures (Food and Agriculture Organization 2007a: 58) – as a potentially major outcome of climate variability and/or change in the oPt.

This *Palestinian Adaptation Programme of Action* is informed by adaptation policy frameworks endorsed by UNDP (Lim et al. 2005). From these frameworks, the Project Team adopted a *vulnerability-based approach* in developing the climate change adaptation programme and strategy. In the oPt there are complex relationships between the climatic and non-climatic drivers of vulnerability. Climate-related events that are potentially harmful constitute hazards. Climate hazards are physical manifestations of climate variability or change: these can be events – such as droughts and heavy rainfall episodes – or longer-term changes in the mean value of climatic variables. *It is not possible at the moment to differentiate climate hazards in the oPt on the basis of climate variability or long-term climate change with any scientific rigour.* It will be argued in this report that a precautionary approach is warranted in which improving adaptive capacity in the oPt – both for institutions and communities – will deliver 'no regrets' and 'low regrets' benefits in terms of disaster risk reduction and human development even if long-term climate trends are less harmful than predicted.

This report is a companion volume to the *Climate Change Adaptation Strategy for the Occupied Palestinian Territory* (UNDP/PAPP 2009c) released at the same time. The *Climate Change Adaptation Strategy* sets out in detail the Vulnerability Assessment and Future Climate Risks Assessment by which key adaptation needs and options for the oPt are justified. The purpose of this *Palestinian Adaptation Programme of Action* is to:

- **Summarise the findings of the Vulnerability Assessment and Future *Climate Risks Assessment in the UNDP/PAPP Climate Change Adaptation Strategy for the occupied Palestinian territory***
- **Set out the consultation process by which the Palestinian adaptation strategy and programme of action were developed**
- **Identify key adaptation needs for the oPt**
- **Identify priority adaptation measures for the oPt**
- **Provide recommendations for the mainstreaming of climate change adaptation in the oPt**

The structure of this *Palestinian Adaptation Programme of Action* (PAPA) follows the format for National Adaptation Programmes of Action (NAPAs) prepared by Least Developed Countries under the United Nations Framework Convention on Climate Change (UNFCCC); however, as 'Palestine' as a Party is not recognised in this convention, the PAPA does not yet have any formal recognition within the UNFCCC (see Section 5.4).

The **Framework of Adaptation Programme** (Section 2) outlines current and projected climate conditions in the oPt, then summarises socio-economic conditions and trends. With reference also to stakeholder consultations, the main sources of vulnerability are then set out, before positing the main climate risks in terms of water and food security. Section 2 finishes with the main parameters for adaptation planning in the oPt, as determined by Palestinian national planning priorities and as assisted by UNDP/PAPP.

Section 3 – **Identification of Key Adaptation Needs** – discusses the various means of stakeholder participation employed by the Project Team: these included consultations, a questionnaire survey, scoping meetings and field observations. Stakeholder input was necessary to characterising current and future climate vulnerability in the oPt. Section 3 includes graphic summaries of the climate vulnerability pathways identified by stakeholders in the Gaza Strip and the West Bank (the development of these pathways is described in more detail in Section 3 of the *Climate Change Adaptation Strategy for the Occupied Palestinian Territory*). This is followed by a summary of sector vulnerabilities to climate change.

The **Identification of Priority Adaptation Measures** in Section 4 is focused on proactive (planned) actions, which are designed to reduce the severity of climate change impacts. Building on the vulnerability assessment of the *Climate Change Adaptation Strategy*, these adaptation measures cover options for the Palestinian water sector and agricultural land use. Priority is given to 'no regrets' (low cost) and 'low regrets' (medium cost) measures which combine high adaptive capacity and high technical feasibility. There are also high cost adaptation measures identified which are judged to have high adaptive capacity and technical feasibility, but these would need significant donor funding.

The overriding goal of the *Palestinian Adaptation Programme of Action* is to identify the most effective means by which the PA can enhance the capacity of the Palestinians to cope with current and future climate hazards. This requires the integration of climate change adaptation in national policy-making, which is discussed in Section 5: **Mainstreaming Climate Adaptation in the oPt.** First, information needs for climate risk management are identified, then key aspects of national-level institutional capacity-building are discussed. Monitoring and evaluation, which is necessary for the successful delivery of a Palestinian climate adaptation strategy, is then addressed. Given that there is currently no Palestinian presence in the UNFCCC, it is important that the international community recognises the climate vulnerability of the oPt. Section 5 therefore finishes with an examination of this issue and also a short discussion of the availability of international financing for climate change adaptation in the oPt.

The **Conclusion** summarises the main findings of the *Palestinian Adaptation Programme of Action*. There are important technical and financial challenges to the development of effective climate adaptation planning in the oPt, but the most significant constraints are external political barriers, as represented by the continuing Israeli occupation of the West Bank and the Gaza Strip. The political feasibility of addressing these barriers depends of the uncertain prospect of final status negotiations between the Palestinians and Israelis. It is conceivable, nevertheless, that the shared challenge of climate change could at least lead to Palestinian-Israeli technical cooperation.

2. Framework of Adaptation Programme

2.1 Current climate conditions

Climate change will lead to an intensification of the global hydrological cycle and is likely to have major impacts on regional water resources, affecting both ground and surface water supply for domestic and industrial uses, irrigation, in-stream ecosystems and water-based recreation. 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).

Climate change is projected to have significant impacts on conditions affecting global agriculture, including temperature and precipitation. Agriculture is still directly dependent on climate, since heat, sunlight and water are the main drivers of crop growth. While some aspects of climate change – such as longer growing seasons and warmer temperatures may bring benefits – there will also be a range of adverse impacts, including reduced water availability and more frequent extreme weather events. These impacts may put agricultural activities, certainly at the level of individual land managers and farm estates, at significant risk (AEA Energy & Environment 2007).

Where there has been limited high-resolution climate modelling for the eastern Mediterranean region, increased warming is forecast this century, combined with changes in rainfall amount and distribution. Some scientists have argued that climate changes are already happening: analyses of precipitation and temperature data in the last century reveal rising summer temperatures and a delay in the rainfall season (Khatib et al. 2007), as well as increasing inland aridity (Kafle and Bruins 2009). Agricultural production in the oPt has already been affected by recent droughts and climate predictions suggest that these will become more pronounced over time. Thus, a great challenge for the PA in the coming decades will be the task of increasing food security (by domestic production and/or imports) in conditions of increased water stress. However, it is argued below (Section 2.3) that the influence of forecast climate changes on water availability in the oPt is still much less significant then water allocation patterns determined by Israel.

The climate of the oPt is traditionally described as 'Mediterranean', which is characterised 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 2.1): climatic zones range from extremely arid to humid according to the De Martonne aridity index classification for arid areas (Land Research Centre 2007).

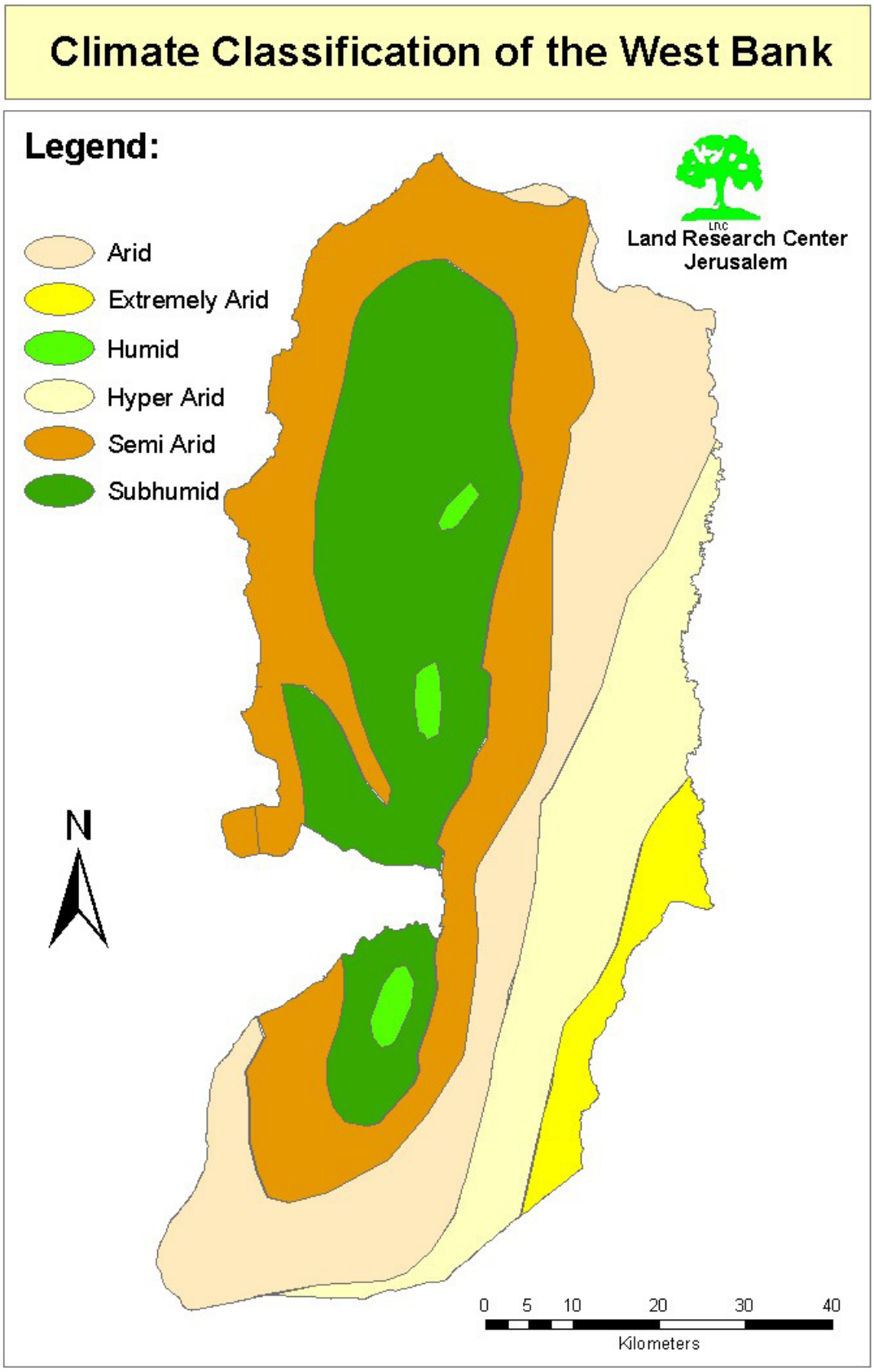


Figure 2.1: Climate classification of the West Bank

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: 2). 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).

Despite its small area (365km2) and generally flat terrain, there are also significant variations in the Gaza Strip'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). The Gaza Strip experiences hot, dry summers and mild winters. There is already some evidence that global warming is affecting the Gaza Strip: 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 mimimum temperature values (El-Kadi 2005). This finding is corroborated by Israeli research demonstrating that average temperatures in the eastern Mediterranean have increased steadily over the last 100 years (Krichak et. al 2007).
The present problems in the oPt that are related to water are many and varied. As in Israel and Jordan – also with limited water resources – the last eight years have seen reductions in the amount of rainfall received. Average rainfall for the West Bank during 2008-9 was 425mm – 22 percent below the historic average of 538mm, and at 316.3mm for the Gaza Strip was 12% below the historic average. The Palestinian Ministry of Agriculture recorded negative impacts of rainfall reductions on agricultural production in the West Bank, with problems to winter crops from delayed rains in the Gaza Strip; though agricultural conditions there were impacted more by Israeli military and security activities (Ministry of Agriculture 2009).

The oPt has low levels of per-capita water availability – three-quarters of the population are estimated to consume between 60-100 litres for domestic use per person per day (Zeitoun 2008: 14), compared to 330 litres/person/day in Israel. In the West Bank, average water availability for Palestinians is the lowest at 50 litres/person/day, which contrasts with the 369 litres/person/day used by Israeli settlers (Palestinian Hydrology Group 2006; World Bank 2009). The WHO *minimal* standard for daily water consumption for direct human consumptive and hygiene needs is 100 litre/person/day (Chenoweth 2008: 247). Continuing population growth and predictions for regional climate change – with associated changes in precipitation levels and distribution – will intensify water stress for Palestinians. Indeed, it has been estimated that the oPt will experience a water deficit of 271x106 m3 by 2020 (Mimi et al. 2003). Forecasted climate changes for the eastern Mediterranean mainly affect the start and duration of the different seasons, and the quantity of rainfall. This has two anticipated effects: firstly, periods of heavier rainfall will be concentrated in a shorter time, with consequent increased run-off and erosion and decreased absorption capacities of the soil. Less retained water will result in lower pasture production, forcing herders to purchase (more) fodder. Secondly, on the other hand, reduced rainfall will result in a lower quantity of water harvested and stored in cisterns, forcing herders to purchase (more) tankered water.

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 to increase with the anticipated decrease in water availability, hotter temperatures and shorter winters. Under such conditions, 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 would cause Palestinian agricultural sector to lose its advantage over countries in colder climates as an early exporter of flowers, fruits and vegetables (Palestinian Ministry of Agriculture 2008).

2.2 Climate projections

For the eastern Mediterranean, climate predictions have to contend with a lack of scientific observations on regional atmospheric conditions and limited long-term environmental data. There are also unresolved issues regarding the calibration of Atmosphere-Ocean General Circulation Models (GCMs) and Regional Climate Models (RCMs) in order to simulate conditions consistent with environmental processes of particular importance to the Mediterranean region, such as the incorporation of dust into the atmosphere and multiple sources of pollution (Wigley 1992: Mellouki and Ravishankara 2007). However, regional climate change simulations undertaken by different models have delivered a surprisingly consistent account of climate change over the Mediterranean (Giorgio and Lionello 2007; Plan Bleu 2008). These forecasts give general 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 and 5.1ºC 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).

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 the oPt:

- 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).

- The GLOWA-Jordan River RCM, which uses an American non-hydrostatic meteorological model with nested steps at resolutions of 54km2, 18km2 and 8km2 **(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: 1-41, GLOWA-Jordan River Project 2008; Khatib 2009).

- The Sea Atmosphere Mediterranean Model **(SAMM)**, which combines the French AGCM ARPEGE-Climate Model of 50 km2 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 the oPt because of the use of simplifying parameterisations, the different emission scenario runs and, given the small size of the territory (6020 km2), 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 the Gaza Strip. Above all, *none of these models takes into account socio-economic impacts particular to the oPt*, which suggests the need for a regional downscaling model tailored to address Palestinian adaptation priorities in the face of future climate risks (see Section 5.1). More generally, a *multi-model comparative approach* is necessary to reduce uncertainty regarding the future impacts of climate change in the eastern Mediterranean.

2.2.1 Temperature

A pronounced warming for the eastern Mediterranean is projected throughout this century by each of the climate models above, which would be highest in the summer season. The GLOWA MM5 model and French SAMM model (Figure 2.2) both predict temperatures rises up to 3.5°C by the end of the century with warming stronger in the summer than the winter, while the JMA-AGCM model forecasts annual mean surface temperature rises for the region of between 2.6°C (moderate climate sensitivity) and 4.8°C (high climate sensitivity) for the region. Recent runs of the ECHAM4 and HadCM3 GCMs under the B2 emissions scenario confirm substantial temperature rises of up to 4°C for the eastern Mediterranean region (Hertig and Jacobeit 2007). Increases in inter-annual variability of temperatures, along, with mean warming, are also forecast to lead to a greater number of high temperature events (Giorgi and Lionello 2007).

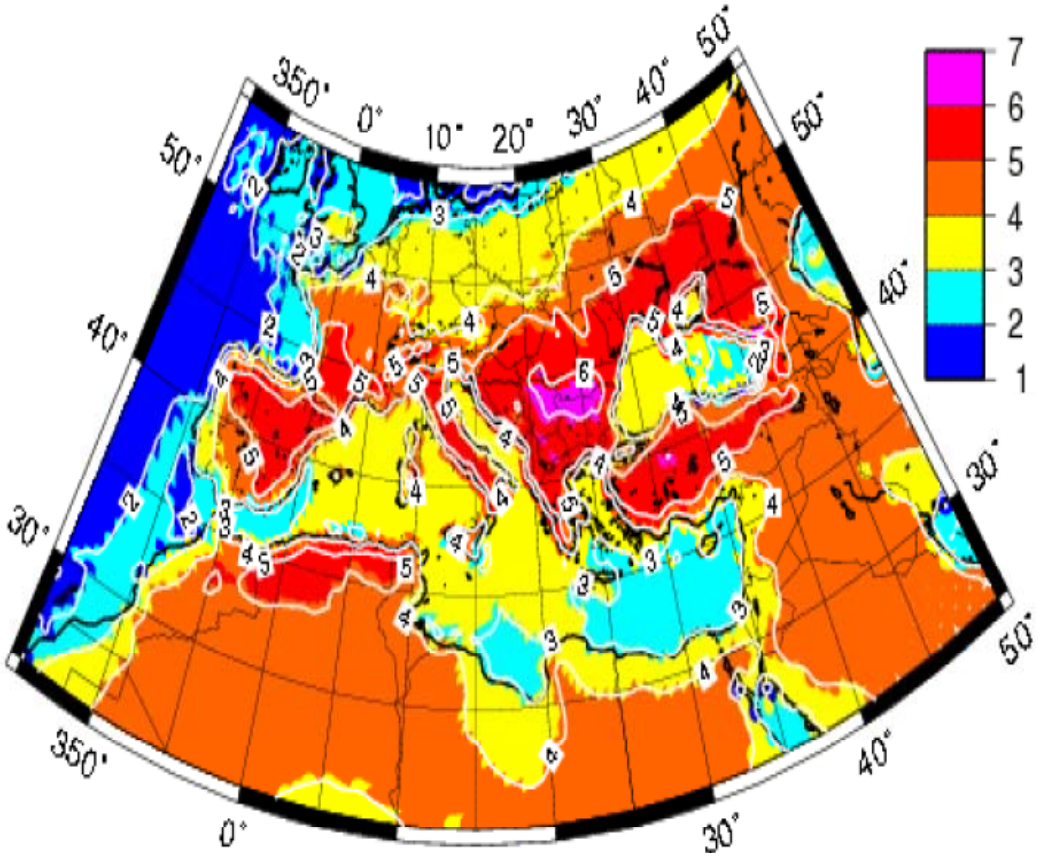


Figure 2.2: Forecasted annual mean variation of air temperatures in summer oC – 2070-99 vs.1961-90 (Source: Somot et al. 2008: 119)

2.2.2 Precipitation

There is significant uncertainty regarding forecasted precipitation patterns for the eastern Mediterranean and the Middle East, in part because of insufficient observational data for the oPt. For example, in the mid-1990s Israeli researchers (Ben-Gai et al. 1996) 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: 5-7).

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 precipitation by 2100 of up to 35% compared to late twentieth century timelines. As shown in Figure 2.3, The GLOWA MM5 run between 1958-1996 and 2007-2045 forecasts a mid-century decrease in precipitation by 100 to 200mm in the northern oPt (above 31ºN), and a shift in the rainfall season into March and April (Khatib 2009). Precipitation falls are attributed to increased anticyclonic circulation and stability. Combined with an increase in temperatures, this drying is forecast to causing higher losses from evaporation. The two climate models incorporating hydrological discharge calculations have divergent results for the Jordan River – the WaSim hydrological model coupled with the GLOWA MM5 forecasts discharge reductions of up to 40% by 2070-2099, while JMA-AGCM projects a dramatic 82-98% collapse in the Jordan River flow (at an unspecified location) by 2100.

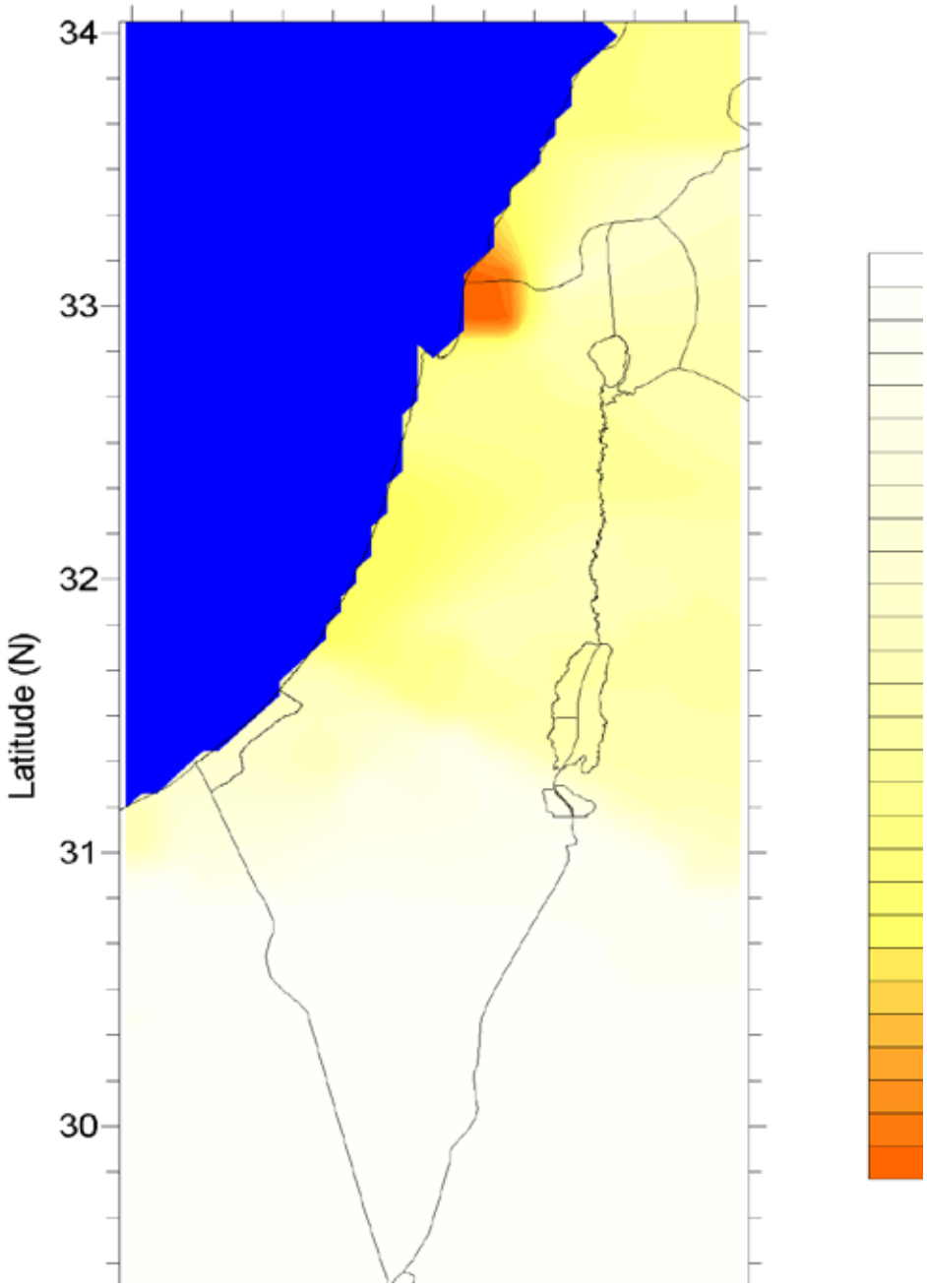


Figure 2.3: Forecasted changes in precipitation, under IPCC emissions scenario A1B, for 2007-2045 compared to annual average precipitation during 1958-1996 (Source: GLOWA-Jordan River Project 2008)

Recent data on average annual rainfall for the West Bank and Gaza Strip does indicate a decline since 2002/3: at 354.1mm the 2007/8 annual rainfall for the West Bank was at 66% of the 25-year historical average; while at 261.9mm the 2007/2008 average rainfall for the Gaza Strip was the lowest since 1999 and 73% of the 25-year historical average (Ministry of Agriculture 2008). The period is too short, of course to confidently attribute this recent fall-off in rainfall as part of longer-term decline induced by climate change as opposed to 'natural' climate variability. It is clear that the expected changes in precipitation (and humidity) will affect groundwater sources. No studies have been carried out on this to date, however, and the impacts of changes in climate on groundwater resources is difficult to estimate with any certainty.

2.2.3 Extreme weather events

There is an indication from the regional climate models that a tendency towards more extreme weather events can be expected for the eastern Mediterranean as a result of climate change. This includes a higher number of yearly days of high temperature (daily maximum temperatures above 30°C), though there is more uncertainty here than with general temperature and precipitation trends. The Applied Research Institute-Jerusalem (2006) has identified nine extreme weather events in the oPt from 1997-2004, including acute heat waves (July-August 1998, July 2000, May 2004), a major sand storm induced by the lowest recorded atmospheric pressure in May 2003, and heavy spring storms in the West Bank (March 1997) and Jerusalem (January 1999). Israeli forecasts of regional climate change also feature a prediction of more extreme and volatile weather conditions throughout this century (Office of the Chief Scientist 2008).

For the oPt, high precipitating events (HPEs) leading to flash floods are of particular significance in contexts in which the regional water management infrastructure lacks resilience. Such was the case in the Gaza Strip at the end of October 2008, where stormwater and wastewater drainage systems were overwhelmed by an unusually intense HPE-induced flash flood (Figure 2.4). Beaulant et al. (2008) have run the SAMM climate model to reproduce precipitation systems typical of Mediterranean regions, including HPEs, but this has not yet been applied to the specific hydrological contexts of the oPt. Ongoing research with the GLOWA MM5 model is focusing on an analysis of extreme events (Khatib 2009).

Figure 2.4: The disruptive and destructive impacts of a flash flood in the Gaza Strip, following 36-hours of heavy precipitation on 27-29 October 2008 (Source: UNDP/PAPP).

2.2.4 Evapotranspiration

The combination of temperature increases and reduced precipitation caused by global warming is conventionally expected to increase evapotranspiration rates. With limited long-term data sets for the oPt, none of the regional climate models is capable of generating plausible predictions on evapotranspiration for the West Bank and the Gaza Strip. Below (Section 3.4.2), we summarise one of the few scientific efforts to model the agricultural effects of climate-induced evapotranspiration rates for two governorates in the West Bank. In addition, the Applied Research Institute-Jerusalem (2006) has examined changing evaporation rates in the Gaza Strip by comparing averaged data sets for 1925-1934 and 1997-2005. This analysis recorded *reduced* average monthly evaporation rates, which is explained in part by a long-term rise in soil salinity as a result of growing groundwater extraction. Such apparent anomalies highlight the continuing uncertainty attached to predicting climate change impacts in local environmental contexts within the oPt, as well as the need to enhance significantly the data collection and climate modelling capacity of the PA.

2.2.5 Sea level rise

Without considering climate change, the Ministry of Environmental Affairs 2000 Plan for Coastal Protection and Environment cites sources predicting annual storm surges of 64cm, with century surges rising up to 110cm (Ministry of Environmental Affairs 2000). According to different greenhouse gas emissions scenarios (IPCC 2000), sea levels are forecast, by 2100, to rise at least 18 to 38cm (emissions scenario B1) and as much as 26 to 59cm (emissions scenario A1F1) (IPCC 2007). Recent research on polar ice flow processes has indicated that these estimates in the IPCC *Fourth Assessment Report* may be too conservative. Indeed, in its *Climate Change Adaptation Programme* (2008), the Israeli Ministry of Environmental Protection anticipates a 10mm/year rise in sea level in the Mediterranean, though this dramatic forecast is on the basis of expert consultation rather than robust climatological analysis (Office of the Chief Scientist 2008). 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. Improved data collection and analysis would improve scientific understanding on why, since 1993, the sea levels in the Eastern Mediterranean have risen more than the Western Mediterranean (Plan Bleu 2008: 1-22). 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 the Gaza Strip, through the 'saline intrusion – livelihoods' vulnerability path identified below (3.5.2)

2.3 Current socio-economic conditions and trends

Current socio-economic and political conditions in the oPt are increasing the vulnerability of those groups and sectors most exposed to the negative effects of present climate variability and future climate change. The oPt is ranked 106 in the Human Development Index for 2007/8, in the middle-lower income of countries, although this ranking masks major regional and local disparities. According to 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. Following the end of the *Second Intifada* in February 2005, expectations were raised that the oPt would likely meet most MDGs by 2015 (Palestinian National MDG Steering Committee 2005), but recent trends show a sharp deterioration: 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 2009a).

According to the PA, there are substantial pressures on the social service infrastructure – especially public school and hospitals – arising from the high birth rate, with a population growth rate of 3.4% per annum in the oPt. This is one of the highest in the Middle East and North Africa and 75% of the population is now under the age of thirty. The young population has borne the brunt of a recent deterioration in health and employment prospects – with young women facing higher hurdles for educational and economic advancement. (Palestinian National Authority 2008: 22). It is recognised

that, for reasons more to do with the lack of political and economic sovereignty than demographic growth as such, the expanding population is becoming increasingly poor and vulnerable, leading to higher numbers dependent on social and humanitarian assistance.

The human development situation in the Gaza Strip is particularly bad. Even before Israel undertook *Operation Cast Lead* in Gaza (December 27 2008 to January 18 2009), Israeli economic sanctions and an external blockade had triggered a collapse in industrial activity and an historically high unemployment rate (49% just prior to Israeli military operation in December 2008). Aside from the high level of human casualties caused by *Operation Cast Lead*, post-conflict damage assessment indicated a serious threat to food and water security in the Gaza Strip – the razing of up to 18% of cultivated lands (including the destruction of greenhouses, livestock and poultry farms), serious damage or destruction to eleven registered groundwater wells and four water reservoirs, as well as damage to 19,920 metres of water pipes (UNDP/PAPP 2009b: Palestinian National Authority 2009).

The first Millennium Development Goal (MDG 1 – the eradication of extreme poverty and hunger) is deemed by UNDP to be unlikely to be achieved by 2015 for the oPt as a whole. A recent survey of the latest available household and expenditure data for the West Bank and the Gaza Strip confirms that the oPt has faced a deepening of poverty, which relates to a continuing deterioration of living conditions (UNRWA 2009). A food security assessment undertaken by the Food and Agriculture Organization in March/April 2008 estimated that 25% of the West Bank population and 56% of the Gaza Strip population are food insecure (FAO 2008). Food insecurity is reflected in a rise of chronic malnutrition rates in children under five years of age – from 7.5% in 1996 to 10.4% in 2007: if such rates persist, it is likely that there will be long-term damage to standards of health in the oPt (UNDP/PAPP 2009a).

As noted elsewhere in this report (Section 2.4), food insecurity in the oPt may increase due to the environmental effects of climate variability and change (e.g. rain-fed crops and grazing ranges hit by drought), but these impacts are always accentuated by the lack of effective Palestinian control over land and natural resources. This leads UNDP/PAPP to state that MDG 7 (ensuring environmental sustainability) is also unlikely to be met in the oPt by 2015. While the 2005 draft Palestinian Constitution recognises the right to a clean, safe environment and the PA has a dedicated environmental agency – the Environmental Quality Authority (EQA) – ecological sustainability cannot be delivered until the conflict with Israel is resolved and there is unimpeded regulatory capacity for the PA (UNDP/PAPP 2009a).

Consultations undertaken in December 2008 by the climate adaptation Project Team on behalf of, and in collaboration with, EQA and UNDP/PAPP surveyed perceptions by key stakeholders in the West Bank and Gaza – notably PA ministries and Palestinian NGOs – on those policy sectors (potentially) exposed to climate change. This stakeholder input corroborated the premise of the Project Team that water usage and the agriculture sector in the oPt justified priority focus in terms of climate change impacts. The major exposures anticipated are summarised as follows.

Water

- Increased water shortages from lower rainfall and higher evaporation
- Increased stormwater flooding from greater rainfall variability
- Insufficient rain to recharge aquifers.
- Reduced surface and groundwater quality.
- Lower supply of water from Israel.

Agriculture

- More frequent droughts and increased desertification.
- Changes in economic viability of crops (e.g. shorter growing seasons)
- Increased crop water requirements
- Decline in grazing ranges and stocks.
- Higher food prices.

Energy

- Increased energy demands to cope with more temperature extremes
- Rising fuel demands to cope with water shortages.

Public health

- Increase in public health aliments related to the lack of water such as diarrhoea, cholera and dehydration.
- Increased heat stress from high temperature extreme events.
- Spatial and temporal alteration of disease vectors, including malaria, leishmaniasis, and tick-borne diseases.

Coastal management (Gaza Strip)

- Saline intrusion into the Coastal Aquifer.
- Land use impacts from sea-level rise and coastal erosion.
- Soil degradation.
- Loss of biodiversity

Uncertainty about the future of course also characterises the general welfare of the Palestinian population. At 3.4% per annum growth rate, the 2020 Palestinian population is expected to be 5.7million (3.5M in West Bank, 2.2M in the Gaza Strip). The 2040 population could grow to over 10 million (6.8M in the West Bank, 4.1M in the Gaza Strip), and could expand further with the return of refugees to an independent Palestinian state. These numbers would increase the demand for water, which would be beyond the limits of current water allocations set by Israel. Certainly, and at the very least, the MDG targets set for 2015 would not have been met, and poverty rates will rise as public health levels drop. The situation could be expected to be less dramatic were the Palestinian economy to recover. Doubts remain, however, as to the possibility of this occurring.

Were the Israeli partial blockade (on the West Bank) and total blockade (on the Gaza Strip) lifted completely, the Palestinian economy could be expected to flourish as it did in the late 1990s (exceeding even World Bank expectations: World Bank 2003a, World Bank 2003b). However, the current political climate obliges all analysts to be realistic about the opportunities for significant improvement in the near or even medium-term future. The 'worst case' scenario in the oPt is usually also considered the 'most likely' scenario.

2.4 Future climate risks

The assessment of future climate risks for the oPt is limited by significant uncertainty regarding the nature and scope of regional and local impacts. This is a consequence of incomplete data and limited climate modelling within the PA. In such a situation, obtaining information from stakeholders on how they perceive climate risks can provide valuable guidance for adaptation planning. Stakeholder input has therefore been very important for the drafting of this report, alongside a review of scientific forecasts of climate change and a climate vulnerability analysis focusing on water and food insecurity.

The use of stakeholder analysis in identifying major climate risks is described in Section 3 below, where the role of the vulnerability assessment is also summarised. The full vulnerability assessment is set out in the companion document to this report – the *Climate Change Adaptation Strategy for the Occupied Palestinian Territory* (UNDP/PAPP 2009c). From this assessment six key *climate-induced* risks to food and water security were identified for the West Bank and the Gaza Strip:

10. Crop area changes due to decreases in optimal farming conditions
11. Decreased crop and livestock productivity
12. Increased risk of floods
13. Increased risk of drought and water scarcity
14. Increased irrigation requirements
15. Increased risks to public health from reduced drinking water quality (including saline intrusion in the Gaza Strip).

The precise determination of future climate risks requires in-depth domestic research capabilities. There is a clear need for the PA to acquire increased capacity for monitoring and modelling rainfall variability and long-term climate change in the oPt. However, the major climate risks listed above serve as a justifiable basis for the identification and prioritisation of climate adaptation measures in the West Bank and the Gaza Strip (Sections 4 and 5). This reflects the immediate needs of policy-makers in the context of major problems of food and water insecurity facing the Palestinian people.

2.5 Sources of vulnerability

The stakeholder consultations undertaken by the Project Team in the oPt identified several forms of 'vulnerability' in the oPt. Apart from the expected impacts due to altered rainy seasons, temperature and humidity, physical infrastructures and livelihoods are also subject to the effects of the movement restrictions (especially in the Gaza Strip, but also between communities in the West Bank), the Wall, settlement expansion, and weak governance.

The array of non-environmental sources of vulnerability led the Project Team to employ the broad concept of *climate vulnerability*. It was clear also from stakeholder consultations that the 'real' or 'net' impact of the combination of environmental and non-environmental risks was 'dampened' 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 following sections provide a framework for understanding the relationship between the relevant factors.

2.5.1 Adaptive capacity and coping mechanisms

The terms 'adaptation' and 'coping mechanisms' are often used inter-changeably in relation to environmental (and other) hazards. In examining the responses of communities to climatic phenomena, it is useful to think of each in terms of some sort of unit of measurement - coping range and adaptive capacity, as shown in Figure 2.5. The two measures may be distinguished by their temporal aspects – with coping range relating to shorter-term responses, and adaptive capacity relating to longer-term responses.

Figure 2.5 shows how a minor decrease in water availability one season, for example, may induce a coping response such as water delivered by tanker from outside the watershed. A more substantial decrease in water availability may lead to the more significant consequences of a failed harvest, while an extended drought period may push the affected community beyond its coping and adaptive limits – with consequences difficult to predict, but likely to be severe.

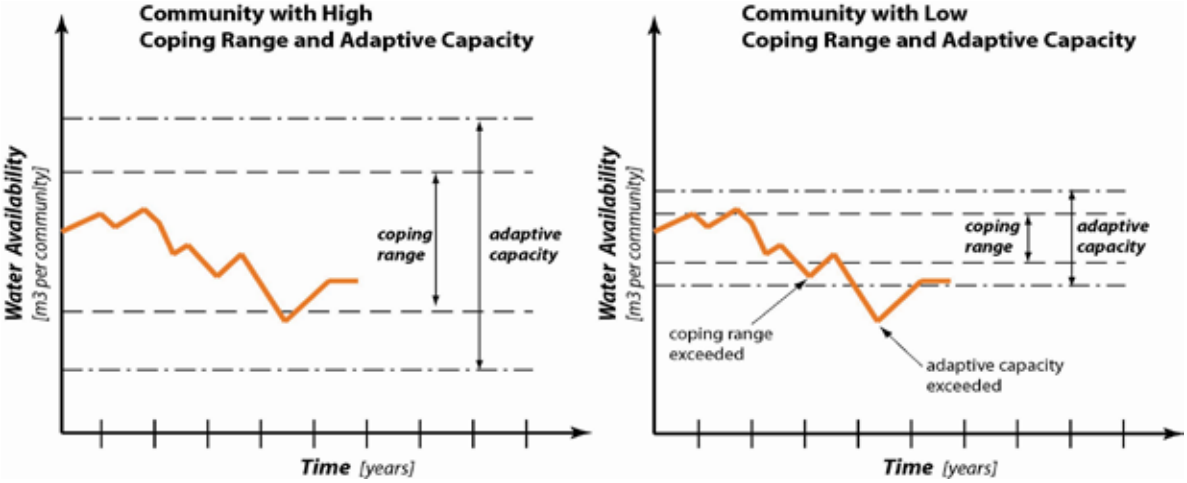


Figure 2.5: Coping range and adaptive capacity of communities related to water availability. Adapted from Vincent (2004).

Both coping range and adaptive capacity are key components of the central concept of this report – climate vulnerability, defined below (2.5.2). As shown in the companion volume to this report, *Climate Adaptation Strategy for the oPt, the existing weak coping capacity of Palestinians in the face of water and food insecurity indicates that their ability to adapt to changing climate conditions is inadequate.*

2.5.2 Working definition of climate vulnerability

Vulnerability describes the ability of a system or actor(s) to cope with particular events and impacts, which are environmental and/or socio-political in nature. For this report, climate vulnerability is defined as *the propensity of people or systems to be harmed by climate hazards in the context of other domains of vulnerability, as well as in relation to response capabilities in both the short-term (coping) and long-term (adaptation).*

Climate change is changing exposures to climate-related hazards, understood as extreme weather events (e.g. flooding, extreme heat, droughts) which may trigger various societal shocks (e.g. food productivity falls, population displacements). What the IPCC labels 'key' vulnerabilities to climate change – those meriting policy attention as symptomatic of 'dangerous anthropogenic interference' with the climate system (UNFCCC Article 2) – are seen to depend on the magnitude, timing and distribution of climate impacts (Schneider et al. 2007, p. 784). While early IPCC formulations favoured biophysical framings of climate impacts and ecosystem vulnerability, it is now recognised that vulnerability to climate change properly extends to the socio-economic and political conditions that affect how communities cope with the impacts of climate-related hazards. This has led to a more integrated understanding of vulnerability, which is designed to capture the role of non-climatic pressures on individuals and groups who are also facing climate hazards (Adger 2006). This broader vulnerability perspective is the one adopted in this report.

The 'sensitivity' aspect of climate vulnerability features social, economic and political components alongside ecosystem sensitivity. It is recognised that social features of a community – such as internal cohesion and group knowledge – may decrease the overall vulnerability of that community to environmental risks (e.g. by increasing adaptive capacity). Similarly, a community that enjoys a wealthy and diverse economic base would be considered less (socially) vulnerable than a community whose economy is weak and dependent on external factors. Communities may further experience the effects

of political drivers of vulnerability, through 'exposure' resulting from sudden changes in the political context eliciting an armed or legal response. We will now elaborate further on non-environmental components of vulnerability.

2.5.3 Non-environmental sources of vulnerability

Social, economic and political aspects of climate vulnerability cover a broad range of issues. Political aspects relate primarily to the equitable distribution of resources and services – for example, whether water storage and distribution infrastructure or national climate change adaptation planning (both of which would reduce vulnerability) extend to the most marginalised communities. The issue of the inequitable distribution of such services is particularly salient in the oPt, where the advantages of well-established urban families over rural, Bedouin or refugee communities is well-documented (Roy 1995,Trottier 1999). Moreover, the residents of the Gaza Strip as a whole are currently more vulnerable than the residents of the West Bank, because of the harsh conditions on livelihoods and public health, created mainly by the Israeli blockade.

In consultation meetings undertaken by the Project Team, the chief non-environmental source of vulnerability throughout the oPt was generally agreed by stakeholders to be the Israeli occupation, in particular its access and mobility restrictions. The extensive impact of the Israeli occupation on vulnerability is felt at both the national and community level.

The current form of the Israeli occupation of the West Bank and the Gaza Strip is a complex set of controls and restrictions affecting many aspects of daily life for all Palestinians. A salient and peculiar form of the Israeli occupation is that the management of human activity in the West Bank and Gaza is the responsibility of – and undertaken by – Palestinians themselves, through the PA. Thus, the EQA shares the same responsibilities as any ministry of environment, but with its actual authority compromised by elements of the Israeli occupation, such as restrictions on movement of EQA staff. This means that environmental initiatives (including projects to build resilience to the effects of climate change) typically face major hurdles. The same applies to the Palestinian Ministry of Agriculture and Ministry of Planning. The Palestinian Water Authority, for its part, is further hampered by the well-drilling restrictions imposed by the 1995 Oslo II Agreement, as well as the project-approval hurdles placed by the Joint Water Committee (Selby 2003). PA institutions are further weakened by deficits in technical capacity, rent-seeking behaviour and instances of maladministration, such that they are unable to respond effectively to the climate vulnerability of the communities they are intended to serve.

The Israeli occupation also directly affects the climate vulnerability at the community-level. With over 400 checkpoints or roadblocks in the West Bank, many villagers are cut-off from alternative water supplies. In the Gaza Strip, any attempts to build infrastructure (such as the construction of reservoirs to increase resilience to dry spells, or coastal defences) are severely hampered by Israeli restrictions on the importation of basic building materials. Indeed, these continuing restrictions compromise the 'building back better' principle of the *Palestinian National Early Recovery and Reconstruction Plan for Gaza*, which aspires to infrastructure improvements in the wake of the extensive damage from the 2008/2009 Israeli military offensive (Palestinian National Authority 2009: 14-15).

So pervasive are the effects of the Israeli occupation on the climate vulnerability of Palestinian communities that the occupation – in and of itself – is considered here a 'risk', alongside environmental risks such as sea-level rise and altered rainfall patterns. Other non-environmental sources of climate vulnerability include livelihoods dependent on external factors (or limitations in the adaptive capacity of livelihood diversification), social divisions, weak social protection structures, inadequate physical infrastructure and weaknesses in governance capacity.

Most Palestinian families derive their incomes from a variety of sources, including labour/direct livelihoods, but also small side-businesses (markets), remittances from family members (in the past, through work in Israel but more recently from work in the Gulf). Many more – especially in the Gaza Strip – also receive welfare. But the diverse incomes do not necessarily directly translate into resilience. The case of reliance on remittances from work in Israel shows how vulnerable the system was to the Israeli policy of less dependence on Palestinian workers (and the 'boom' which attracted many Palestinians to work in the Gulf has similarly dried up to a certain extent, with the financial crisis which began in 2008).

The political and economic sources of vulnerability are further compounded by divisions within Palestinian society. There are significant social and economic differences amongst Palestinians at a number of levels: between urban and rural citizens, between refugee and non-refugee communities in the same city, and between rural settlements and nomadic tribes.

2.6 Climate change adaptation planning in the oPt

In the oPt there are major governance challenges to climate change adaptation planning – the generally weak capacities of national agencies and local authorities to develop effective strategies on adaptation and disaster risk management; the lack of tools and systems to enable appropriate planning and implementation of climate change adaptation; and a general lack of information on technological adaptation and sustainable development options.

This UNDP/PAPP-funded climate change adaptation initiative for the oPt 2008-2009 reflects strategic UNDP goals for national capacity-building regarding climate change adaptation (UNDP Environment and Energy Group 2008):

- To enhance capacity of developing countries to design and implement policies to integrate adaptation into domestic plans, budgetary and fiscal policies, investments and practices
- To help countries identify, prioritise and implement short-term 'no regrets' adaptation responses (e.g. revised spatial and land-use plans, use of drought tolerant crops, enhanced emergency preparedness)
- To help countries mobilise additional sources of funding for implementing adaptation responses

In the oPt, this is consistent with UNDP/PAPP's *Mid-Term Strategic Framework 2008-2011*, particularly its cross-cutting theme of environmental sustainability and its priority focus on democratic governance, including strengthening the capacity of the PA (UNDP/PAPP 2008).

The climate change adaptation initiative for the oPt involved developing a national *Climate Change Adaptation Strategy* (UNDP/PAPP 2009c) and this *Palestinian Adaptation Programme of Action*. This work is anticipated to deliver the following capacity-building outcomes for the PA:

- The identification of key climate change information and modelling needs for national development planning and environmental policy-making
- The identification of priority climate change adaptation policy options and measures
- Improvement in the capacity of PA decision-makers effectively to take account of climate change impacts
- Improvement in the capacity of PA staff to monitor and evaluate policies with regard to climate change

These objectives are consistent with the *Palestinian Reform and Development Plan 2008-2010* (PRDP) (Palestinian National Authority 2008), which includes enhanced quality of life and good governance as national policy goals: EQA, as the relevant line ministry, has stated that an assessment of climate change impacts in the West Bank and the Gaza Strip is essential for national decision-making. Currently, climate change impact considerations are not integrated into the *Palestinian National Policy Agenda* (PNPA) – the framework setting the medium term priorities for the PA – and the PRDP. However, climate change risks are most likely to impinge on PRDP goals to increase agricultural output and provide more efficient and equitable water delivery to households. They are also likely to affect a number of other PRDP goals, including social security protection and health quality improvement. There is thus a clear need for climate change adaptation planning.

3. Identification of Key Adaptation Needs

3.1 Stakeholder engagement approach

This section summarises the results of the stakeholder engagement undertaken by the Project Team on behalf of, and in collaboration with, EQA and UNDP/PAPP. This engagement consisted of *interviews and discussions* with key stakeholders, a *questionnaire survey* of relevant experts, and two *scoping meetings* – one in Birzeit on December 15 2008 and a video-conference scoping meeting with Gaza City participants on December 17. Additional regional meetings were held in Jericho (December 2008), Hebron (November 2008 and May 2009), and Gaza City (May 2009), with accompanying field observations. The stakeholder involvement informed the development of the proposed adaptation strategy and programme of action for the oPt. In August 2009 final stakeholder meetings were held in Gaza City and Birzeit to gather feedback on a draft of the *Climate Change Adaptation Strategy*: this report has been revised on the basis of comments received.

The stakeholder engagement followed guidance in the UNDP *Adaptation Policy Frameworks for Climate Change* (Lim et al. 2005). Stakeholders were identified as those affected by, or with an interest in, climate change adaptation planning and management. In order for adaptation decision-making to be inclusive in a human development sense, the Project Team set also set out to identify sectors and communities in the oPt most affected by the risk of climate change.

3.2 Initial stakeholder consultations

The start of the stakeholder engagement process involved consultation meetings undertaken by the Project Team in collaboration with EQA and UNDP/PAPP. These meetings, which took place November 2-6 2008, targeted relevant stakeholders – notably PA ministries and Palestinian civil society organizations in Jerusalem and the West Bank to discuss the project objectives. In addition, the London-based members of the Project Team conducted a video-conference consultation meeting with key Gaza Strip stakeholders on December 2.

3.2.1 Consultations with West Bank stakeholders

The first consultation meetings sought to ascertain the viewpoints – on the proposed UNDP/PAPP climate change adaptation initiative – of relevant Palestinian governmental and non-governmental stakeholders with an interest in, or potentially affected by, climate change impacts. The consultations were conducted by the Project Team (represented by Michael Mason and Ziad Mimi), Nedal Katbeh-Bader (Deputy Director General, EQA), and Rima Abu Middein with Mercedes San Roman (UNDP/PAPP). All meetings were held in Ramallah aside from the meeting with the Arab Research Institute – Jerusalem, which took place in Bethlehem. The meetings included at least one senior official from the relevant organisation. Key points and recommendations are summarised below (the names of respondents are not included for reasons of confidentiality).

Palestinian Water Authority [November 3]

a. The Project Team should contact neighbouring countries to seek a coordinated climate change adaptation approach.
b. The formation of a National Steering Committee on Climate Change would help to mainstream climate change issues in national planning.
c. There is an existing water scenario planning capacity within the PWA, notably SUSMAQ (Sustainable Management of the West Bank and Gaza Aquifers). SUSMAQ (2003) included an analysis of rainfall variability and climate change in the oPt: this should be taken into consideration by the Project Team.

Ministry of Planning [November 3]

a. Climate change is a political and global process rather than to do with the vulnerability of local communities. We share climate vulnerabilities on a regional basis.
b. It is essential to review previous work in the water sector to make sure that the climate change adaptation effort is not a duplication of other previous work.

c. UNDP should ensure coordination on the climate change project with relevant stakeholders – especially all UN agencies, NGOs and all key donors.
d. Coordination is also necessary with other national projects currently active, i.e. Palestinian participation in Red-Dead Canal. A meeting with the regional office of the World Bank is advisable.
e. The impact on the ground of the proposed project is essential. Too often in the oPt, the PA has implemented programmes that reflect donor priorities and that haven't addressed wider issues or delivered necessary outcomes.
f. With regard to policies and strategies, we should not take decisions based on the current situation. We should not assume existing planning frameworks are useful. We should look at wider social trends – e.g. population dynamics.
g. Arabic versions of project reports are essential for benefit sharing and information dissemination.
h. A national database on climate change impacts is essential.

Ministry of Transport [November 3]

a. The Ministry has an interest in climate change mitigation: with World Bank support, we are looking at the conversion of gasoline to gas as a fuel for public bus services. However, this depends on Israeli agreement, both for the supply of gas and for security clearance regarding changes to the vehicles.
b. There is scattered meteorological data for the West Bank and the Gaza Strip: 50 new meteorological stations are being added to make 120 in total.
c. The Ministry expects the climate change study to propose actions to be taken by PA in the form of recommendations, i.e. reduction of greenhouse gas emissions (GHG) from vehicles, and transforming gasoline vehicles into natural gas fuelled ones.

Ministry of Agriculture [November 4]

a. The UNDP/PAPP climate change adaptation initiative should address drought and desertification/risk assessment.
b. Risk management and crisis management need to be taken into consideration. Risk management requires preparation, prediction, evaluation and mitigation.
c. A rational planning framework on drought is needed: we are not correctly distinguishing between drought and desertification. Funding only tends to go on emergency actions and we are reliant on external assistance. There is an increasing vulnerability of people and communities, especially related to agriculture. Agriculture is the first sector to be affected by drought (as happened this year) – e.g. 94% of Palestinian agriculture on the West Bank is rain-fed; only 6% is irrigated.
d. It is necessary to characterise correctly climate change and drought. We need a common understanding of the meaning of drought. There are different types of drought – meteorological, agricultural, hydrological and socio-economic. The Palestinians are suffering from 'political drought' – our water resource management is distorted by the Israeli occupation.
e. There is a need for technical advice on priority points of intervention: identifying weakest points in the agricultural system and having suitable indicators (e.g. precipitation index).
f. The design of a drought early warning system has to be done well: identifying priorities (short and long term), awareness-raising, minimising risk. A drought early warning system is under installation, funded by the Italian Government. We need a scientific system for identifying a drought emergency (e.g. 35% annual precipitation). Donors have used perceptions of farmers on drought, which have under-estimated agricultural losses from drought.
g. We need dedicated rainfall stations (as opposed to meteorological stations): there are no rainfall stations in the Jordan Valley. The distribution of rainfall is important for farmers. The biggest challenge is accessibility of good data on rainfall and soil moisture: this data is needed for an early warning system.
h. There is a need for a multi-institutional process – a National Committee for Drought with key ministries (especially PWA, Ministry of Agriculture, EQA). The National Committee to Combat Desertification has

not been effective. The National Water Council is also not effective at the inter-ministerial level (only one meeting in the last 6 years), although it has a working technical committee. There needs to be a working technical committee addressing drought management and informed by a stakeholder approach. Other countries have drought management experience (e.g. Tunisia, Morocco) that we could draw upon.

Palestinian Energy Authority (PEA) and Palestinian Energy & Environment Research Center [November 4]

a. The PEA has not been involved so far in any climate change adaptation. However, it has a strong interest in climate change mitigation, e.g. a proposed 100MW Concentrated Solar Power (CSP) plant for Jericho with American private sector involvement (Anova).
b. The PEA is also in discussion with the PWA over a proposed solar-powered desalination plant. Also, there is much use of domestic solar water heaters in the oPt.
c. Mitigation measures need to be reported in the Climate Change Adaptation Strategy for the oPt.
d. There is a need for regulations and laws that enhance energy efficiency.

Palestinian Hydrology Group [NGO] [November 4]

a. The water crisis in Palestine is not a result of climate change; it is above all a result of Israeli control over Palestinian water resources
b. Re: Project Team's candidate vulnerable communities – why Yatta as a vulnerable community and not Qalqilia?
c. PHG support the Project Team's proposal to look at the climate vulnerability of Jericho District (there is existing data and research on how temperature and precipitation changes might affect agricultural water demand for open field crops).
d. There is no clear evidence for climate change. In recent years, some places have increased precipitation, others decreased precipitation: it depends on location.
e. Control over Palestinian water resources should be the main issue to be highlighted in the reports and documentation of the climate change adaptation project. If there is no Palestinian control over the resources, the adaptation strategy or program will not succeed.

Negotiations Support Unit, Palestine Liberation Organisation [November 4]

a. The Israelis are using climate change in their negotiations narrative to support their position on water.
b. The World Bank Environmental and Social Assessment Study accompanying the Red-Dead project should be visited. ERM consultants are undertaking the environmental-social assessment, though there is little reference to climate change.
c. Relevance of the legal responsibility of Israel as the occupying power ('effective control') in the West Bank and the Gaza Strip (international environmental and humanitarian law).
d. Need to pay attention to surface water rights, which must be dealt with multilaterally in the Jordan Basin region.
e. Since climate change trends in Palestine are not obvious, developing a flexible adaptation strategy is essential.
f. Installing a network of meteorological stations for future monitoring of climate change impacts is a priority as there is currently no access to Israeli meteorological data.
g. Capacity building for the PA is a high priority.
h. Involvement in UNFCCC crucial for climate change adaptation aims in the oPt. Link to Palestinian involvement as an observer in international environmental agreements – Desertification Convention, Biodiversity Convention, Barcelona Convention. Palestinians can get GEF funding on a regional basis so may be able to apply indirectly for UNFCCC adaptation funding.

Arab Research Institute – Jerusalem [NGO] [November 5]

a. Re: proposed study communities. Suggest selecting one of the case studies in the northern part of West Bank that lies in the average annual rainfall belt (400mm-500mm), or extending Jordan Valley to the north to areas of higher precipitation than the Jericho Governorate.
b. Shared wastewater infrastructure with settlements in the West Bank is legitimising the occupation and contrary to the previous Palestinian position not to allow this.
c. Use European Neighbourhood Policy framework as a good means of entrance for Palestinian climate change adaptation planning (more flexibility and power than UNDP or UNFCCC mechanisms?).
d. Communicate with Arab Climate Change Alliance for experience sharing.

3.2.2 Consultations with Gaza Strip stakeholders

Initial consultations with Gaza Strip stakeholders (identified for their water and agricultural sector interests and expertise) featured email exchanges and a video-conference discussion – held on December 2 2008, between the Project Team in London (represented by Michael Mason and Mark Zeitoun) and Gaza Strip participants attending the UNDP/PAPP Office in Gaza City. The Gazan participants of the initial consultation included EQA, PWA and Coastal Municipalities Water Utility (CMWU) officials (attending as independent water experts), UNDP/PAPP Gaza Strip staff, an environmental scientist and an NGO representative.

There was positive interest from the Gaza Strip stakeholders in the UNDP/PAPP climate change adaptation project, though it was not seen as a priority concern as current water and food insecurity is mainly caused by non-climatic reasons. The following key points were made by the Gaza Strip participants:

- The current water insecurity in the Gaza Strip is not to do with climate variability (short-term) or climate change (long-term) but mainly the result of ***unsustainable water extraction and contamination issues*** (e.g. nitrates). However, a climate change adaptation approach for the Gaza Strip should deal with these other issues, which may well be influenced by climate change.
- There needs to be a ***systematic climate change analysis for the Gaza Strip*** in the context of the wider Eastern Mediterranean region, which needs to address potential changes to groundwater recharge and agricultural crop yields, as well as saline intrusion. Participants were supportive of the proposal for a donor-funded climate change analysis, developed in consultation with Palestinian stakeholders, by the UK Hadley Centre for Climate Change (Hadley Centre for Climate Research 2008).
- There are important ***transboundary aspects*** to focus on; for example water pollution and natural saline groundwater coming into the Gaza Strip from Israel: climate change could affect these flows.
- There is a particular ***wastewater infrastructure problem*** in the Gaza Strip that may be influenced by climate change in different ways - both positive (e.g. reduced levels for wastewater collection pools from reduced precipitation) and negative (e.g. flooding from extreme seasonal precipitation events).
- There is a ***serious solid waste problem*** in the Gaza Strip, which is part of the humanitarian crisis in the region.
- The proposed focus of the consultancy team on Mawasi and Beit Lahiya as particularly vulnerable communities in the Gaza Strip is not justified for climate change reasons as ***the whole of the Gaza Strip faces extreme water and food insecurity*** under the Israeli military blockade and sanctions. The 'community coping' mechanisms in operation in the Gaza Strip are increasingly 'negative coping mechanisms' (responses that lead, for example to criminal actions or other effects detrimental to the society as a whole). Under this severe pressure, the climate change adaptation work should reflect the political situation. So the human vulnerability focus of the climate change adaptation project should be on the whole of the Gaza Strip with local examples of coping (positive or negative) drawn from various communities.
- The climate change project should be aware of the ***risk of desertification*** in the southern end of the Gaza Strip, which could be made worse by increased temperatures and evaporation rates, but is also caused by agricultural areas being abandoned as a result of Israeli restrictions in the border area.

The consultancy term were persuaded by the argument to focus on the Gaza Strip as a whole for water insecurity issues. This became even more relevant since the Israeli military operation in the Gaza Strip between December 27 2008 and 18 January 2009. The military incursion caused extensive damage to the water and wastewater infrastructure. During the operation the Coastal Municipalities Water Utility was unable to maintain basic water and wastewater services.

3.3 Questionnaire survey on climate adaptation needs

In November-December 2008 the Project Team undertook a questionnaire survey of key stakeholders to gauge perceptions and opinions on climate change impacts, adaptation actions and information needs in the oPt. The questionnaire (see **Annex I**) was developed by the Project Team based on a template drafted by the United Nations Commission for Europe and also the UNDP Climate Adaptation Policy Framework. In line with the selection of the water sector as the priority for adaptation planning in the oPt, it focused on climate change impacts on water resources. The aims were:

1. To collect information on the degree of awareness concerning the issue of climate change impacts on water resources.
2. To survey perceptions of vulnerability to climate change.
3. To compile potential adaptation measures and strategies.

The questionnaire was sent to 18 key Palestinian stakeholders identified by the consultancy team in discussion with EQA and UNDP: the stakeholders (policy actors with a significant interest and expertise in climate change adaptation) included:
Palestinian Authority: EQA, Ministry of Agriculture, Ministry of Interior, Ministry of Transportation, Palestinian Central Bureau of Statistics, Palestinian Economic Research Centre, PWA (Gaza and West Bank)
Civil society (experts/NGOs): Al Quds University, Arab Research Institute-Jerusalem, House of Water and Environment, Land Research Centre, Palestinian Hydrology Group.

By January 2009 12 completed questionnaires had been received. It was stressed to respondents that the questionnaire responses were not the official positions of the organisations to which they belonged. Questionnaire results were not attributed to individuals. Respondents were asked to identify which information source their answers were based on and most (8 responses) stated expert knowledge. The findings are summarised below (for each of the four sections of the questionnaire: see Annex I).

PART A – ASSESMENT OF FUTURE IMPACTS
There was general agreement among the respondents that coastal zones (Gaza Strip) and agricultural areas (Gaza Strip and West Bank) are the most sensitive to climate change in the oPt. Of the changes in water resources anticipated by 2050 as a result of climate change, the respondents estimated a drop of 10-70% in rainfall, with a modal average of a 20% drop in precipitation; a reduction in groundwater recharge (Gaza Strip and West Bank) of between 5-50%; both an increase (10-20%) and possible decrease (5-30%) in drought frequency; and for the Gaza Strip both a rise (15-30cm) and possible fall (2-20cm) in sea-level.

These conflicting predictions are evidence of uncertainty over the impacts of climate change. Nevertheless, generally climate change was estimated to pose a serious negative effect on water resources – decreased & more variable precipitation and reduced surface and groundwater quality – which will impact most on water supply and the agricultural sector.

PART B –ADAPTATION MEASURES
There was wide variation in the perception of potential adaptation measures needed to respond to Palestinian water scarcity problems (whether or not as a result of climate change).

Respondents were aware of several drought reduction/low flow protection measures already implemented – e.g. increased well construction, investment in water distribution infrastructure and more efficient irrigation – but stated most agreed that more actions are necessary. Most respondents to Part B agreed that improving forecasting, monitoring and information were necessary climate adaptation tools. Most respondents recognised the need for coastal zone adaptation measures – notably coastal protection & land use changes.

PART C – ADAPTATION INITIATIVES/ACTIONS

There was little awareness amongst most respondents of actual adaptation actions regarding water availability. However, four respondents knew of specific adaptive measures in the water sector (in both the Gaza Strip and the West Bank) involving the Ministry of Agriculture, PWA & local authorities. Interestingly, the current level of adaptive capacity was largely seen as an unintentional side-effect of other water policy objectives for water network rehabilitation, rainwater utilisation, and the introduction of more efficient irrigation systems.

Adaptation was seen to rely on *ad hoc* funding of donors. The main obstacles to adaptation were recognised as political (lack of access to, and control of, land and water), organisational (lack of co-ordination by planners and donors), and technical.

PART D – CLIMATE INFORMATION NEEDS FOR PLANNING

There was wide agreement amongst respondents that:

- Long-term (10-50 years) climate change information is needed for strategic policy and planning purposes
- Medium-term (6-9 months) information on climate variability is needed for planning and operational purposes
- Short-term (0-10 days) weather data is needed for operational ends (e.g. flood warnings).

There was also general agreement amongst respondents that the information needs for climate risk management include: the availability of climate information, assessments of climate vulnerability, open adaptation decision-making, and information on integrating adaptation into economic or social development.

In conclusion, the questionnaire survey demonstrated that:

- There is agreement amongst experts that climate change will have a negative impact on water resources in the oPt
- There is uncertainty about the scope and effect of climate changes
- There is an awareness that current adaptation measures are largely side-effects of addressing other policy objectives
- Adaptation decision-making faces organisational, technical and above all political obstacles (notably the Israeli occupation)
- There are clear climate change information needs for planning at different decision-making scales.

3.4 Scoping meetings

The Project Team organised two scoping meetings with invited stakeholders in order to discuss the objectives of the proposed climate change adaptation project. The scoping meetings included presentations on the planned climate change analysis and vulnerability assessment, followed by brainstorming on adaptation priorities in the context of Palestinian policy-making processes, livelihood choices and external development assistance. More than sixty participants attended a meeting at Birzeit University, Ramallah on December 15 2008, which ended with three break-out groups for the brainstorming sessions on planning, livelihoods and external aid. The Gaza scoping meeting (held by video-conference hosted by UNDP/PAPP as it was not possible for the consultants to visit Gaza City until May 2009 and August 2009) featured one structured discussion on adaptation opportunities and constraints. Both meetings identified political, social and economic obstacles to climate change adaptation in the oPt.

3.4.1 Summary of Ramallah scoping meeting

The climate change adaptation scoping meeting for the West Bank was held at Birzeit University, Ramallah on December 15 2008. 70 stakeholders were invited from a list compiled by UNDP in consultation with EQA and the Project Team: this list featured governmental and non-governmental actors with an interest in climate change. There were 61 participants from a diverse range of governmental and non-governmental organisation with an interest in climate change adaptation (Figure 3.1).

The meeting began with introductions from Jamel Mtour (Deputy Chair, EQA) and Rima Abu Middein (Natural Capital Team Leader, UNDP/PAPP). It then featured the following presentations:

i. *Climate Change: A Global Concern* by Mahmoud Abu Shanab (EQA)
ii. *UNDP Adaptation Policy Framework for the oPt* by Michael Mason
iii. *Climate Vulnerability Framework* by Mark Zeitoun
iv. *Climate Change, Water Resources and Adaptation* by Ziad Mimi

Questions and initial discussion after the presentations covered the time-scale of climate change to be addressed by the Project Team, the challenges to the Palestinian Authority in accessing external development aid for climate change adaptation (notably the Clean Development Mechanism), and the role of the climate change adaptation project within the national planning structures.

Figure 3.1: Participants at the Ramallah scoping meeting, December 15 2008

The main scoping work at the Ramallah meeting was conducted by three Focus Groups facilitated by the Project team in collaboration with EQA and UNDP/PAPP colleagues. These groups were thematically organised – National Capacity-building for Climate Change Adaptation ('Planning'); Community Coping Mechanisms for Water and Food Insecurity ('Livelihoods'), and External Support for Climate Change Adaptation ('Donors'). Each group discussion was guided by structured questions and a vulnerability assessment matrix.

PLANNING FOCUS GROUP

The recommendations of the Planning Focus Group centred on enhancing and improving water resource management. However, it was also stressed that an end to the Israeli occupation is a necessary condition for effective national planning.

- Future urban planning should consider storm water collection systems (networks and central pools.).
- Central desalination projects to be considered.
- Reuse of treated wastewater to be considered.
- Development of Irrigation Management Information System aiming at efficient irrigation.
- Soil degradation to be considered.
- There is a need for new legislation as well the effective application of existing water laws.
- Development of an Environmental Information System is essential for better planning.
- Farming Pattern Plans should be developed.
- Land use master planning should be considered, taking into consideration plans for the evacuated areas (yellow areas).
- Development of regional climate change adaptation programmes.
- Capacity building for institutions and local communities should take into consideration the role of women.
- Flexible adaptation strategy should be developed with regard to water resources management.
- Food security should be considered.

LIVELIHOODS FOCUS GROUP

With lower and more variable precipitation noted as the primary environmental risks from climate change, the group listed some determinants of vulnerability:

- dependence on water availability for livelihoods and lives.
- links with public health, i.e. higher prevalence of disease.
- higher food prices and lower yields leading to food insecurity (e.g.
- tomatoes now $3/kg, but all goes to the middle man, not the farmer).
- threats to livelihoods: e.g. farmers forced to become labourers (but reduced opportunities for labourers from occupation restrictions).
- In the wet areas of the West Bank, the main problem is political. In dry areas, the problems are climatic and political.

The Focus Group identified a number of ways in which people cope with the vulnerability their livelihoods are characterised by:

- Seed selection: some seeds (like hybrids) could be more drought-resistant, or better-adapted for shorter growing periods; also the option of shifting crops.
- New water supply options: tanker water purchase, but this is expensive – e.g. about $2.5/m3, especially around Jenin (200 NIS for 3m3).

Because of the Israeli-Palestinian power dynamic, it was stated that any drops in regional precipitation due to climate change were likely to be felt mainly by the Palestinian side. Additionally, there were perceived internal tensions over water allocation, for instance over jurisdiction between the PWA and the Ministry of Agriculture and between users in cities and farmers. Water User Associations that have been set up, for instance in the Jordan River Valley, have exacerbated the situation by aggravating tensions with local authorities.

DONORS FOCUS GROUP

The Donors Focus Group considered the sources and role of external financial support for climate change adaptation in the oPt. It was noted that development assistance should continue to focus on assisting the Palestinian Authority provide basic services to all (e.g. water, sewage, energy). Climate considerations should feed into this core service function, and donors need to acknowledge the climate change impacts on their own programmes of service support. It was also noted that donors are reluctant to challenge Israel over the occupation (constrained by diplomatic positions) even though the occupation reduces the effectiveness of their programmes. The focus group recommended:

- Developing an Integrated National Climate Change Adaptation Plan taking into consideration water resources and humanitarian issues that is able to attract funds and donations.
- Mainstreaming national plans and efforts into regional and international efforts.
- Establishing successful pilot projects able to attract funds.
- The recognition of Palestinian climate change vulnerability as legitimate by the international community (e.g. UNFCCC).
- Examining Environmental Trust Funds and Climate Change Adaptation Funds as potential vehicles for external funding.

3.4.2 Summary of Gaza Strip scoping meeting

The Gaza City scoping meeting had to be organised by video-conference link as the Project Team were prevented travelling to the Gaza Strip due to the Israeli border closure. The scoping meeting took place on December 17 through a video-conference link between the UNDP offices in Gaza City and Ramallah. The ten Gazan attendees featured six governmental and three non-governmental representatives, as well as a UNDP/PAPP facilitator.

The meeting began with an introduction by Rima Abu Middein (Natural Capital Team Leader, UNDP/PAPP). It then featured the following presentations (from Ramallah) by Project Team members:

i. *UNDP Adaptation Policy Framework for the oPt* by Michael Mason
ii. *Climate Vulnerability Framework* by Mark Zeitoun
iii. *Summary of Initial Questionnaire Results* by Michael Mason

In order to facilitate effective discussion, the presentations had been sent before the meeting to the participants from the Gaza Strip. Questions and initial discussion after the presentations covered the possible role of the oPt in the post-Kyoto framework (e.g. the global focus on alternative sources of energy), such that the Palestinians have to be on the international agenda for climate change adaptation. The discussion was structured into four themes – the first addressed 'Climate Vulnerability' in response to Mark Zeitoun's presentation; the remaining three mirrored the themes in the Ramallah scoping meeting – National Capacity-Building for Climate Change Adaptation ('Planning'), Community Coping Mechanisms for Water and Food Insecurity ('Livelihoods'), and Donor Support for Climate Change Adaptation ('Donors).

In general, the Israeli siege of the Gaza Strip was seen as the main source of vulnerability of all communities in the Gaza Strip. The effects of climate change are expected to make the current crisis situation worse. Moreover, the Gazan population is exposed to many different environmental hazards (high biophysical vulnerability), and has overall very low capacity to adapt (high social vulnerability). Therefore, it may be considered that ***the Gaza Strip as a whole has high climate vulnerability***. The different exposures lead to different coping mechanisms and adaptive capacity, some of which were as described following.

PLANNING ISSUES

It was noted that there is a need to strengthen the *Environmental Preparedness Plan* for the Gaza Strip. This *Environmental Preparedness Plan* should further be developed (and integrate integrated water resources management, coastal management, agricultural planning, land-use, etc) to take into account real and potential climate change impacts. However

current planning on environment-related issues is not integrated across sectors, it has lost its centralised direction, and is essentially absent since the major drop in donor assistance to Palestinians in the Gaza Strip following the election of the Hamas government (January 2006). Building accountable and reliable response capacities should be highlighted, which means greater institutional capacity for preventing and preparing for risks and disasters.

Under the Civil Defence Law, the Civil Defence Department chairs a disaster response committee which formally involves 13 different institutions from across the Palestinian Authority, but this is not functioning. The Civil Defence Law must be strengthened, or the means to enforce it increased. More information of environment-related risks must be gathered, and disseminated, so climate change risks can be integrated into this institutional structure. Because long-term climate change adaptation (such as re-location) is not an option, ***prevention of risks is even more urgent than preparedness and response*** (see Section 5.2 of this report).

Water stresses in the Gaza Strip will be made worse by forecasted changes in climate (e.g. recurrent droughts, saline intrusion in the Coastal Aquifer, extreme events): higher temperatures will encourage more groundwater extraction with less recharge to the Coastal Aquifer (and therefore more salinisation). However, there is already a water crisis from a) ***over-extraction*** of the Palestinian portion of the Coastal Aquifer – to the magnitude of 3 times (170 million m3 per year) the annual rainfall recharge (roughly 60 million m3 per year); and b) ***pollution*** from saline intrusion, naturally-occurring salts in the Eocene in Israel, and nitrates and chlorides from untreated wastewater (CMWU *Water Safety Report* October 2008). Planning should be based on scientific modelling and cover different possibilities. It should cover both short-term planning (to improve upon existing coping mechanisms) and long-term planning (to build adaptive capacity). Heavy rains in the Gaza Strip pose risks because of the poor or absent storm water collection systems: these risks are accentuated as the low sites for water collection are often in the middle of built-up areas.

New bulk-water solutions need to be considered, whether from transportation, importation or desalination. Large-scale (but step-by-step) desalination is a possible long-term solution to the freshwater crisis in the Gaza Strip. Increased purchase of water from Israel was seen as problematic for reasons of cost, quality, security, and strategic national reasons. Imported water from Egypt is another option.

LIVELIHOOD ISSUES

The main reason for the low level of adaptability is insufficient resources and capacities. Residents of the Gaza Strip are exhausted by the current situation – their 'environmental' coping strategies (e.g. large recycling rates, individual well-digging, re-use of frying fuels for vehicle fuel, rainwater harvesting) are not by choice – they are ***enforced coping mechanisms*** (it makes no sense here, therefore, to characterise between 'positive' and 'negative' coping mechanisms). 80% of Gazans are below the poverty line, unemployment is very high, most trade is restricted (e.g. framers are therefore unable to get money at the end of the agricultural season), so 'negative' coping – e.g. smuggling through the tunnels, stealing food – becomes a matter of survival. Enforced coping carries its own risks, such as the health risks caused by using raw sewage for irrigating farms when there is no proper connection to sewage services, especially as farmers have been switching from trees to vegetables.

According to CROPWAT simulations conducted by CMWU, an annual average increase in temperature of 1oC will increase crop water requirements in the Gaza Strip by 6-11%. Even before the December 2008 military incursion, Israeli Defense Force military activities were already directly constraining agricultural livelihood options (e.g. uprooting of trees, annexation of agricultural land for the 'buffer zone' inside the Gaza Strip, blocking agricultural exports), which are leading to potentially irreversible impacts, such as desertification in the south: farmers there can no longer cultivate barley.

DONOR ISSUES

It was agreed that financing for climate change adaptation in the Gaza Strip should be coordinated and consistent with Palestinian national planning needs. An integrated national plan for climate change could facilitate this, it was noted, by providing systematic information on climate change impacts (current and potential) and also highlight to donors the overlap of climate change with humanitarian challenges. This will enable vital needs to be prioritised.

The recognition by the international community of Palestinian climate change adaptation as a humanitarian issue was seen as critical here: as one participant noted: "we have to present ourselves globally in terms of facts, our conditions" – for example, through recognition of 'Palestine' in UNFCCC. This regional and international communication on climate change in the oPt should "unite funders in one basket." There is a need to get a commitment from the Israelis not to destroy any civilian infrastructure constructed for adaptation to climate change, which is consistent with international environmental and humanitarian law (see Section 5.4 of this report).

3.5 Regional climate vulnerabilities

The consultation sessions held by the Climate Adaptation Project Team with relevant stakeholders revealed a number of direct and indirect ways in which people's livelihoods and climate vulnerability are related in the oPt. It was agreed in these sessions that the agricultural sector was the Palestinian economic sector most sensitive to climate hazards, both current and future. Agriculture has the highest sector usage for water in the oPt, consuming 155 MCM/yr, which is 66% of the water withdrawn by Palestinians (Lautze and Kirshen 2009: 192). It is also an economically significant sector accounting for about 10% of the Palestinian GDP, 20% of exports and 15% of total employment (FAO 2009: 12). Vulnerability-livelihood interactions in the agricultural sector have thus been highlighted in the development both of the *Climate Change Adaptation Strategy for the Occupied Palestinian Territory* and this *Palestinian Adaptation Programme of Action*. This is not to imply that other sectors may not also be negatively affected by climate variability and change; rather, that there is an urgent need to address climatic adaptive capacity for those dependent on agricultural livelihoods.

One of the objectives of the stakeholder engagement was to consider which geographical areas in the West Bank and the Gaza Strip might be subject to the highest climate vulnerability, with a view to undertaking a more detailed vulnerability assessments of these regions. Guided by the UNDP model of vulnerability assessment, candidate areas of high climate vulnerability were selected by the Project Team on the basis of:

- Limited self-governing capacity
- High levels of water and food insecurity
- Movement and livelihood restrictions imposed by the Israeli occupation
- High levels of humanitarian assistance

This method initially suggested that the most vulnerable groups would be found in Area 'C' of the West Bank (Massafer Yatta, Jordan River Valley) and Umm al Nasser, Mawasi and other coastal areas in the Gaza Strip. These candidate areas were discussed at the stakeholder scoping meetings in the West Bank and Gaza City during December 2008. Stakeholder input corroborated the initial premise of the Project Team that the water usage justified priority focus in terms of climate change impacts, and that the case studies for vulnerable communities should be identified on the basis of high levels of water and food insecurity. The consultation exercise refined the local vulnerability focus for the West Bank, with **Massafer Yatta** (south Hebron hills) and the easternmost oPt areas of the **Jordan River Valley**. However, stakeholder representatives from the Gaza Strip persuaded the Project Team – even before the Israeli military operation of 27 Dec 2008 to 17 Jan 2009 – that the **Gaza Strip** must be dealt with as a whole in terms of high climate vulnerability rather than the local communities initially suggested. The vulnerability assessment for these case studies is discussed in Section 3 of the *Climate Change Adaptation Strategy for the Occupied Palestinian Territory* (UNDP/PAPP 2009c).

3.5.1 West Bank Climate vulnerability pathways

The main source of livelihoods of rural communities in the West Bank is agriculture. Agricultural activity is influenced by both the biophysical and socio-political components of climate vulnerability – specifically, risks associated with various aspects of the Israeli occupation and risks associated with decreased (and more variable) precipitation. As communicated in stakeholder discussions, the most direct impact of increased water scarcity on the vulnerable livelihoods of agricultural communities was taken to be reduced yields.

Both rain-fed and irrigated agriculture is common in the West Bank. Table 3.1 presents the total cultivated area in the West Bank as well as the crop (fruit trees, field crops and vegetables) distribution. The two types of irrigation systems, rain-fed and irrigated comprise, respectively, 94% and 6% of the agricultural area.

Table 3.1: Rain-fed and irrigated area of fruit trees, field crops and vegetables in the West Bank (PCBS, 2006) [hectares]

	Fruit trees	Field crops	Vegetables	Total
Rain-fed area	106,900	43,400	4,000	154,300
Irrigated area	2,100	1,500	8,600	12,200
Total	109,000	44,900	12,600	166,500

Under current water availability restrictions, and taking into consideration restricted access to lands, the irrigated area is unlikely to expand in the West Bank. The bulk of the cultivated land in the West Bank is located in the Jordan River Valley (Tubas and Jericho Governorates), and in the Governorates of Jenin and Tulkarm. Agriculture was one of the key sources of growth in the economic recovery that took place after 2003. Changes in agricultural activities are more sensitive than other economic to climatic variability and change, though socio-economic and political factors mediate this environmental influence. In the West Bank the GDP from the agricultural sector is about 12% (PCBS, 2006).

The biophysical and social vulnerability of communities in the Jordan River Valley and Tubas dependent on irrigated agriculture is observed in the reductions of yields in recent year. In the Jordan River Valley the livelihoods of the communities of Fesa'el and others are affected by Israel settler take-over of the land (Peza'el settlement), and by the development of water supply through well-drilling, dependent on approval by the Joint Water Committee. On those fields where irrigated agriculture *is* possible, the decision to sow or not is usually governed by both a) the cost of water (which in this case is delivered and priced by Israel), and b) expected returns from the produce given the market restrictions (at Israeli checkpoints, most notably the 'Hamra' checkpoint preventing produce from reaching markets in Nablus).

The irrigation farming communities in the Jordan River Valley and Tubas join the rainfed farming communities of Massafer Yatta (southern Hebron Governorate) when it comes to **vulnerability to climate variability and extremes**. Both reductions and changes in rainfall patterns have a direct impact on reduced yields, and therefore on livelihoods. Repeated drought cycles reduce the springflow for Tubas, limiting the extent of time the farmers there have for irrigating their crops – and for producing second or third yearly harvests. Dry years also result in freshwater cuts from the Israeli water supplier Mekorot to the residents of the Jordan River Valley (as was the case in 2008 also for domestic consumers in Israel), thereby limiting the number of harvests. The impact of reduced (or late) rains on the rainfed communities in Massafer Yatta is direct and disastrous (see Section 3.3 of the *Climate Change Adaptation Strategy for the Occupied Palestinian Territory*, UNDP/PAPP 2009c). The failure of crops during the localised drought of 2005, for instance, was extensive to the point of obliging the international community to respond with emergency food distributions. Other interactions between agricultural livelihoods and climate risks include the increased salinity of groundwater and soils (reducing yields) due to reduced precipitation; the increased cost of tankered water (as a coping mechanism, during dry summer months) driven up by drought; and the degradation of grazing lands.

The real physical scarcity of natural resources in West Bank is compounded by **high social vulnerability**. 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 3.2 suggests visually a number of these 'vulnerability paths' identified following consultations with stakeholders. 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 3.2 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.

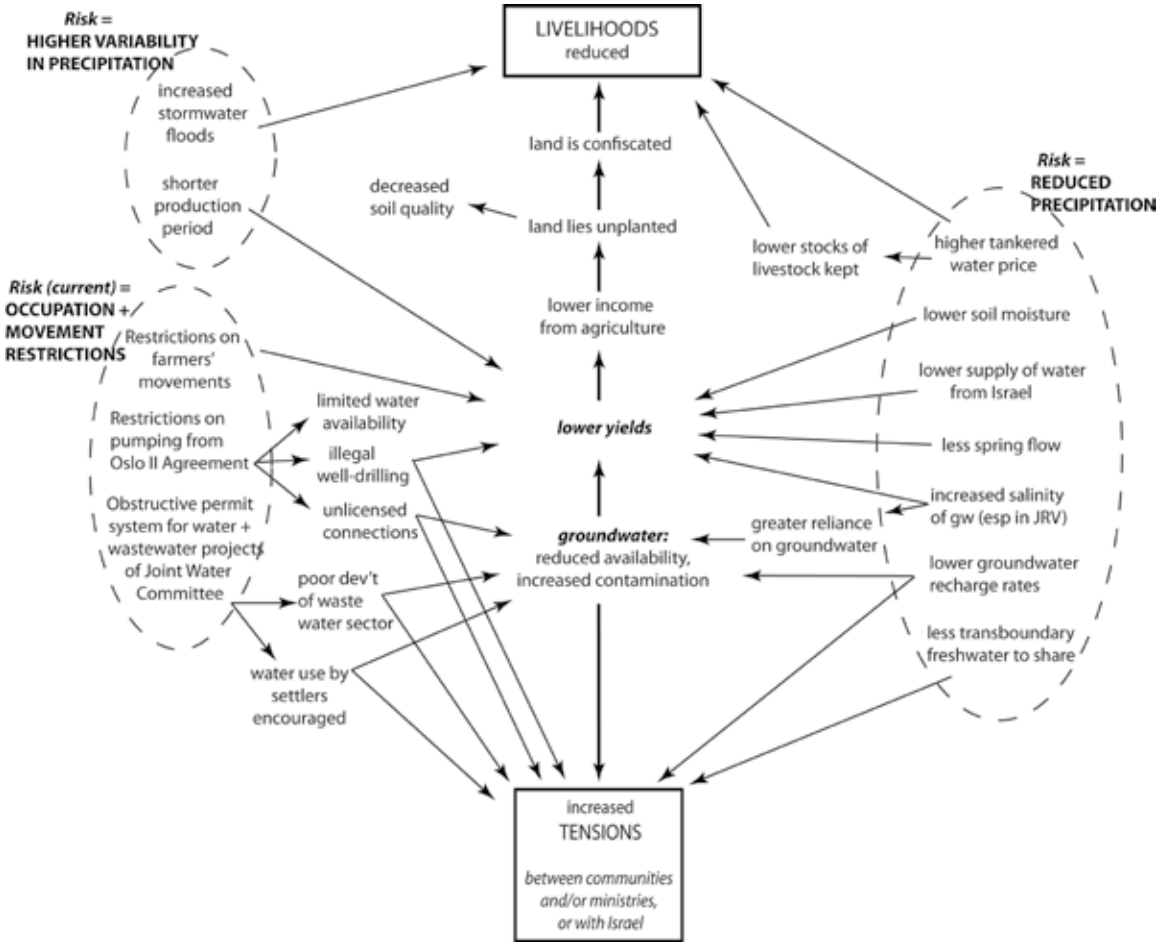


Figure 3.2: Climate vulnerability pathways in the West Bank

3.5.2 Gaza Climate vulnerability pathways

Palestinians living in the Gaza Strip are affected by **high climate vulnerability.** The real physical scarcity of natural resources in the Gaza Strip is compounded by human-induced or conflict-induced scarcity. The effects are felt in terms of collapsed livelihoods, minimal public health and social break-down, amongst others, leading to internal political tensions, and a substantial dependence on donor assistance.

There are severe problems both with water quantity and quality in the Gaza Strip, which relate above all to over-pumping of the Coastal Aquifer. The 'sustainable limit' of the Coastal Aquifer has been estimated at 350 MCM/year of which the Gazan portion is roughly 55 MCM/year (Yacoubi 2008). Total pumping within the Gaza Strip in 2006 was estimated at roughly 150 MCM/year (distributed evenly between agricultural usage and domestic consumption). Not accounting for return flows, this means that the Gazan portion of the aquifer is already being over-drawn at *nearly three times its natural limit*. The lack of alternative water sources contributes to water quality problems arising from seawater intrusion, the infiltration of untreated or partially treated wastewater and 'natural' contamination from Eocene salts migrating under the border from Israel. Salinity levels in the groundwater can rise as high as 300-500 mg/l (Vengosh et al. 2005; Almasri 2008). The increasingly poor drinking water quality in the Gaza Strip necessitates the increased purchase of desalinated water from private-sector neighbourhood-level reverse osmosis units, or the purchase of under-the-sink water filtration units, both of which contribute to the ever-greater share of household income spent on basic services (Palestinian Water Authority 2008a, 2008b).

Since January 2006 (with the entry into government of Hamas), the Israeli closure of the Gaza Strip has reversed a trend towards increased overall wealth (held as a model by the World Bank, until 1999) to one where, after the Israeli military offensive, poverty levels stand at around 65% (Palestinian National Authority 2009: 39). According to a *Joint Rapid Food Security Assessment* conducted in 2008, some 56% of citizens of the Gaza Strip are food insecure and 75% are receiving food assistance (WFP/FAO/UNRWA 2008). The closure limits exports, thereby cutting off a source of income from produce (generally strawberries, oranges and cut flowers) destined for Israel, Egypt or Europe. It has also blocked imports of regulated fertilisers – which could significantly increase yields. Yields are also significantly reduced by decreases in water quality – primarily the increased salinity of the groundwater.

The high social and biophysical vulnerability of residents of the Gaza Strip is further compounded by the expected environmental impacts of climate change. A higher variability in precipitation translates into reduced yields for rainfed agriculture, and could also mean a greater frequency of flash floods (Figure 2.4). The predicted reductions in precipitation will likely exacerbate groundwater salinity levels through reduced soil flushing and groundwater recharge, while reductions in air moisture will likely increase the soil water requirement of crops, or reduce fruit production. Finally, any sea level rise will contaminate the coastal soil and increase the saline intrusion already experienced throughout the Gaza Strip. Figure 3.3 shows graphically environmental risks relating to climate vulnerability identified by Gazan stakeholders. It can be seen that the bulk of vulnerability paths arise from, or are compounded by, the Israeli closure of the Gaza Strip. Also visible from Figure 3.3 is that the bulk of the vulnerability paths end in reducing the quality of the groundwater, resulting ultimately in reduced public health levels and more precarious livelihoods.

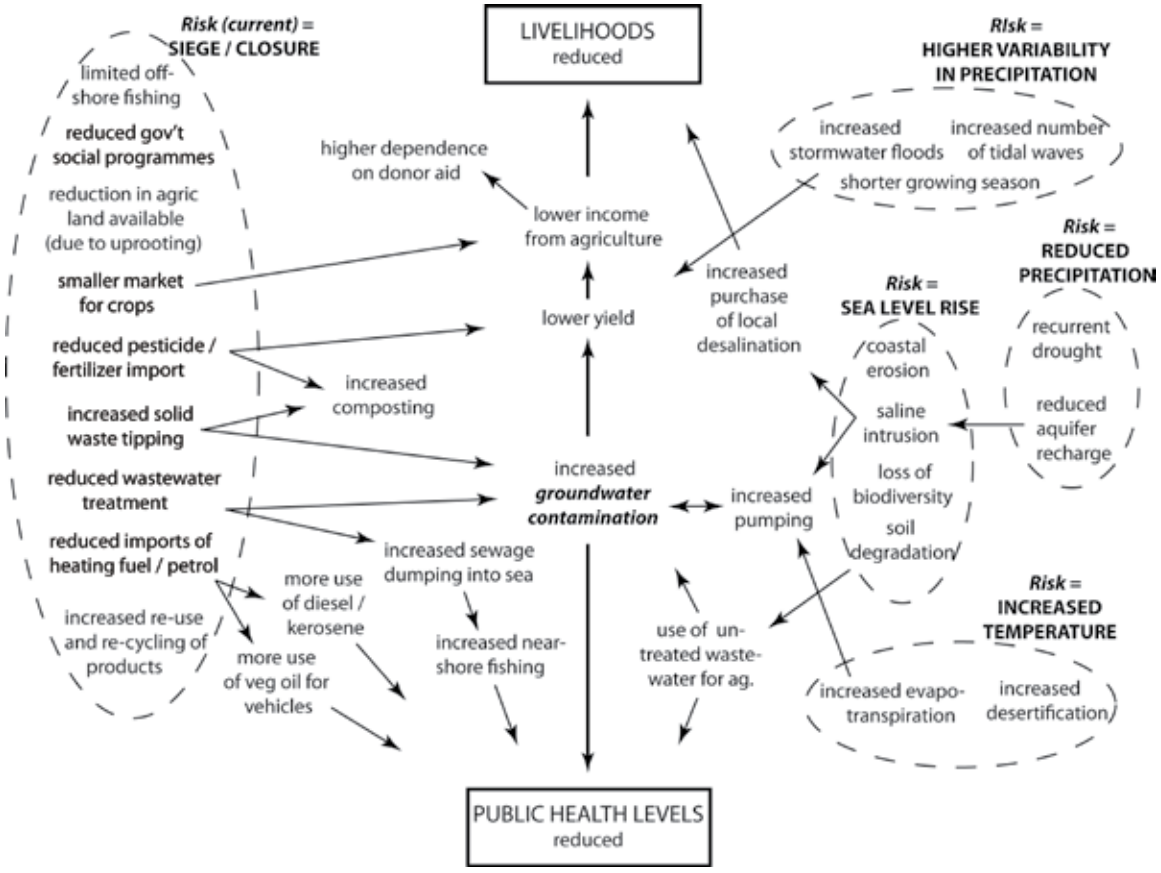


Figure 3.3: Climate vulnerability pathways in the Gaza Strip

As the population of the Gaza Strip are denied the transfer of water from the West Bank or the purchase of significant quantities of water from Israel, the need for a major (150 MCM/year) desalination facility in the Strip is arguably becoming more urgent (Phillips et al. 2009: 182), and was supported by Gazan stakeholders in meetings with the Project Team. Increasing food imports from Egypt or Israel may eventually enable Gazans to adapt in the long-term to its over-population (or lack of natural resources). Farmers may cope with the poor quality water through switching of crops. Yet if, in a worst-case scenario, an increase in crop water requirements combines with a further decrease in water quality, such coping mechanisms may prove insufficient to sustain the farmers' livelihoods. With that threshold breached, a new set of vulnerabilities may have to be faced, such as the prospects for alternative livelihoods in an economy prevented from trading with the world. Once more, the social dimensions of climate vulnerability are seen to be more determining than are the biophysical dimensions.

3.6 Sector vulnerabilities

When considering possible climate change impacts on national policy sectors in the oPt, it is necessary to recall the significant analytical limitations. The nature of climate change forecasts means that there is high uncertainty when disaggregating predicted impacts on a regional scale. As a small territory, the oPt suffers from coarse grid coverage in global climate models, and even when regional modeling is included (Section 2.2 above) – which factors in, for example, the key East-West orographic influences on rainfall in the oPt – there is very little scientific basis for the forecasting of precise regional and sub-regional impacts (e.g. the Gaza Strip is only 360km2). The following discussion of policy sectors is therefore general. The uncertainty about particular impact patterns justifies adaptation options that favour climate resilience across the population (and prioritizing the most vulnerable).

3.6.1 Agriculture

Palestinian farmers both in the West Bank and the Gaza Strip 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/ security fence, the expanding presence of settlements and settlers roads, and the imposition of restrictions on movement and access have jeopardised 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 a few attempts to model the effects of climate change on the agricultural sector in the oPt. As already mentioned above, according to CROPWAT simulations conducted by CMWU, an annual average increase in temperature of 1oC will increase crop water requirements in the Gaza Strip by 6-11%. In the West Bank, a recent assessment was undertaken by Abu-Jamous (2009), who used the 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 (Waggoner, 1990; Ben-Gai et al., 1998; Abu-Taleb 2000). As set out in Figure 3.4, these 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 (ETo), Crop Water Requirement (CWR) and Irrigation Water Requirement (IWR) for Jericho and Al-Aghwar Governorate were calculated.

Figure 3.4: Climate change predictions (Abu-Jamous 2009 and Waggoner 1990)

Phenomena	Projection of Probable Global Annual Average Change	Regional Average Distribution of Change	Confidence of Projection for Global (G) and Regional (R) Averages
Temperature	+2 to 5°C	-3 to +10°C	G- High R- Medium
Sea Level	+10 to 100 cm		G- High R- Medium
Precipitation	+7 to 15%	-20 to +20%	G-High R- Low
Evapo-transpiration	+5 to 10%	-10 to +10T	G-High R- Low
Runoff	Increase	-50 to +50%	G-Medium R-Low

Figure 3.5 calculates irrigation water demand figures by applying the relative temperature changes of T+1°C, T+2°C, and T+3OC to the monthly average series temperature and relative precipitation changes of P-20%, P-10%, P, P+10% and P+20%.

Figure 3.5: Total Irrigation Water Requirement for Jericho and Al-Aghwar Governorates 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 scenarios show that increasing temperatures accentuate the impacts on IWR of decreasing precipitation; with the T+3, P-20% scenario being the worst in terms of additional water requirements needed – an additional 2.95 MCM/year are required annually to overcome the water lost in evapotranspiration compared to the 'best' scenario (temperature steady, P + 20%). It should be noted that crop yields are shown to be more highly affected by changes in temperature than changes in precipitation. This type of water modelling is essential to determine the risks to the Palestinian agricultural sector caused by current and future climate hazards.

3.6.2 Energy

The Palestinian Energy Authority 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, in consultations for this report, PEA staff judged that the energy consequences of climate change impacts are most likely insignificant in relation to bulk power supply priorities in the oPt. There is continuing growth in energy demand across all sectors, but the PA relies heavily on energy imports from Israel and is prevented from securing energy sources from other countries. The modernisation of power transmission and distribution networks is currently underway, facilitated

by donor commitments and a 2007 Energy Sector Review conducted by the World Bank (World Bank 2007). In the Gaza Strip this programme of work has been set back by the extensive destruction of electricity infrastructure as a result of the recent Israeli military offensive (Palestinian National Authority 2009: 30-31).

In discussions with this report's 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. Projects under consideration include a proposed 100MW Concentrated Solar Power plant for Jericho and a proposed solar-powered desalination plant in the Gaza Strip. In addition, the scaling up of production of domestic solar water heaters in the oPt (already used by two-thirds of Palestinian households) would deliver local economic and environmental benefits.

There is clearly an untapped potential in the oPt for energy measures that *simultaneously deliver climate mitigation and adaptation benefits*, particularly in situations of increased water scarcity as a result of climate change. Though the feasibility of solar power for desalination has yet to be established, its utility for household electrification has been demonstrated throughout the Mediterranean. Similarly, small-scale use of wind energy could well be feasible for water pumping from shallow wells in the Gaza Strip and particular hilly areas in the West Bank (Ibrik 2009). Furthermore, the decentralised use of solar PV technology for the pumping of irrigation water has already been successfully demonstrated on a pilot basis in Jordan and has significant potential in remote areas of the West Bank, where citrus farmers typically depend on micro-irrigation methods using spring water. It is important to stress that such developments should be justifiable in relation to climate-related water scarcity rather than as adaptations to Israeli restrictions on groundwater extraction and prohibition of access to the Jordan River. These political restrictions on Palestinian water availability fall under the legal scope of the Fourth Geneva Convention (and other international humanitarian law) and are properly the subject of final status negotiations on water.

3.6.3 Public health

Palestinians living in the affected areas are set to face increased public health issues related to the lack of water such as diarrhoea, cholera and dehydration. One main problem is a growing problem of mosquitoes – one of the issues raised by the stakeholder consultation meetings. In its initial appraisal of the domestic consequences of climate change, the Israeli Ministry of Environmental Protection also predicts an increase in mosquito populations and their distribution (Office of the Chief Scientist 2008: 91-93). The treatment of such a problem is expensive as the farmer/shepherd will be required to spray insecticides once every couple of weeks with an average of 1 litre 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 oPt with the longer and hotter summers resulting from the projected delay of winter rains. This is an area where there is an urgent need for further research.

3.6.4 Coastal management

In 2000, the Ministry of Environmental Affairs – forerunner of the EQA – made a persuasive case for the immediate implementation of a Coastal Area Protection and Management Plan (Ministry of Environmental Affairs 2000). Their report 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. A recent UNDP Disaster Risk Reduction report further emphasises the importance of the coast for the livelihoods and quality of life of residents in Gaza (Al-Dabbeek 2008).

The Ministry of Environmental Affairs Coastal Protection Plan makes specific recommendations that will help conserve the coastal areas – such as 'set back lines' (beyond which no construction is allowed), improvements in fisheries legislation and techniques and habitat conservation efforts. The very poor regulatory and legal context in the Gaza Strip, however, ensures that even the most basic of such recommendations will likely not be implemented. Expected changes in currents that will follow climate change-induced sea-level rises will impact the coastal area in ways that are difficult to predict, but may safely be expected to exacerbate the situation.

3.6.5 Biodiversity conservation

The variety of physical environments within the oPt gives rise to rich land and marine biodiversity. While there is no systematic database of biodiversity in the Gaza Strip and the West Bank, the oPt shares threats to biodiversity with other territories in the Mediterranean biome – these include rising human population density, urbanisation, agricultural land use and invasive species (Underwood et al. 2009). However, the unique structures and practices of the occupation in the oPt have negatively affected biodiversity through extensive settlement building, the construction of the Wall and the growth of a parallel road infrastructure for the use of settlers and the military. The effects of climate change on natural ecosystems in the oPt are difficult to predict, being highly dependent on the nature of local ecological habitats, as well as the rate and scope of climate-induced environmental changes. For example, there are indications that regional warming may stimulate growth of some fisheries of economic value to the Palestinians (*Sardinella aurita*), while at the same time causing local population extinctions and the proliferation of harmful species. The spread of warm-water species in the eastern Mediterranean will likely have multiple direct and indirect effects, including new introduction of exotic species through the Suez Canal.

Consideration of the impacts of potential climate change on biodiversity is outside the remit of this *Palestinian Adaptation Programme of Action*, which is focused on human well-being in the face of existing and future threats to food and water security. In the realm of human development, it is nevertheless important for the further development of climate change adaptation policy to focus on the linkages between *livelihoods* and biodiversity conservation. This is particularly relevant for the Palestinian agricultural sector; for example, the impacts of temperature changes on the flowering and fruiting of olive trees, and the role of indigenous species and genetic diversity in the selection of crops and ruminants tolerant to high temperatures and drought (one of the low-regrets adaptation options presented below: see Table 4.3). Increasing afforestation with native species can improve water retention and quality, while also providing protected natural and semi-natural areas of value for recreation and (eco)tourism. Beyond the realm of livelihoods, protected natural areas have a high cultural value for Palestinian self-identity.

4. List of Priority Adaptation Measures

4.1 National proactive adaptation

National adaptation to climate change encompasses a range of responses to the impacts of this change, focusing on climate events that pose a significant risk to a country. In the case of the oPt over the next 40-50 years, regional climate change trends are likely to include a fall in annual average precipitation, an increased incidence of drought, and an increase in the frequency of extreme events. The assessment of future climate risks for the oPt is of course limited by various uncertainties regarding the nature and scope of regional and local impacts, but adaptation is justified because the costs of inaction may well be substantial. Climate change impacts are likely negatively to affect human and economic development in the oPt in a number of key areas – agriculture and food security, water resources, coastal zones, public health, and disaster risk reduction. Above all, these impacts will fall on a population already with high social vulnerability and dependent to a large degree on external humanitarian and development assistance.

Adaptation to climate change can involve governmental, civil society and private sector actors. The focus of this proposed *Climate Change Palestinian Adaptation Programme of Action* is on state institutions and actors, such as those responsible for setting the general plans and policies by which significant climate change impacts can be addressed by all societal actors. Of course, due to the belligerent (non-consensual) occupation by Israel of the West Bank and the Gaza Strip, the PA is currently denied sovereign jurisdiction to exercise exclusive political authority regarding the management of climate risk. This situation, which obliges Israel and other external actors to assist the Palestinians in reducing their climate vulnerability (see Section 5.4), has been taken into consideration in the prioritisation of adaptation policies and measures below.

The focus of the following proposed adaptation measures is also on proactive (planned) as opposed to reactive actions. Proactive responses involve anticipation and planning in climate change risk management, while reactive responses are taken after climate change impacts have been realised (Adger et al. 2006: 7-8). Examples of the former at the governmental level include national polices for strengthening food and water security, while reactive state responses include post-event infrastructure reconstruction and water rationing. It is important to note that, while any national strategy for climate adaptation should stress proactive actions to reduce the severity of climate change impacts, the uncertainties in forecasting climate hazards mean that reactive responses will always also be necessary. These can usually only be considered in the context of particular events. However, the areas of highest risk can be anticipated and responsible national bodies can consider and prepare guidance on reactive response options.

4.2 Identification of adaptation measures

A number of options are now presented for adaptation measures in the oPt. To recall, the overriding goal both of the *Palestinian Adaptation Programme of Action* and the *Climate Change Adaptation Strategy for the oPt* is to identify and implement the most effective means by which the PA can build the capacity of the Palestinians to cope with current and future climate hazards. The water and agriculture sectors are argued to justify initial identification of adaptation options on account of their high sensitivity to climate change and their critical importance to public health and livelihoods in the oPt. The participatory process by which this strategy has been developed (stakeholder consultations and feedback) is compatible with the National Adaptation Programmes of Action (NAPAs) developed by several Least Developed Countries under the UNFCCC.

Table 4.1 below presents a set of adaptation measures for the oPt in relation to key *climate-induced* risks to food and water security. Six major risks are identified, which are linked to the vulnerability pathways summarised in Section 3 of this report for the West Bank (Figure 3.2) and the Gaza Strip (Figure 3.3):

1. Crop area changes due to decreases in optimal farming conditions
2. Decreased crop and livestock productivity
3. Increased risk of floods
4. Increased risk of drought and water scarcity

5. Increased irrigation requirements
6. Increased risks to public health from reduced drinking water quality (including saline intrusion in the Gaza Strip).

The measures represent integrated adaptation options for the agriculture and water sectors in the oPt. They are consistent with the emphasis in the *Palestinian Reform Development Plan* on the continuing strategic importance attached by the PA to the Palestinian agricultural sector (for economic development, food security and poverty reduction). This means that structural economic change *away* from agriculture is not a politically feasible climate adaptation strategy in the short-term. Each proposed adaptation measure is classified by:

- Category – whether the adaptation measure is technical (T), managerial (M), or infrastructural (I);
- Scale – whether the measure would be implemented at a regional/ local rural level (R), national sector level (N) or in urban areas (U);
- Adaptive capacity – the relative value of the measure in enhancing coping capacity to climate hazards: low (L), moderate (M) or high (H).
- Technical feasibility – on the basis of national technological knowledge and expertise, this is scored low (L), moderate (M) or high (H);
- Potential (economic) cost – prior to any precise costing, an indicative value of low (L), moderate (M) or high (H) is given for each measure.

Table 4.1: Consequences for food and water security of the identified climate risks, adaptation options, option category, scale of implementation, adaptive capacity, technical feasibility and potential cost

Consequences for food and water and security	Agricultural and water-sector adaptation	Category [1]	Scale [2]	Adaptive capacity [3]	Technical feasibility [3]	Potential cost [3]
Risks						
1. Crop area changes due to decreases in optimal farming conditions						
Main climatic causes of risk: Changes in monthly precipitation distribution Increased temperatures in critical periods Decreased groundwater recharge rates Increased erosion						
Farming optimal conditions altered resulting in increased risk to rural income	Rural livelihood diversification	M	N	H	M	M
	Strengthen capacity of agricultural extension services	M	N	M	M	M
	Irrigation of highest value crops	I	R	H	H	M
	Changing cultivation practices	M	R	M	H	H
	Increased freshwater use	I	R	H	H	M
	Switching to drought-resistant crops and ruminants	T	R	M	M	L
Loss of indigenous species	Introducing drought-resilient varieties of indigenous crops	T	R	M	M	L
Soils deterioration due to land use changes	Precision agriculture: improve soil and crop management	M	R	H	M	M

Consequences for food and water and security	Agricultural and water-sector adaptation	Category [1]	Scale [2]	Adaptive capacity [3]	Technical feasibility [3]	Potential cost [3]
2. Decreased crop and livestock productivity						
Main climatic causes of risk: Changes in monthly precipitation distribution Increased temperatures in critical periods (heat stress) Decreased groundwater recharge rates						
Crop productivity decrease	Change in cropping and grazing patterns for productivity gains	M	R	M	M	L
	Increased input of agro-chemicals	M	R	H	H	H
	Increased irrigation of main crops	I	R	H	H	H
Land abandonment	Adaptive land use planning	M	N	H	M	M
	Rural livelihood diversification	M	N	H	M	M
3. Increased risk of floods						
Main climatic causes of risk: Increase of extreme events frequency Increased magnitude of extreme events						
Increased expenditure in emergency and remediation actions	Contingency plan development	M	N	H	H	L
	Enhanced flood plain management	M	N	M	M	M
Flash flood frequency and intensity increase	Increased local-level rainfall interception (e.g. green lands)	M	R/U	H	H	L
	Reduction of grazing pressures to protect against soil erosion	M	R	M	M	M
Flooding	Increased drainage & storm runoff capacity	I	R/U	H	H	L/M
4. Increased risk of drought and water scarcity						
Main climatic causes of risk: Decreased annual and/or seasonal precipitation Decreased groundwater recharge rates Increase in the frequency of extreme conditions (droughts and heat waves)						
Conflicts among water users due to drought and water scarcity	Set clear water use priorities	M	N	H	H	L
	Increase water use efficiency	M	N	H	H	H
Water supply reduced	Increased regional-level rainfall interception (e.g. afforestation)	M	N	H	H	H
	Increased freshwater production	N	R/U	H	H	M
	Awareness-raising on water conservation techniques	I	R/U	M	H	L
	Improved field drainage and soil absorption capacity	T	R/U	L	M	M
	Use of drought tolerant crops and ruminants	M	R	H	M	M
	Local use of treated wastewater for agriculture	T	R	M	H	H
	Development of new water sources including desalination	I	N	H	H	H

Consequences for food and water and security	Agricultural and water-sector adaptation	Category [1]	Scale[2]	Adaptive capacity[3]	Technical feasibility[3]	Potential cost[3]
5. Increased irrigation requirements						
Main climatic causes of risk: Decreased and more variable precipitation Decreased groundwater recharge rates Increase of drought and heat stress conditions frequency						
Water availability decrease	Investment in efficient irrigation equipment (e.g. trickle irrigation)	T	R	H	H	M
	Use of treated wastewater	T	R	M	H	H
	Increased water harvesting (e.g. Critchley et al. 1991)	T	R	M	H	H
	Desalination of brackish water	M	R	H	H	L
	Development of new wells	I	N	H	M	M
6. Increased risks to public health from reduced drinking water quality (DWQ)						
Main climatic causes of risk: Decreased and more variable precipitation Decreased groundwater recharge rates Saline intrusion from sea-level rise (Gaza Strip)						
Drinking water quality decrease	Incorporation of climate risks in national DWQ management	M	N	H	H	L
	Increased water quality monitoring	T	N	H	M	H
	Identification of minimum household water requirements	T	N	H	M	H
	Equitable groundwater utilisation					
Groundwater contamination		M	R/U	H	M	M
	Prohibit use of untreated wastewater in agriculture	I	R	M	H	M
Saline intrusion in the Gaza Strip	Increased wastewater treatment					
	Protection of coastal sand dunes	I	U	M	H	H
	Coastal protection structures	M	R	H	H	M
		I	R	H	H	H

1 Category = T: Technical, M: Management, I: Infrastructure
2 Scale of implementation = R: Regional/local rural level, N: National policy sector, U: Urban areas
3 Adaptive capacity level, technical feasibility and potential cost = M: Moderate, H: High, L: Low

4.3 Prioritisation of adaptation measures

Due to concerns by poorer countries over the potentially high costs of adapting to climate change impacts, it is necessary to prioritise adaptation options according to so-called 'no-regrets' and 'low-regrets' activities, where:

- *No-regrets options* are those that are justified under current climate conditions and are further justified when probable climate change is considered.
- *Low-regrets options* are those that require limited additional outlays to address the effects of climate change.

In the context of the oPt, where recent climate trends are already resembling the drought-prone conditions forecast by climate change models, the burden of proof for justifying climate adaptation measures has been reduced. This is reinforced by the fact that those most vulnerable to climate change are also those groups already targeted for poverty reduction, food security measures and other MDG activities by the PA and external donors. Protection of the most vulnerable is an overlapping strategic objective between this *Palestinian Adaptation Programme of Action* and the UN human development agenda for the oPt.

The adaptation options identified above are now categorised in terms of no-regrets (Table 4.2) and low-regrets (Table 4.3) measures, with prioritisation of the measures according to levels of adaptive capacity and technical feasibility. It is logical to give preference to measures with higher adaptive capacity and technical feasibility – again, *the crucial distinction between the two sets of measures is that no-regrets measures make sense even if no climate change occurs, while the low-regrets measures are directed more at the negative effects of climate change*. The prioritised climate adaptation measures listed – those with high adaptive capacity – may be considered as practically feasible for implementation within the next three years under the PRDP process.

These are indicative rankings, informed by stakeholder consultations and evidence-based judgments. Current data limitations on climate impacts in the oPt mean that a systematic quantitative valuation and ranking of priority adaptation options is not possible. Should the PA choose to adopt this *Palestinian Adaptation Programme of Action*, they would be the starting-point for more precise budgetary calculations and technical assessments. This type of matrix can also be used to identify adaptation measures for other policy sectors, as determined by national planning bodies, ministries and other specialised agencies (Section 5.2). This would be expected as the climate change adaptation strategy extends out from water and agriculture to other policy sectors.

Table 4.2: No-regrets adaptation options (no order of priority)

Adaptation measure	Adaptive capacity	Technical feasibility
1. Development of flood contingency plans	**High**	**High**
2. Local increases in rainfall interception	**High**	**High**
3. Establishment of clear water use priorities	**High**	**High**
4. Introduction of more efficient irrigation	**High**	**High**
5. Review of drinking water quality management system to incorporate climate risks	**High**	**High**
6. Increased (sustainable) use of freshwater	**High**	**High**
7. Increased use of brackish water and treated wastewater	**High**	**High**
8. Equitable and reasonable allocation of transboundary water resources between Israel and the Palestinians	**High**	**High** (but politically challenging)
9. Awareness-raising on water conservation	Medium	**High**
10. Change in cropping and livestock patterns for productivity gains	Medium	Medium

Table 4.3: Low-regrets adaptation options (no order of priority)

Adaptation measure	Adaptive capacity	Technical feasibility
1. Increased irrigation for highest value crops	**High**	**High**
2. Increased scale of water harvesting	**High**	**High**
3. Protection of coastal sand dunes	**High**	**High**
4. Rural livelihood diversification	**High**	Medium
5. Adaptive land use planning	**High**	Medium
6. Precision agriculture: improved soil and crop management	**High**	Medium
7. Alteration of crop and ruminant selections for more tolerance to heat and drought	**High**	Medium
8. Prohibition of use of untreated wastewater in agriculture	Medium	**High**
9. Strengthened capacity of agricultural extension services	Medium	Medium
11. Enhanced floodplain management	Medium	Medium
12. Reduction of grazing pressure on rangelands	Medium	Medium

Consideration of no-regrets and low-regrets options does not mean that high cost adaptation measures should be ignored. Example of those also judged to have *both high adaptive capacity and technical feasibility* are:

- **Increased water use efficiency from infrastructure investment**
- **Development of 'new water' sources, including major (150 MCM/year) desalination capacity for the Gaza Strip**
- **Coastal protection measures for the Gaza Strip (e.g. wave breaks and offshore structures)**

These are the types of sector-wide options that may be considered by the PNA donors, especially for donor-funded investment programmes in water infrastructure that are needed anyway for human and economic development reasons. Moreover, major investment in seawater and brackish water desalination for domestic use and industrial use could release pressure on renewable water sources for agriculture (for example, the proposed 150 MCM/year seawater desalination plant for the Gaza Strip mentioned above in Section 3.5.2).

5. Mainstreaming Climate Adaptation in the oPt

The complexity of the challenge in addressing major climate stresses in the oPt is evident from the 'vulnerability pathways' illustrated in Figures 3.2 and 3.3. Also revealed by the stakeholder engagement for this UNDP/PAPP climate adaptation initiative was the relatively low adaptive capacity of Palestinian governmental institutions in the face of climate risks. Adaptive capacity, to recall, is the long-term ability of a system to cope with existing and future climate hazards (see Section 2.5.1). In this section, the focus is on means by which the most relevant Palestinian Authority (PA) institutions – EQA, Ministry of Agriculture and the PWA – could improve their capacity to reduce climate vulnerability in the West Bank and the Gaza Strip. These institutions should have lead political responsibility for adaptation, helping to create the conditions to build the adaptive capacity of communities and individuals.

There are major structural challenges facing the PA agencies relating to effective climate adaptation policy-making, which have been traced by observers to political differences, resource deficiencies and managerial weaknesses. In terms of PA capacity-building, coordinated environmental information collection and use is an immediate priority. Again, though, such constraints are accentuated by the *external* challenges posed by the Israeli occupation. Adaptive capacity at the national level in the oPt is directly compromised by movement restrictions as well as insecure, insufficient water and land resources. Some of the best agricultural land is taken by Israeli settlements in the Jordan River Valley, while 20% of arable land in the Gaza Strip is off-limits to farmers because it falls within the Israeli security zone adjoining the border. Similarly, Israeli restrictions prevent both bulk imports of clean water in the Gaza Strip and the development of irrigation in the West Bank. Plans to develop capacity to reduce climate vulnerability must be grounded in the current political reality of PA institutions with limited jurisdiction and weak authority over the oPt.

5.1 Information needed for climate risk management

Effective climate risk management in the oPt requires the coordinated collection, analysis and dissemination of relevant information. There are many potential sources of information (both environmental and non-environmental), but data can be structured according to the three key risk management challenges:

4. Identifying climate impacts in the oPt by means of environmental monitoring networks and the development of forecasting capacity
5. Monitoring the climate vulnerability of sectors and communities at risk
6. Collating and disseminating relevant information on successful (and unsuccessful) climate adaptive practices

Creating this information requires a focused approach where data is collected, stored, processed and analysed and then disseminated according to priority issues and needs, as determined by dialogue among stakeholders. This is challenging as multiple actors and policy sectors are likely to be relevant. It is thus advisable that one agency should be responsible for conducting or supervising the production of climate risk information, focusing on what data is needed, and how it can be produced, collated and disseminated. It is important that the adequacy of existing data sources is assessed (e.g. the coverage and data scope of meteorological stations in the West Bank and the Gaza Strip), and the continuity of climate data gathering is maintained. The challenge is to manage climate data in the oPt 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.

Within the oPt, climate-relevant environmental information (e.g. drought assessments, meteorological data, water supply and quality information) is collected by the Ministry of Agriculture, the Palestinian Central Bureau of Statistics, the Palestinian Meteorological Department and the Palestinian Water Authority. The available data is scattered, and is collected by different institutions without adequate coordination. The data is not always effectively processed, screened and evaluated, though there are emerging examples of good practice, such as the drought early warning system developed by the Ministry of Agriculture. As yet, though, there is no central hub or 'clearinghouse' within this dispersed climate

1 The priority ordering, where 'first' indicates greatest policy priority and 'third' lowest policy priority, relates to an appraisal of the probability of occurrence, probability of damage, the number of expected human losses and injuries, and the value of expected damages to national resources (al-Dabbeek 2008: 22).

information infrastructure. It is recommended, therefore, that *the Environmental Quality Authority serves as the lead agency within the PA for co-ordinating the collection, analysis and dissemination of core information relating to climate variability and long-term change.*

Environmental information management training would be a prerequisite for those charged with managing climate information within the PA. A common reference point for this information could be a national climate assessment for which the *Climate Adaptation Strategy for the Occupied Palestinian Territory* (UNDP/PAPP 2009c) is a potential starting-point – notably its Vulnerability Assessment and Climate Risks Assessment. A unified national assessment, supported by technical capacity-building on electronic information management tools and services, would be the most efficient means of identifying a clear hub of up-to-date climate information. Of course, there will be regional and sectoral information needs from a diverse set of user (decision-makers, the public, private sector actors), which will often require additional data generation and collation. The public agency in charge of the management of climate information might benefit from a stakeholder advisory board, in order to help determine climate information collection and management priorities over time.

5.2 National-level institutional capacity-building

The involvement of stakeholders in all stages of the UNDP/PAPP adaptation planning for the oPt is designed to nurture effective and legitimate adaptation planning policy. Climate change risks are most likely to impinge on PRDP goals to increase agricultural output and provide more efficient and equitable water delivery to households. As representative of, and responsible to, the Palestinian people, PA mainstreaming of climate change adaptation will strengthen the climate change resilience of vulnerable communities.

Disaster risk reduction (DRR) – the development and implementation of policies and practices that minimise risks from disasters – is the first line of institutional defence against serious climate change impacts (Mitchell and van Aalst 2008). Therefore, the DRR capacity within the PA is critical to effective climate change adaptation within the oPt. Under the Palestinian Civil Defence Law (1998), the Minister of Internal Affairs chairs a disaster response committee – the Higher Council of Civil Defence (HCCD) – which formally involves 13 different institutions from across the PA, but this is not currently functioning. A recent UNDP/PAPP-funded review of the DRR infrastructure on the oPt (Al-Dabbeek 2008) revealed a number of weaknesses, including:

- Limited legal frameworks for disaster risk reduction, which are response-led rather than preventative
- Underdevelopment of policies for disaster preparedness, mitigation, and emergency response
- Weak capacity in disaster management and rescue operations
- Lack of capacity and training in disaster risk management and policy implementation at government level (national and local)
- Lack of coordination between central and the local level authorities in disaster management activities

It should be noted that these considerable capacity gaps in DRR will remain insofar as there remains no functioning Palestinian sovereignty – evident in the lack of control of borders, the absence of a monopoly of control of military force, and the inability to exercise exclusive judicial authority (even in Area A) – undermines the ability of governmental institutions to meet civil defence and disaster risk reduction responsibilities. This institutional gap has created a substantial role for non-governmental organisations (NGOs) in providing disaster assistance and relief (e.g. Palestinian Medical Relief Committee, Palestinian Red Crescent). A National Agency for Disaster Risk Reduction was established in 2004 to coordinate NGO efforts, but this has not removed the need for building an autonomous capacity for DRR within the PA.

In the consultations conducted by the Project Team, governmental stakeholders agreed that the Civil Defence Law should be strengthened, that HCCD should be reinvigorated, and that climate change risks need to be integrated into an effective

institutional structure for DDR in the oPt. This will require more systematic information on environment-related risks in order to provide an integrated understanding of the role of climate hazards. However, there exists Palestinian expertise on *water vulnerability mapping* for the Gaza Strip (e.g. Almasri 2008) and the West Bank (e.g. Mimi and Assi 2009) that can be utilised and extended to incorporate climate information in systematic hazard and risk assessment.

Table 5.1: Main types of hazards in the oPt (adapted from Al-Dabbeek 2008: 22)

Hazard Type	Probability of Occurrence	Probability of Damage	Priority[1]	Total damage in last 10 years	Last severe events
Floods	Low	Low -limited	third	Millions of dollars	1963,1966,1987, 1991
Earthquakes	High	High	first	Limited	1927
Droughts	Medium	High in the long run	second	Tens of millions	———
Land / mud slides, rock falls and avalanches	Medium	Medium-High	second	Millions	1992,1997, 2003 2005
Epidemic outbreaks of disease	Low	Low	third	Millions	1981
Industrial accidents	High	Medium-High	first	Millions	1999, 2006
Population displacement/ refugee influx	High	High	first	Tens of millions	2001-2006
Sea Disasters	Medium	High in the long run	second	Tens of Millions	———
Pollution of groundwater	High	High	second	Tens of millions	———
Desertification	High	High on the long run	second	Tens of millions	———
Occupation, Wars	High	High	first	Billions	2000-2006

Table 5.1 (above) sets out the results of a preliminary hazard assessment for the oPt conducted by Al-Dabbeek (2008: 22). It can be seen that disaster risks directly related to climate change are significant: the probability of damage from *droughts* and *desertification* is estimated to be high in the long run, though still deemed to be less of a policy priority than the Israeli occupation, population displacement, and earthquake preparedness. According to Al-Dabbeek (2008: 20), the recent experience with drought has renewed concerns about the inadequacy of contingency planning efforts and the lack of proper risk assessment, response plans and coordination between the different governmental levels. These concerns were also relayed to the Climate Change Adaptation Project Team in consultations with the Ministry of Agriculture. A drought early warning system is now under development supported by Italian Development Cooperation. This will improve data collection on rainfall and soil moisture, providing a more scientific basis for minimising the risk of drought.

Indeed, there is already enough agricultural information and meteorological evidence to justify priority risk management by the Prime Minister's Office and the PA to address the impacts of drought and desertification in the oPt. *The National Committee to Combat Desertification is the appropriate Palestinian strategic body to take lead responsibility for developing policies and measures relating to drought minimisation and management* (a broader remit than currently planned). This could include the authority to impose emergency measures during hydrological and/or agricultural droughts. While similar national committees have not always been effective at the inter-ministerial level (e.g. the National Water Council), they tend to have efficient technical committees comprising relevant experts. Such a technical committee would comprise relevant PA ministries (especially the Palestinian Water Authority, the Ministry of Agriculture, and the Environmental Quality Authority). In addressing drought management it could draw on similar practice in other countries with proven experience in minimising drought risks (e.g. Tunisia, Morocco). Informed by stakeholder engagement, this expert group could identify planning priorities and management options for the National Committee.

Lastly, it is recommended that *climate change adaptation planning be formally embedded within the PA, with the Environmental Quality Authority the line agency*, in cooperation with the Ministry of Agriculture and the Palestinian Water Authority (and in consultation with other ministries according to sectoral impacts forecasted as a result of climate change). At the moment climate change risks are not integrated into national development planning. Integrating climate change adaptation (and logically also climate change mitigation) responsibility into the current PRDP and its successor will necessitate capacity-building for the main ministries involved: suggested key areas for institutional strengthening are set out in Section 5.2 below.

In summary, the recommendations for consideration by the PA are:

- The integration of climate risk management with national disaster risk reduction under the responsibility of a revived *Higher Council of Civil Defence*
- The strategic development of policies and measures relating to drought minimisation and management under a *National Committee to Combat Desertification*
- The designation of the *Environmental Quality Authority as the PA line agency for national climate change adaptation planning*

It is also recommended that 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 PA is advised to consider adopting the *Climate Change Adaptation Strategy for the Occupied Palestinian Territory* (UNDP/PAPP 2009c). This would imply:

- Integrating climate change adaptation (and logically also climate change mitigation) into the successor to the *Palestinian Reform and Development Plan 2008-2010* (PRDP). Climate change risks already impinge on PRDP goals to increase agricultural output and provide more efficient and equitable water delivery to households; and these risks also affect other PRDP goals, including social security protection and health quality improvement. The need for integration is therefore obvious.
- As recommended above (Section 5.1), that EQA serves as the lead agency within the PA for coordinating the collection, analysis and dissemination of core information relating to climate variability and long-term change. The technical committee on climate change already established within EQA (Section 5.2.1 below) should continue in order to support this adaptation planning role, as mandated by the PA
- Dedicated funding from the Ministry of Planning targeting sectors and communities in the oPt with the highest climate vulnerability. Development assistance frameworks (Section 5.5) are the logical source for such funding, but in accordance with Palestinian priorities for climate adaptation rather than donor preferences.

For the four governmental bodies likely to be most involved in climate change adaptation planning, there are also separate capacity issues. Highlighted now are those issues that arose in stakeholder consultations:

5.2.1 Environmental Quality Authority

EQA is the lead agency on climate change for the PA – 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 PA in 2000. Its institutional restructuring as EQA, which was supported by a number of external donors (including the IUCN, Italian Cooperation and UNDP), has created a professional, decentralised environmental agency that is committed to inter-ministerial working and participatory decision-making. However, there are currently problems arising from constraints placed by Hamas on EQA staff in Gaza, including the Chairman of EQA. It is essential that EQA is allowed to operate effectively as a national environmental agency for the oPt for the benefit of all Palestinians.

This *Palestinian Adaptation Programme of Action* is a key outcome of a UNDP/PAPP-funded initiative to assist EQA to formulate a national strategy for dealing with climate change, under the Natural Resources Conservation policy area of the Palestinian National Policy Agenda. While not explicitly mentioned in the PRDP 2008-10, the Ministry of Planning approved the climate adaptation project for EQA at the end of 2007. As mentioned earlier in this report (Section 2.6), the project was designed to deliver the following capacity-building outcomes for the PA:

- The identification of key climate change information and modelling needs for national development planning and environmental policy-making
- The identification of priority climate change adaptation policy options and measures
- Improvement in the capacity of PA decision-makers effectively to take account of climate change impacts
- Improvement in the capacity of PA staff to monitor and evaluate policies with regard to climate change

EQA has been the lead agency for the UNDP/PAPP *Climate Change Adaptation* and consolidation of the capacity gains generated by it rests, firstly, on the formal designation of EQA as the line agency responsible for climate change adaptation planning within the PA, in close cooperation with the PWA and Ministry of Agriculture. Within EQA, the management of the climate change adaptation project has been the responsibility of a national technical committee featuring Director Generals from Environmental Resources, Environmental Protection, Projects and International Relations, Policies and Planning, and Administration and Financial Affairs. *It is recommended that this technical committee continues to oversee the adoption and implementation of both a national climate change adaptation strategy for the oPt.* The committee could also consider follow-up work; for example, the development of climate change mitigation policies and measures with the Palestinian Energy Authority and other agencies.

The comprehensive assessment of future climate risks requires domestic research and expertise. There is an identified need for the PA to acquire increased capacity for monitoring and modelling rainfall variability and long-term climate change in the oPt. Without such systematic analysis, there will remain significant uncertainties regarding future climate change impacts in the oPt, and the scientific basis for the prioritisation of adaptation policies and measures. Training of EQA and other PA staff with climate planning responsibilities should cover essential technical aspects of climate risk management, taking advantage of advanced training programmes offered by external donors; e.g. EQA staff members have taken courses on Climate Change Adaptation and Mitigation delivered by the Swedish International Development Cooperation Agency (SIDA).

The UNDP/PAPP Climate Change Adaptation Initiative has highlighted, above all, the climate vulnerability of the agricultural sector. Under Article 17 of the Palestinian Environmental Law No. 7/99, the Ministry of Environmental Affairs (now EQA) is required to cooperate with the Ministry of Agriculture and other specialised agencies in developing procedures for

dry-land farming. In accordance with this responsibility, which covers some of the agricultural areas most sensitive to protracted drought, it is recommended that EQA participates, with the Ministry of Agriculture, in the development of drought minimisation and management guidelines in support of the *National Committee to Combat Desertification*.

Under Article 75 of the Environmental Law 7/99, EQA is charged with cooperating with other countries to exchange scientific and technical information, coordinate joint environmental research programmes, and undertake joint environmental cooperation regarding relevant Palestinian environmental commitments. On this basis, EQA has an active international relations role for the PA, including observer status in the UN Convention to Combat Desertification. It is important that this external work is extended to the international climate change regime. EQA is already leading PA efforts to ensure formal Palestinian participation in the United Nations Framework Convention on Climate Change (UNFCCC), which should be supported by UNFCCC Parties according to international environmental law (see Section 5.4) and UN General Assembly Resolution 52/250: *Participation of Palestine in the work of the United Nations*. The status and scope of this involvement would be determined in negotiations with the UNFCCC Secretariat and contracting Parties, but would need to include the question of Palestinian access to UNFCCC climate adaptation funding mechanisms.

In summary, capacity-building for climate change adaptation planning within EQA would need to include at least the following components:

- The formal designation of EQA as the line agency responsible for climate change adaptation planning within the PA, 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 PA for co-ordinating the collection, analysis and dissemination of key information relating to climate variability and long-term change. This includes scenario planning and high-resolution regional climate modelling tailored to Palestinian climate risk management needs
- The training of selected EQA and other PA 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 programmes offered by external donors, but also be able to rely on a core training budget provided by the PA
- In cooperation with the Ministry of Agriculture and other agencies, the participation of EQA in the development of drought minimisation and management guidelines for the *National Committee to Combat Desertification*
- EQA, on behalf of the PA, to lead efforts to ensure formal Palestinian participation in UNFCCC. The status and scope of this involvement would be determined in negotiations with the UNFCCC Secretariat and contracting Parties, but should include Palestinian access to UNFCCC climate adaptation funding mechanisms.

5.2.2 Ministry of Agriculture

From the vulnerability pathways identified earlier in the *Climate Change Adaptation Strategy* (Figures 3.2 and 3.3), it can be seen that climate change is forecast to impact negatively on livelihoods, primarily through reduced crop yields from lower, more variable precipitation and higher temperatures (and also saline intrusion in the Gaza Strip). Agricultural livelihoods in rain-fed farming communities are particularly vulnerable, though this vulnerability is also caused by Israeli restrictions on movement and access to land, resources, and markets, and an increase in farming production costs (including for water) along with decreasing profits. The constraints posed by the Israeli occupation are generally beyond the reach of government interventions. However, there are also internal structural weaknesses in the Palestinian agricultural sector: the Food and Agriculture Organization (FAO 2009: 14-15) has pinpointed the following:

- Most Palestinian products for domestic markets are not competitive in terms of quality compared to similar products coming from Israel
- Marketing strategies are still traditional, which favour small-volume sales through intermediaries with limited returns
- There has been limited investment in new agricultural equipment, new technologies and crop diversification
- The lack of availability of irrigation water is compounded by weak enforcement of existing laws, the over-extraction of aquifers and the deterioration of water infrastructure

An immediate adaptive capacity-building priority for the Ministry of Agriculture is to model the effects of climate change on the agricultural sector in the oPt, as part of the information management for climate risk mentioned above, where EQA is recommended to be the lead climate information coordinator (Section 5.1). This *Palestinian Adaptation Programme of Action* has already drawn attention to the type of research necessary, using the example of the analysis by Abu-Jamous (2009) of climate change impacts on the demand for irrigation water. From this assessment (and as noted in Section 3.6.1), it was observed that crop yields were affected more by changes in temperature than changes in precipitation. This suggests that the careful monitoring of humidity and crop evapotranspiration rates should be part of any monitoring network designed to enhance the adaptive capacity of the agricultural sector. This type of modelling – extended also to rain-fed agriculture – is essential to determine the risks to the Palestinian agricultural sector caused by current and future climate hazards.

Climate change considerations need to be integrated into the agricultural development goals of the PRDP 2008-10, which include a 15% increase in agricultural output, a 10% growth in agricultural employment and an increase of 25% in agricultural exports. For the PA the agricultural sector has a pivotal role in economic recovery, poverty alleviation and reducing food insecurity in the oPt. At the same time, it is recognised that the Ministry of Agriculture needs strengthening in order to drive these development goals. It makes sense, therefore, to incorporate climate risk management in proposed capacity-building of the ministry's General Directorate for Planning and Policy, which already has responsibility for the technical management of drought. This would affect departments responsible for policy and planning, project preparation, technical and international cooperation, monitoring and evaluation, and GIS mapping (FAO 2009: 34).

In the stakeholder consultations with the Project Team, the Ministry of Agriculture stated that an inter-ministerial planning framework and technical committee is needed to address the risks in the oPt of recurrent droughts and desertification, including linkages to climate variability and change. It is recommended that the Ministry of Agriculture lead the development of drought minimisation and management guidelines for the agricultural sector in support of a functioning *National Committee to Combat Desertification* (the Ministry already has a thematic group looking at drought). These should provide a scientific basis for identifying drought emergencies (including linkages to desertification), which can draw on the new drought early warning system developed by external donors for the ministry.

Strengthening of the extension services function of the Ministry of Agriculture has been identified as a capacity-building priority by FAO (2009: 15). It is recommended that future technical assistance for building up extension services should take into account climate risk management considerations, as the neglect of climatic stresses and hazards could undermine the sustainable development of the Palestinian agricultural sector. Technical and financial assistance to farmers compatible with reduced climate vulnerability include: the improved management of soil moisture in rain-fed areas, the introduction of more water harvesting techniques (e.g. Abdallah 2006), the rehabilitation of grazing areas, switching to drought-resistant crops, and the development of community-based irrigation schemes (e.g. Hedger and Cacouris 2008: 51-52). As suggested by the Ministry in consultations, the private sector could also be mobilised effectively here; for example, by developing an effective insurance system for the agricultural sector.

In summary, capacity-building within the Ministry of Agriculture to increase the resilience of farmers would include at least the following components:

- 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 minimisation and management guidelines in support of the *National Committee to Combat Desertification*
- Improved agricultural outreach and extension services
- Strategic climate planning capacity (including modelling, in cooperation with EQA)

5.2.3 Palestinian Water Authority

The PWA has commissioned a number of reports related to its capacity-building, three of which overlapped with the UNDP/PAPP Climate Change Adaptation Initiative: these are:

- *Water Governance Programme: Building the Capacity of Institutional Reform of the Water Sector* (PWA 2008b)
- *An Audit of Operations and Projects in the Water Sector in Palestine: The Strategic Refocusing of Water Sector Infrastructure* (Audit Environmental 2008)
- *West Bank and Gaza: Assessment of Restrictions on Palestinian Water Sector Development* (World Bank 2009)

The latter two reports focused on the political obstacles to effective national-level water management in the oPt. Causes identified by the World Bank for poor water management by the PWA – that are relevant to water-related climate vulnerability and adaptation planning – include: (a) implementation constraints [movement restrictions by Israel] that impede investment and maintenance of water infrastructure; and (b) the weak institutional capacity of the PWA for planning, implementation and management, including the loss of regulatory capacity in the Gaza Strip (World Bank 2009: 67).

The capacity of the PWA to reform itself was highlighted in the UNDP-financed Water Governance Programme (PWA 2008b). This report noted the benefits that would derive from enhanced capacity at all levels – from licensing and consumer affairs through to middle-level management in the Planning and Quality Assurance departments, through to the level of the PWA Director Generals themselves. The effects of a weak legal and regulatory context were also emphasised: this context inevitably impedes the ability of the PWA to implement climate change adaptation plans and other climate risk management measures.

The Norwegian-financed *Audit of Operations and Projects in the Water Sector in Palestine* proposed the introduction of a Fast-Track Approval Process (FTAP) to bypass the effects of the Israeli movement restrictions, particularly in the Gaza Strip. The FTAP is designed to facilitate the construction of water projects of a humanitarian nature, and if adopted by both sides, would serve to directly address the climate vulnerability of the communities in the Gaza Strip, and the West Bank communities of Area C. Climate risk information should be available during FTAP decision-making. The Audit also recommended the creation of a Strategy, Policy and Project Implementation Unit to refocus the institutional priorities of the PWA. Such a prioritisation is an opportune moment to consider policy related to climate vulnerability and adaptation in the oPt.

The capacity required by the PWA to address climate vulnerability ultimately depends on its role within any National Climate Adaptation Plan adopted by the PA. Basic capacity that would be required in any and all cases would focus on the central point of the 'vulnerability pathways' identified in this report for the West Bank (Figure 3.2) and the Gaza

Strip (Figure 3.3) – groundwater quality. The PWA is thus advised to reinforce its water quality monitoring programmes, and supplement these with predictive capacity on future groundwater use and availability. Particular attention should be paid to seawater intrusion in the Coastal Aquifer (Gaza Strip) and saline levels in the Jordan Rover Valley. The monitoring programme should also cover surface water sources, notably the wadis and – following Permanent Status negotiations – the Jordan River.

In summary, capacity-building within the PWA to address climate variability and change would include at least the following components:

- 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 modelling, in cooperation with EQA) in support of water policy-making

5.2.4 Ministry of Planning

The Ministry of Planning has a central role in coordinating socio-economic development in the oPt, including overseeing the strategic planning process, linking planning to budgeting, and ensuring that international assistance to the Palestinians is effectively managed. As donors show an increasing interest in financing climate change adaptation (and mitigation) activities, it is essential that the Ministry is able to coordinate aid so that there is no duplication of activities between donors: this is a point that the Ministry highlighted with the Project Team in stakeholder discussions for the *Climate Change Adaptation Initiative*. The Ministry has also been strongly supportive of the high level of stakeholder engagement in the development of the *Climate Change Adaptation Strategy for the oPt and the Palestinian Adaptation Programme of Action*.

Above (Section 5.2) it was recommend that there be dedicated funding from the Ministry of Planning to sectors and communities in the oPt with the highest levels of climate vulnerability. Development assistance frameworks (Section 5.5 below) are the logical source for such funding, but in accordance with Palestinian priorities for climate adaptation and human development, and also taking into account wider social trends (e.g. population growth forecasts in the Gaza Strip and the West Bank). Institutionally, the Directorate General of Aid Management and Coordination (DG-AMC) in the Ministry of Planning has been strengthened in recent years (as a result partly of significant financial and technical assistance from Belgian Technical Cooperation), and there are currently four Strategy Groups and associated Sector Working Groups promoting aid harmonisation with national planning objectives. However, climate change adaptation issues falls outside this structure, so there is need to integrate climate risks in this work.

Capacity-building within the Ministry of Planning to address climate risks would therefore include at least the following components:

- Including climate change adaptation (and climate change mitigation) priorities in the next *Palestinian Reform and Development Plan*;
- Supporting PA recommendations for the Ad Hoc Liaison Committee to include climate adaptation financing in its remit (Section 5.5. below);
- Including climate risk management information, where relevant, in the selection and approval of development programmes and projects by Sector Working Groups;
- Investigating the options for participating in regional climate change adaptation programmes compatible with the social and economic development needs of Palestinians.

5.3 Monitoring and evaluation

Adoption, in part or whole, of this *Palestinian Adaptation Programme of Action* by the PA would require a monitoring and evaluation plan for implementing the relevant elements. This strategy's recommended adaptation actions – the prioritisation of adaptation measures (Section 4) and mainstreaming of climate change adaptation in national institutions (Section 5) – are complementary and should be pursued simultaneously for the effective development of climate change adaptation in the oPt. Monitoring is required to oversee these twin adaptation tracks, and provide routine information on the progress of their various components according to targets agreed by stakeholders. Evaluation is the process of systematically and determining the effectiveness, efficiency, and fairness of climate change adaptation activities.

In common with best practice for adaptation planning, it is recommended that a central monitoring and evaluation unit be established within, or under the jurisdiction of, a strategic government agency (Perez and Yohe 2005: 209). The location for such a unit in the oPt would be the responsibility for the PA; however, it would make administrative sense for the Ministry of Planning to have this jurisdiction. If it is agreed with the recommendation above (Section 5.2) that EQA becomes the line agency responsible for overseeing the implementation of a national climate change adaptation strategy in the oPt, *the EQA-led technical committee on climate change could serve this monitoring and evaluation unit role* (with delegated authority from the Ministry of Planning). This role fits also with another recommendation above that EQA should serve as the lead PA agency for coordinating the collection, analysis and dissemination of key information relating to climate variability and long-term change (Section 5.1). Of course, this would necessitate the allocation of appropriate financial and human resources, including relevant staff training.

UNDP/PAPP goals for enhancing the capacity of the PA to adapt to climate change include the integration of adaptation activities into domestic planning, budgetary and fiscal policies, and other policy interventions (Section 2.6). It is therefore important that climate change adaptation priorities are included in the 2010-2012 PDRP, which would help prevent their marginalisation from strategic planning priorities and PA-approved flows of donor assistance. As climate adaptation moves, over time, into mainstream national planning, the monitoring and evaluation of adaptation measures would be expected to become part of routine management processes in the relevant ministries. However, there is likely to remain the need for a dedicated monitoring and evaluation unit on climate change adaptation, if only because the high degree of uncertainty regarding climate change risks and socio-economic trends in the oPt. Also, in Palestinian Permanent Status negotiations with the Israelis, knowledge of climate change risks will be necessary for protecting Palestinian interests in key files relating to water and food security.

The development of a monitoring and evaluation framework for implementing this *Palestinian Adaptation Programme of Action* would recognise that its overall objective is:

- **To implement the most effective means by which the PA can enhance the capacity of the Palestinians to cope with current and future climate hazards**

It has been argued in this report, based on stakeholder consultations, that the *water usage* in the oPt justifies priority focus in terms of climate change impacts, and that *agriculture* is the Palestinian economic sector most sensitive to climate hazards. This leads to the identification of two strategic outcomes for climate change adaptation in the oPt:

- ***Water security*** **– sustained access of individuals to sufficient safe water for heath and well-being in the face of significant climate risks (e.g. water scarcity and reduced quality).** One relevant benchmark that could be considered for adoption is the WHO *minimal* standard of daily water consumption for direct human consumptive and hygiene needs – 100 litres/person/day (Section 2.1);

- ***Food security*** **– sustained household income and consumption above a minimal level per day, with no decreases in total food and non-food expenditures, in the face of significant climate risks.** This follows the benchmark for food security in the oPt set by the Food and Agriculture Organization (2007a: 58), although its selected minimal level of daily income and expenditure (US $1.65) is questioned by some stakeholders in the oPt.

Planning matrices can be developed for the no-regrets and low-regrets adaptation measures formulated above (Section 4.3). To recall, these measures were suggested after identifying the key *climate-induced* risks to food and water security for the oPt. Six major risks were identified, linked to the vulnerability pathways mapped out in Section 3.5 of this report for the West Bank and the Gaza Strip:

1. Crop area changes due to decreases in optimal farming conditions
2. Decreased crop and livestock productivity
3. Increased risk of floods
4. Increased risk of drought and water scarcity
5. Increased irrigation requirements
6. Increased risks to public health from reduced drinking water quality (including saline intrusion in the Gaza Strip)

Of course, the evaluation of adaptation measures will need to be continually revised with increasing availability of precise information on these risks from high resolution climate modelling and regional environmental monitoring.

While not comprehensive, *illustrative* matrices (Tables 5.2 and 5.3) are now presented for the priority climate adaptation measures. Depending on which adaptation options (if any) are adopted by the PA, it is recommended in practice that the proposed EQA technical committee on climate change (Section 5.2.1) compiles the detailed monitoring and evaluation matrices. Such matrices can be applied to different scales and levels to capture both geographical and social (e.g. gender) inequalities in climate vulnerability. This matrix development should include consultation with stakeholders. As stressed by stakeholders, the formulation of measurable indicators is critical to verifying the effectiveness, fairness and efficiency of adaptation measures.

Table 5.2: Monitoring and Evaluation of No-Regrets Priority Adaptation Measures

Adaptation measure	Indicator examples	Baseline data sources	Indicative targets	Lead PA responsibility
Development of flood contingency plans	No. of active flood plans; Access to flood shelters; Flood Hazard Index.	Rates of flood occurrence; Forecasting of flood events; Population density.	Increased no. of flood plans; Greater access to flood shelters; Training for civil defence staff.	Ministry of Interior (Civil Defence), Ministry of Local Government & PWA
Local increases in rainfall interception capacity	Proportion of rainfall intercepted (in representative environments).	Rainfall intensity & distribution; Vegetation storage; Evaporation; Runoff rates.	Options for increasing local rainfall interception (e.g. greening land use)	EQA & Ministry of Agriculture

Adaptation measure	Indicator examples	Baseline data sources	Indicative targets	Lead PA responsibility
Setting clear water use priorities	Social support for National Water Plan; Stakeholder support for National Water Council.	Stakeholder views on water use priorities in the oPt; Survey of water-related disputes and conflicts.	Redrafted National Water Plan based on consensus; Functioning National Water Council.	PWA
More efficient Irrigation	Use of irrigation by farmers (by area, season, farm type, irrigation system and volume).	Survey data on irrigation usage; Evaporation rates for different crop selections and mixes.	Increased coverage of more efficient irrigation (by area and relative water volume).	Ministry of Agriculture
Reviewing drinking water quality management system	No. of climate resilient drinking water quality plans; No. of relevant training courses undertaken.	Water quality data; Climate risk coverage in drinking water quality policy and plans.	Increased water quality monitoring; Integration of climate risks in water quality planning.	Ministry of Health & PWA
Increased (sustainable) production of freshwater	Sustainable aquifer recharge rates; Use of, and access to, freshwater sources.	Aquifer recharge rates; Joint Water Committee approvals of Palestinian freshwater proposals.	Increased water extraction from sustainable sources; Joint Water Committee approval of Palestinian water projects.	PWA
Increasing brackish and treated wastewater use	Use of treated wastewater; Use of brackish water; Reuse of harvested rainwater.	Public attitudes on water re-use; Survey of water conservation.	Increased use of treated wastewater; Increased use of brackish water; Increased reuse of harvested rainwater.	PWA, Ministry of Agriculture, and EQA
Equitable and reasonable utilisation of water shared with the Israelis	Extraction rates of groundwater (by region and district; time series, and Palestinian versus Israeli); Allocation and consumption shares of freshwater between the Israelis and Palestinians.	Aquifer recharge and storage rates; Water extraction rates from licensed and unlicensed wells; Estimate of sustainable water use rates (including water use by Israeli settlers in the oPt).	Sustainable use of groundwater; Prohibition of over-pumping by settlers; Equitable reallocation of shared water resources to the Palestinians; Increased efficiency in water supply Infrastructure.	Palestine Liberation Organisation, PWA

Table 5.3: Monitoring and Evaluation of Low-Regrets Priority Adaptation Measures

Adaptation measure	Indicator examples	Baseline data sources	Indicative targets	Lead PA responsibility
Increase in irrigation for highest value crops	Irrigation network coverage for highest value crops.	Irrigation scheduling and coverage; Irrigation water use rates.	Increased network coverage for proven irrigation methods.	MoA
Increased use of water harvesting	Use rates and coverage of floodwater harvesting; Use rates and coverage of rainwater harvesting.	Studies of water harvesting; Water storage rates for different water harvesting techniques (e.g. Critchley et al. 1991).	Growth in use of harvested flood-water; Growth in use of harvested rainwater.	PWA, MoA & Ministry of Local Govt.
Protection of coastal sand dunes	Excavation of sand from coastal dunes (licensed and unlicensed); Biodiversity mapping of costal dunes.	GIS information on extent of costal dunes; Monitoring data from Coastal & Marine Environmental Action Plan.	Sustainable and licensed sand extraction rates; Effective enforcement of protected set-back zones.	EQA, CMWU, Ministry of Planning
Rural livelihood diversification	Household income rates; Rural livelihood sources; Access and movement restrictions on communities.	Sources and rates of rural household incomes; Investment in rural livelihood diversification activities.	Increased rural incomes; Increased mix of rural jobs; Improved access and movement in rural areas.	MoA
Adaptive land use planning	Proportion of operational land use plans incorporating climate risk information.	GIS information on land use assessment and management; Climate risk assessment.	Adoption of climate risk assessment in strategic land use planning.	Ministry of Planning, MoA, EQA & Ministry of Local Govt.
Precision agriculture: improved soil and crop management	On-farm use of viable precision agriculture	Soil moisture content; Crop yields and quality data for precision agriculture.	Increased uptake of tested and proven precision agriculture.	MoA

Adaptation measure	Indicator examples	Baseline data sources	Indicative targets	Lead PA responsibility
Heat- and drought-resistant crop and ruminant selections	No. of advisory sessions given to farmers on climate-resilient crop and ruminants; Uptake of heat- and drought-resistant crops and ruminants.	Information on yield and quality on climate-resistant crops and ruminants; Training capacity of agricultural extension services.	Increased uptake of climate-resilient crops and ruminants; Advisory sessions on climate-resilient crops and ruminants.	MoA

5.4 Recognition of Palestinian Adaptation Programme of Action (PAPA) by the international community

For least developed countries within the UNFCCC, National Adaptation Programmes of Action (NAPAs) have been a valuable tool for identifying their climate vulnerabilities and adaptation needs. Under UNFCCC a Least Developed Country Fund and Expert Group have assisted these countries in drawing up NAPAs, following the type of stakeholder-driven approach that has guided the development of the *Palestinian Adaptation Programme of Action* (PAPA) and complementary *Climate Change Adaptation Strategy for the occupied Palestinian territory* (UNDP/PAPP 2009). Of course, the oPt is excluded from the UNFCCC process, so the PAPA has no formal status within the international climate change regime. However, the high climate vulnerability facing the oPt justifies international recognition of its adaptation needs. Indeed, the international community has legal responsibilities to prevent or reduce the negative impacts of climate change in the oPt, and also to assist Palestinians in adapting to climate change. There are also distinctive obligations on Israel with regards to its status as an Occupying Power, which include duties to ensure that the Palestinian population does not suffer from protracted water or food insecurity, as set out in *international environmental law and international humanitarian law*.

International environmental law

According to Article 2 of UNFCCC, states have a *duty of prevention* with regard to dangerous climate change, and they should act to achieve this in a way that allows ecosystems to adapt naturally to climate change, to ensure food production is not threatened and to enable sustainable economic development. Through its global scope, this duty of prevention benefits in principle the oPt. 'Palestine' is of course not a Party to the UNFCCC, though it has legal status within the UN governance system. Insofar as the oPt receives climate change damage, there is also the application of the customary rule of international environmental law that states do not cause harm to the environment of other states or areas beyond national control. States could be construed as fulfilling this harm prevention obligation to the Palestinian population, in regards to climate change, by their climate mitigation efforts (*indirect damage prevention*) and/or by directly assisting adaptation efforts within the oPt (*direct damage prevention*). There are conceptual uncertainties and practical difficulties over apportioning specific responsibilities of harm prevention to particular polluting states. However, the notion of 'common but differentiated responsibility', as employed in UNFCCC Article 3, directs attention instead to the special needs of those developing countries particularly vulnerable to the adverse effects of climate change. This Article could support the PLO, representing a territory with high climate vulnerability, in seeking access to climate change adaptation financing available under UNFCCC even though it is not a Party to the treaty.

International humanitarian law

There are compelling arguments that the occupied Palestinian territory is subject to the international law of belligerent occupation, including the Hague Convention [1907] and the Fourth Geneva Convention [1949] (Dinstein 2009). These instruments – which impinge on Israel by their customary law status and on account of Israeli ratification in 1951 of the Fourth Geneva Convention – require Israel, as the occupying State, to take responsibility for meeting the needs of the civilian population, including the guardianship of natural resources (1907 Hague Convention Article 55) and prohibition of the extensive destruction and appropriation of property (Fourth Geneva Convention Article 147). In addition, Article 54(2) of Additional Protocol I [1977] explicitly prohibits the destruction, removal, and disablement of civilian objects indispensable to the survival of the civilian population, including agricultural areas, drinking water installations and irrigation works (International Committee of the Red Cross 2009a). While the Additional Protocol has not been signed or ratified by Israel, Article 54(2) codifies obligations already widely recognised in customary international law. Thus, there are sufficient legal grounds to suggest that the Israeli disruption and destruction of Palestinian water and agricultural infrastructure (e.g. prevention of the development of water infrastructure, destruction of olive groves) are *prima facie* breaches of international humanitarian law, requiring independent investigation by the international community. These actions, whether by agents of the State of Israel or citizens of that state (e.g. settlers), have significantly increased the water and food insecurity of the Palestinian population: the actions have also undermined the adaptive capacity of Palestinian households and communities in the face of (present and future) climate hazards.

In the West Bank and East Jerusalem, the Israeli-labelled 'security-fence' or 'Wall' (adopting the term of the International Court of Justice) has had major impacts on Palestinian water and food security (alongside other humanitarian impacts). Five years since the International Court of Justice declared in an Advisory Opinion that 'the Wall' being constructed by Israel in the oPt was contrary to international law (International Court of Justice 2004), its persistence and extension have significantly affected agriculture and access to water sources. Impacts have included the confiscation of land, the uprooting of tens of thousands of olive trees, and the physical separation of communities from groundwater wells and natural springs (Food and Agriculture Organization 2007b). While it has not been within the remit of the Project Team to survey the impacts of the Wall and its associated closure regime, its status and scope will impact directly on climate change adaptation measures in the West Bank. For example, the access restrictions on the use of Palestinian wells now on the Israeli side of the Wall are significantly reducing both current water provision (especially for agricultural use) and also the potential for future water extraction (especially from the Western Aquifer Basin).

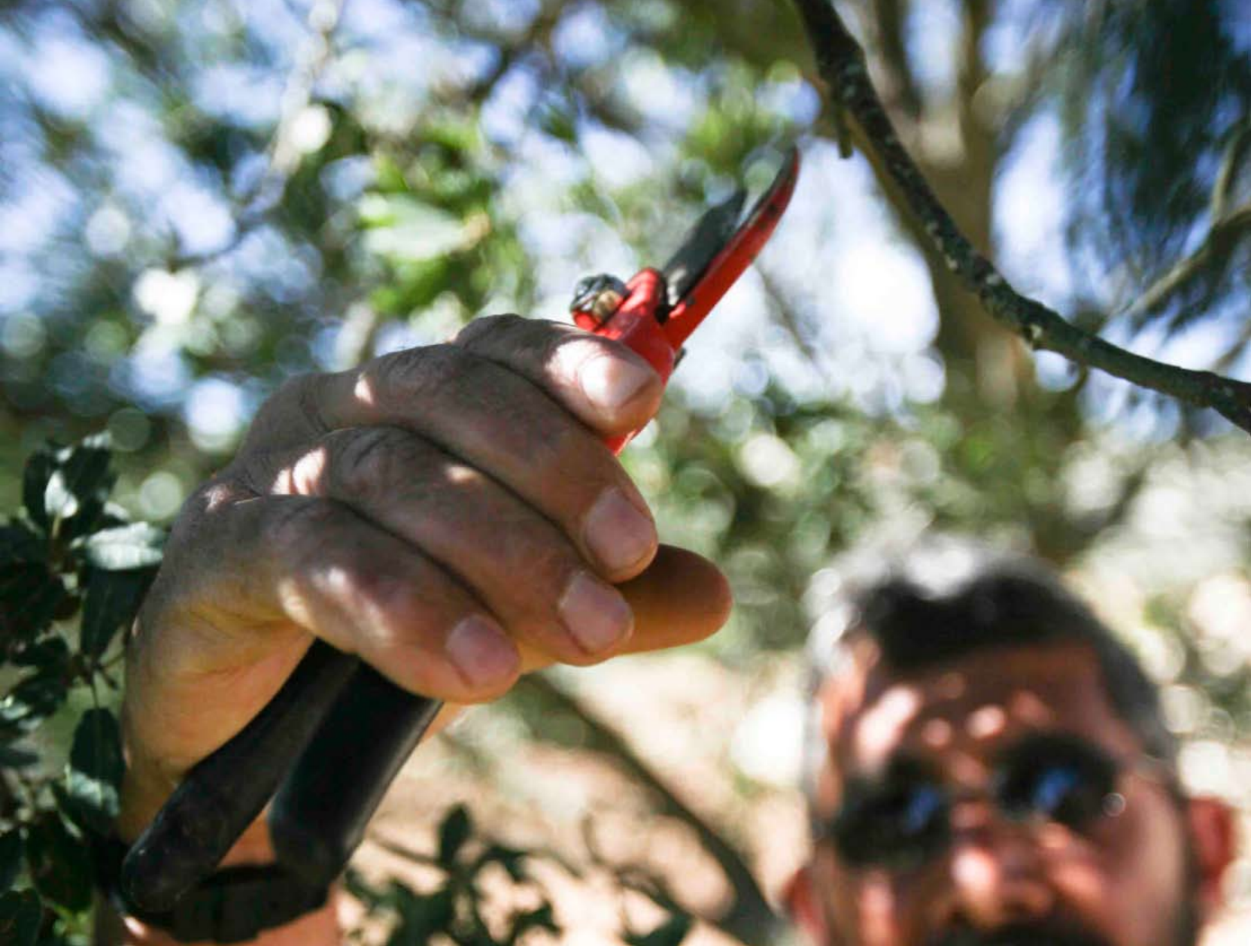
The Advisory Opinion of the International Court includes the legal judgment that Israel should "return the land, orchards, olive groves and other immovable property seized from any natural or legal person for the purposes of construction of the wall in the Occupied Palestinian Territory. In the event that such restitution should prove to be materially impossible, Israel has an obligation to compensate the persons in question for the damage suffered" (International Court of Justice 2004: paragraph 153). According to the Court, all states are obliged under international humanitarian law not to recognise the illegal situation resulting from construction of the Wall.

5.5 Climate adaptation financing

Several international donors have started to express an interest in financing climate change activities in the oPt. Indeed, under a Small Grants Programme managed since 1999 by UNDP/PAPP under the Global Environmental Facility (GEF), there have been approximately 30 demonstration projects addressing climate change mitigation and adaptation in the Gaza Strip and the West Bank: these include the use of solar power for pumping irrigation water, domestic water heating and the drying of agricultural crops. However, few of these GEF pilot projects have led to a wider uptake of adaptive technologies or practices.

More widely, the need to address climate risks hardly features in the substantial commitments to the oPt made at international donors' conferences in December 2007 Paris (US $7.7 billion) and March 2009 in Sharm el-Sheikh (US $.4.48 billion). This is unsurprising given the current focus of major donors' support (e.g. European Union, USAID) on maintaining the institutional viability of the PA and dispensing humanitarian assistance to vulnerable sections of the Palestinian population. Arguably, donors remain preoccupied with emergency interventions rather than longer-term development programmes, as recognised in recent reports by the Food and Agriculture Organization (2009) and the World Bank (2009).

Integrating climate vulnerability concerns into the existing aid architecture for the oPt will not be easy, especially given recurrent concerns about the lack of aid effectiveness (e.g. Le More 2008). *It is recommended that the central coordinative body for donor support to the Palestinians, the Ad Hoc Liaison Committee (AHLC), include climate adaptation financing in its remit*. Where possible, such financing should reinforce existing human development goals and PA priorities; and should embrace the principle of additionality – that external funding for adaptation activities does not come from existing commitments on development aid. To help realise this goal, the AHLC could assist the PA in its efforts to seek direct access to the various funds for climate adaptation activities available under the UNFCCC (Haites 2008) and other sources, notably the World Bank Climate Investment Funds. Moves towards this have already been undertaken with the recent revival of the *Environmental Sector Working Group*, co-chaired by the Swedish Government and EQA.



6. Conclusion

There is clear support for climate change adaptation planning from the Palestinian Authority (PA), which includes all ministries consulted by the Project Team – EQA (as lead ministry), Palestinian Energy Authority, Palestinian Water Authority, Ministry of Agriculture, Ministry of Planning, and Ministry of Transport. Support from leading Palestinian environmental NGOs is more qualified, relating to a perception that climate change vulnerability needs to be understood in the political context of the Israeli occupation. However, all parties have endorsed the stakeholder-driven determination of adaptation priorities supported by UNDP/PAPP, including the need to ensure that climate adaptation planning supports the humanitarian and development needs facing governing authorities in both the Gaza Strip and the West Bank.

The *Palestinian Adaptation Programme of Action* (PAPA) – and its companion volume, the *Climate Change Adaptation Strategy for the Occupied Palestinian Territory* (UNDP/PAPP 2009c) – both adopt the concept of climate vulnerability, defined as *the propensity of people or systems to be harmed by climate hazards in the context of other domains of vulnerability, as well as in relation to response capabilities in both the short-term (coping) and the long-term (adaptation*). Input from stakeholders in the West Bank and the Gaza Strip corroborated the initial premise of the Project Team that the water usage in the oPt justifies priority focus in terms of climate change impacts, and that agriculture is the Palestinian economic sector most sensitive to climate hazards, both current and future. This led to a strategic adaptation focus on *reducing water insecurity and food insecurity*. Within the oPt, the Project Team identified three regions (case studies) as having particularly high levels of climate vulnerability – *Massafer Yatta* (West Bank), the easternmost oPt areas of the *Jordan River Valley* (West Bank) and the *Gaza Strip*.

The most significant environmental effects of climate change for the population of oPt, 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 2.2-5.1ºC according to a realistic emissions scenario (Scenario A1B). Annual precipitation rates are deemed likely to fall – decreasing 10% by 2020 and 20% by 2050 – with an increased risk of summer drought.

There remain significant uncertainties about the precise impacts of climate change in the region. Indeed, *it is not possible at the moment, with high scientific confidence, to differentiate climate hazards in the oPt on the basis of natural climate variability or long-term climate change*. A precautionary approach is adopted in which improving adaptive capacity in the oPt – both for institutions and communities – delivers 'no-regrets' and 'low- regrets' benefits in terms of disaster risk reduction and human development even if long-term climate trends are less harmful than predicted. Furthermore, *there is a need for climate modelling and research capacity-building in the oPt tailored to Palestinian adaptation priorities in the face of future climate risks*.

Already under significant pressure from rapid demographic growth, economic development and restrictions on development from Israel, *freshwater resources in the oPt are predicted to become physically more scarce as climate change causes decreases in annual participation*. If the major asymmetries in water availability between the oPt and Israel remain, the political tensions that exist will be exacerbated. Water scarcity is not a robust predictor of violent conflict as 'virtual water' (water imported in the form of food) can ease local water or food shortages. But this can only serve as an effective means of climate change adaptation for the Palestinians if there is effective governance authority and sustainable economic growth. The expected increased water scarcity also means that the strategic planning of the agriculture sector by the PA needs to consider the potential impacts of climate change on food availability elsewhere in the world.

Historic forms of household and community coping by Palestinians in the face of climate and other hazards offer potential templates for adaptation to climate change in the oPt. However, the ongoing effects of the Israeli occupation undermine the conditions necessary to their operation, both *economic* – the free movement of goods and people – and *political* – national self-determination and democratic governance. Indeed, the continuing Israeli occupation fosters a wide range of maladaptive policies and practices (e.g. subsidised water-intensive livestock farming by settlers and the destruction of

Palestinian olive groves) that need severely restrict the development of Palestinian resilience to climate hazards. In both the West Bank (and especially the Gaza Strip), *enforced coping strategies* as a result of access and movement restrictions represent adaptive practices incompatible with the effective delivery of human development goals.

Disaster risk reduction (DRR) – the development and implementation of policies and practices that minimise risks from disasters – is the first line of institutional defence against serious climate change impacts. Development of the DRR capacity within the PA is critical to effective climate change adaptation within the oPt. It is recommended, based on stakeholder feedback, that *a revived Higher Council of Civil Defence would be an effective vehicle for mainstreaming climate risk reduction at a strategic level within the PA*. This will require more systematic information on climate-related risks in order to provide an integrated understanding of the role of climate hazards in relation to other civil defence challenges facing Palestinians. It is also recommended, therefore, that *the Environmental Quality Authority serves as the lead agency within the PA for co-ordinating the collection, analysis and dissemination of information relating to the risks created by climate variability and long-term climate change*.

There is enough agricultural information and meteorological evidence to justify priority risk management by the PA to address the impacts of drought and desertification in the oPt. *The National Committee to Combat Desertification is the appropriate Palestinian strategic body to take lead responsibility for developing policies and measures relating to drought minimisation and management.* This body needs to be actively supported by a technical committee comprising relevant PA ministries (especially the Palestinian Water Authority, the Ministry of Agriculture, and the Environmental Quality Authority). A drought early-warning system for the oPt is already under development, supported by Italian Development Cooperation. This will improve data collection on rainfall and soil moisture, providing a more scientific basis for minimising the risk of drought and desertification.

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

No-regrets adaptation (in no order of priority)

1. Development of flood contingency plans
2. Local increases in rainfall interception capacity
3. Establishment of clear water use priorities
4. Introduction of more efficient irrigation techniques
5. Review of drinking water quality management systems to
6. incorporate climate risks
7. Increased (sustainable) production of freshwater
8. Increased use of brackish water and treated wastewater use
9. Equitable and reasonable utilisation of transboundary water resources between the Israelis and Palestinians (implying a fairer allocation of groundwater and freshwater).

Low-regrets adaptation (in no order of priority)

1. Prioritisation of irrigation for highest value crops
2. Increased use of water harvesting
3. Protection of coastal sand dunes in the Gaza Strip
4. Diversification of rural livelihoods
5. Incorporation of climate adaptation in land use planning
6. Greater use of precision agriculture for improved soil and crop management
7. Selection of crop and ruminant selections for more tolerance to heat and drought

Consideration of no-regrets and low-regrets options does not mean that high cost adaptation options should be ignored. Those also judged to have both high adaptive capacity and technical feasibility include:

- Increased water use efficiency from infrastructure investment
- Development of 'new water' sources, including substantial desalination capacity for the Gaza Strip
- Coastal protection measures for the Gaza Strip (e.g. wave breaks and offshore structures)

These are the types of sector-wide options that may be considered by the PA donors, especially for donor-funded investment in water infrastructure that is required anyway for human and economic development reasons.

Helping the PA mobilise sources of funding for climate change adaptation actions will require targeted communications work with potential donors. The PA has no direct access to any of the climate change adaptation financing available to Parties under the United Nations Framework Convention for Climate Change (UNFCCC) and Kyoto Protocol. International recognition of the legitimacy and urgency of Palestinian climate change adaptation needs is key to securing necessary financial assistance for vulnerable sectors and communities. There are strong legal grounds for allowing Palestinian participation in UNFCCC with particular rights and privileges (e.g. UNGA Resolution 52/250). Adaptation funding should be additional to existing official development and humanitarian assistance to the oPt.

There are important technical and financial challenges to the development of effective climate adaptation planning in the oPt, but the most significant constraints are external political barriers, as represented by the continuing Israeli occupation of the West Bank and the Gaza Strip. The political feasibility of addressing these barriers depends of the uncertain prospect of final status negotiations between the Palestinians and Israelis. It is conceivable, nevertheless, that the shared challenge of climate change could at least lead to Palestinian technical cooperation with Israel and other regional neighbours.

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Annexes

Annex I

QUESTIONNAIRE ON THE IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES, AND ON POTENTIAL ADAPTATION STRATEGIES IN THE OCCUPIED PALESTINIAN TERRITORY

The aims of this questionnaire
The aims of this questionnaire are:

- To collect information on the degree of awareness concerning the issue of climate change impacts on water resources in the occupied Palestinian territory (oPt);
- To assess the vulnerability to climate change;
- To compile potential adaptation measures and strategies.

Why should you answer the questionnaire?
By answering this questionnaire, you will:

- Ensure that the particular concerns of your sector are adequately considered in the adaptation planning for the oPt;
- Contribute to an initial appraisal of potential climate change impacts and water management adaptation strategies for the oPt.

PLEASE FILL IN AS MUCH OF THE QUESTIONNAIRE THAT YOU CAN

Please return the filled-in questionnaire to:

By email: to Michael Mason – m.mason@lse.ac.uk or Ziad Mimi – zmimi@birzeit.edu
By post or fax: to Dr Ziad Mimi
Associate Professor, Director
Institute of Environmental and Water Studies (IEWS), Birzeit University
P.O Box 14, Birzeit University, Birzeit, West Bank
Tel/Fax 00 970 2 2982120, Mobile 00 972599255310

Questionnaire

Please fill the name of the contact person for this questionnaire:

Name:
Job Title:
Organisation:
Address:
Telephone:
Fax:
E-mail:
Website:

PART A: Assessment of future impacts

1. How sensitive are water resources in the West Bank/Gaza Strip [PLEASE STATE WHICH ONE] to climate change? Please give a judgment for different areas as relevant in West Bank/Gaza Strip and indicate (x) as appropriate.

	Very sensitive	Sensitive	Slightly sensitive	Not sensitive
Coastal zones				
Mountainous areas				
Urban areas				
Lowland areas				
Agricultural areas				
Industrial areas				
Military areas				
Other areas, please specify				

This answer is based on ☐ Expert knowledge ☐ A research study (please make reference) ☐ Other

2. Which changes in water resources do you think will take place in the oPt as a consequence of climate change by 2050? Please give an estimate on the basis of your current knowledge. If necessary, please use the last column to indicate in which regions or aquifers these changes will be most significant.

	Change	Specific region/aquifer
Increase in precipitation (rain and snow) of	__%	
Decrease in precipitation (rain and snow) of	__%	
Increase in runoff of	__%	
Decrease in runoff of	__%	
Increase in groundwater recharge of	__%	
Decrease of groundwater recharge of	__%	
Increase in flood frequency of	__%	
Decrease in flood frequency of	__%	
Increase in drought frequency of	__%	
Decrease in drought frequency of	__%	
Sea level rise of	__cm	
Sea level decline of	__cm	
Others, please specify:		

3. In the following table, please give an assessment of the effects that possible changes in different components of water resources caused by climate change will have on the oPt. Please indicate (x) as appropriate. In case the anticipated impacts will vary regionally, please indicate specific regions or aquifers in the space provided on the right-hand side.

	Very negative	Negative	No effect or not relevant	Positive	Very positive	Regions or aquifers particularly affected
Increased precipitation						
Decreased precipitation						
Increased variability in precipitation						
Decreased runoff						
Increased runoff						
Increased variability in runoff						
Decreased groundwater recharge						
Increased groundwater recharge						
Declining surface water quality						
Declining groundwater quality						
Increased risk of floods						
Increased risk of droughts						
Sea level rise						
Others, please specify						

This answer is based on ☐ Expert knowledge ☐ A research study (please make reference) ☐ Other

4. Please provide an estimate of the impact the changes in climate and water components would have on different sectors in your country. Please fill in numbers from –2 to +2 where appropriate (-2 = strong negative effect; -1 = negative effect, 0 = no effect or no relevance; +1 = positive effect, +2 = strong positive effect). Please leave spaces blank where information is not available.

	Water supply	Wastewater management	Agriculture	Energy supply	Tourism	Transport	Planning	Forestry
Increased precipitation, higher runoff, increased frequency and intensity of floods								
Decreased precipitation, lower river flows, decreased groundwater recharge, higher risk of droughts								
Increased variability in precipitation and river flow								
Reduced surface and groundwater **quality**								
Sea level rise								
Others, please specify								

5. What impacts might changes in water resources have on other (non-economic) sectors (e.g. biodiversity/ conservation, human health) in the oPt?

6. Please briefly describe what you think will be the greatest potential impacts of climate change on Palestinian society (e.g. economic loss, decreasing economic viability of an activity, conflicts between water users, damage to property/ infrastructure, health damage and loss of lives, etc.)

Part B: Adaptation measures

7. The following table lists a number of potential adaptation measures. Please indicate (x) which of these are planned or have been implemented as a response to water scarcity concerns, and which of these you deem necessary and/or effective in addressing climate change-related water scarcity problems. Please add additional measures if necessary.

Adaptation measure	Implemented	Planned	Effective/ necessary (but not planned yet)	Not relevant/ necessary
Flood protection (e.g. from wastewater treatment basins)				
Technical flood protection (e.g. raise reservoir walls, enlarge reservoirs)				
Restriction of settlement/building development in risk areas				
Improving forecasting and information				
Improving insurance schemes against flood damage				
Others, please specify:				
Drought/low flow protection				
Increased control over water allocation from aquifers				
Increased well construction				
Investment in improved water distribution infrastructure				
More efficient irrigation				
Land use changes to improve water balance (e.g. reforestation)				
Improving forecasting, monitoring, information				
Economic instruments (e.g. water pricing)				
Others, please specify:				
Coastal zones				
Reinforce or heighten existing coastal protection infrastructure				
Land use changes in response to sea-level rises				
Others, please specify:				
General adaptation measures				
Policy – including new/revised legislation, regulation, etc.				
Economic incentives and financial mechanisms				
Awareness-raising or information campaigns				
Others, please specify:				

Part C: Title of adaptation initiative/action

Does any action or measure exist in the West Bank/Gaza Strip with regard to adaptation of water management to potential climate change impacts on water availability? If yes, please add the following more detailed information, for each of these actions or measures. PLEASE STATE IF WEST BANK AND/OR GAZA STRIP

8. Summary description (what is the adaptation action/initiative?)

Objective of the measure	Brief description of adaptation initiative
☐	
Relevant water subsector	☐ Demand management (e.g., regulation, metering, education) ☐ Supply management (e.g., irrigation, leakage, new capacity) ☐ Water quality (e.g. regulation, abstraction rates) ☐ Hydrological cycle management (e.g., hydropower) ☐ Other (e.g. recreation, conservation)
Administrative and management scale	Please specify –
Geographical location	Where is the adaptation initiative taking place?

9. Adapting institution(s) (who is involved?)

Institution	Name of organization/government department, etc.
Ownership	Public, private or non-governmental organization (NGO)
Key stakeholders	Public/private sector organizations, communities, individuals

10. Adaptation process (how does any adaptation take place?)

Type of adaptation		(i) Building adaptive capacity (e.g. research, mapping and modelling impacts and vulnerability, risk assessments, planning/strategy development, developing and participating in networks, awareness-raising, training)
		(ii) Policy – including new/revised legislation, regulation, etc.
		(iii) Operational – physical or managerial implementation of adaptation measure(s)
Purpose	Is climate change adaptation the main objective (i.e. intentional) or an unplanned side-effect of a different initiative?	
Triggers and drivers	What stimulated the adaptation initiative? (E.g., weather event, policy/legislation, research results, risk assessment, cost-benefit analysis)	
Decision-making process	Who makes the decision to adapt? Who decides how to adapt? What, if any, criteria are used to evaluate and prioritize adaptation options? What roles do stakeholders play?	
Key information sources	What are the key information sources for informing decision-making?	
Funding sources	What financing mechanism is used? Who is paying for the initiative – are those who benefit from measures involved in the financing (e.g. charges)?	
Obstacles	Which obstacles were met during the planning or implementation process?	

11. Evaluation of Adaptation

Cost and costing method	Estimated cost of planning and implementing the initiative. If appropriate, which costing method is used to estimate the cost?
Major outputs	Technical reports, website, new network, policy briefing/guidance, new infrastructure, etc.
Criteria for evaluation	What, if any, are the criteria for measuring the success of adaptation?
Outcome of the evaluation	Has the adaptation been a success, partial success, failure, or is it too early to say?
References/background information for each of the adaptation measures in part C	

PART D: Further information

12. The following table provides a decision framework on climate variability and climate change. Please indicate the type of climate information you use or would like to use for which type of decisions.

Type of decision	Climate		Weather
	Long term (10–50 years)	Medium term (6–9 months)	Short term (0–10 days)
	Decadal changes	Seasonal Forecasts	Real time
Strategy/policy			
Planning			
Operational			

13. Please indicate in the table below your opinion on the availability of information and tools for different climate related aspects as indicated above, if you would need guidance on these aspects, and if you are interested to assist in developing such tools?

Tools	Availability of information or tools	Need for guidance (tools development)	Interested in helping to develop the tools
Climate information			
Vulnerability assessments			
Adaptation process			
Integrating adaptation into economic or social development			

14. With respect to which impacts or adaptation measures do you think further research is needed?

15. Please provide further information you consider relevant in the context of this survey, or indicate additional persons that you think should be contacted.