Chapter 3

Climate Change Impacts

The Middle East is the world's most water-stressed region. The projected impacts of climate change (such as more extreme weather events, decreased precipitation and rising sea levels) will exacerbate this problem. There are severe environmental, economic, political and security implications.

a. Physical Significance

Available scientific research expects that the climate change will make Israel become more barren. The warming forecast in Israel is a maximal temperature rise of 1.8C° and a 1.5C° rise in the average temperature by 2020 (in comparison with the years 1960-1990).[1] The temperature is expected to rise from 3.5C° to 5C° between 2000 and 2071.[2]

An additional decline of 10% precipitation is expected by 2020 and 20% by 2050. Average rainfall fluctuations will become worse, with very rainy years followed by extreme droughts. Extreme rain events are also expected to increase.[3]

[1] Golan-Angleco I, and Brawer, Y. (2008) "Israel's Preparations for Global Climate Changes", Jerusalem, The Ministry of Environmental Protection, The Chief Scientist's Bureau
http://www.sviva.gov.il/Enviroment/Static/Binaries/ModulKvatzim/p0475_1.pdf

[2] Alpert P., Krichak S.O., Shafir H., Haim D., and Osetinsky I. "Global and Planetary Change" *Climatic trends to extremes employing regional modeling and statistical interpretation over the E. Mediterranean,* 2007

[3] Golan-Angleco I, and Brawer, Y. (2008) "Israel's Preparations for Global Climate Changes", Jerusalem, The Ministry of Environmental Protection, The Chief Scientist's Bureau
http://www.sviva.gov.il/Enviroment/Static/Binaries/ModulKvatzim/p0475_1.pdf

Here are forecast details for impacts on Israel in the 21st century:

- Average temperature rise of **1.5C° by 2020, and 5C° by 2100** (compared to the average between the years 1960-1990).
- **10% drop in precipitation by 2020.**
- 25% drop in water availability between 2070-2100.
- Rising sea level of 50-100 cm by 2100.
- Damage to the coastal aquifer due to rising sea level.
- More frequent and severe floods.
- Coastal strip flooding of 50-100 meters.
- Damage to vulnerable populations in the Middle East will lead to waves of refugees, which will make the region's political map increasingly unstable.
- Seawater warming will cause damage to coral colonies in the Eilat bay.
- Mediterranean coastal cliff erosion and expansion of the danger zone to infrastructures 50m east of the coastline.
- Heat load increase.
- A prolonged dry season and significant damage to vegetation.
- Desert line and desert ecological systems "migrating" north.
- Agriculture seeking more water due to ground precipitation reduction, along with cutting supplies for irrigation, leading to severe damage to agriculture and crop reduction.
- Pests and new types of diseases.
- Increased risk of ground erosion.

i. Water, Drought and Precipitation

The main impacts of climate change on the water economy in Israel relate to the following factors: precipitation decrease, evaporation increase as a result of rising temperatures, extreme rain events, reduced groundwater percolation, and groundwater loss as a result of penetrating sea water.

The Ministry of Environmental Protection predicts a decrease in water availability of at least 25% between the years 2070-2099, in comparison to 1960-1990.

Source: Fact Sheet: "Global Warming's Impacts to Israel" Reut Snir

The ministry has noticed a declining trend in precipitation in Israel since the 1980s. We particularly notice a significant decline in the past 16 years; a constant, non-coincidental decrease of natural enrichment to water sources.

These findings correlate with fears concerning climate change impacts on upper water sources (The Kineret) and ground water (the mountain and coastal aquifers). A 1-2C° temperature rise and a 10% precipitation drop may lead to a 40-70% decrease of annual river flows, damaging water sources. Since precipitation decrease overlaps extreme events as floods, additional amounts of water are lost instead of percolating to groundwater reservoirs.

The pattern of declining precipitation in past winters demonstrates what is predicted. The 2006/7 winter was the third in a row to have lower than average available water volumes in the Kineret. There were also long absences of rain leading to extremely dry winter months. However, this winter had a number of irregular rain events with extremely high precipitation amounts, and April 2006 was the rainiest April since measures began. These events did not interrupt the sequence of arid years, and a water economy emergency state was announced in 2008.

Source: Fact Sheets: "Global Warming's Impacts to Israel," Reut Snir

In addition, a rising sea level endangers the main water source in Israel, the coastal aquifer. A potential rise of 50cm will cause the loss of at least 16.3 million cubic meters for every kilometer along the coastal plain.[4]

ii. Agriculture

Israeli agriculture is especially sensitive to climate change because of barren line proximity, few processed fields, and microclimatic changes from north to south, and east to west. The expected impacts on agriculture derive from precipitation decrease, temperature changes, ecological changes, extreme weather events, and an increase of CO_2 in the atmosphere.

Source: Hinrich, summer 2004, available at: http://en.wikipedia.org/wiki/Image:Ueberladewagen.jpg

[4] http://www.sviva.gov.il/Enviroment/Static/Binaries/ModulKvatzim/p0475_1.pdf

Following the decline in ground water availability due to precipitation decrease and increased evaporation, **a 20% rise in demand of irrigation water is expected.** However, with low precipitation amounts, **agriculture will probably suffer extensive water cuts, with a chance of completely canceling the supply of benign water during long drought periods.**

This means **reduced fruit and vegetable crops.**[5] According to one forecast, agriculture profitability is to decrease by 20% by 2100.[6] Nevertheless, these impacts may be balanced by extensive use of treated wastewater of which 47% of Israel's capacity is already put to use.

The Ministry of Environmental Protection warns of additional agricultural impacts:

- Extreme rain events will increase the chance of ground erosion since 40% of current field crops are already at the risk of severe ground erosion.
- An expected price increase of animal feed.
- The shortening of productive seasons in grazing fields.
- Damage to populations of pollinating insects.
- Winter temperature rise may help certain crops grow, but extreme weather like frost may severely damage crops.
- Damage to nutritional value and the shelf life of agricultural products.[7]

iii. Rising Sea Level

A rising sea level will erode Mediterranean beaches, damage coastal structures, harbors and archaeological sites, decrease hydraulic gradients and reduce the efficiency of power stations and municipal drainage systems. The eastern Mediterranean Sea level is estimated to rise 50-100 cm by 2100.[8] A rise of **1 meter will flood a 50-100 meter coastal strip** (in areas containing sandy beaches, as is found along most of Israel's coast line). Following this, a loss of 8.4 cubic km of beach is expected, or the value of about 4-5 billion shekels.

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[5] Golan-Angleco I, and Brawer, Y. "Israel's Preparations for Global Climate Changes." *The Ministry of Environmental Protection, The Chief Scientist's Bureau*. Jerusalem, 2008.
http://www.sviva.gov.il/Enviroment/Static/Binaries/ModulKvatzim/p0475_1.pdf

6 Goldsmidtm, (2007), "Global Warming and its impacts on Israel" the Knesset, Research and Data Center.
http://www.knesset.gov.il/mmm/data/docs/m01920.doc

[7] Golan-Angleco I, and Brawer, Y. "Israel's Preparations for Global Climate Changes". *The Ministry of Environmental Protection, The Chief Scientist's Bureau*. Jerusalem, 2008.
http://www.sviva.gov.il/Enviroment/Static/Binaries/ModulKvatzim/p0475_1.pdf

8 Rosen, D.S. (2005), summery of coastal processes and the impacts of climate change on beaches and the coastal cliff, towards consolidating a national policy to preserve Meditarraan beaches and the coastal cliff. Israel Oceanographic and Limnological Research (IOLR)

A rising sea level will also cause the coastal cliff to withdraw **and increase the degree of risk for infrastructures 40-50 meters to the east.** A rising sea level will interfere with tourism, vocational activities, coastal buildings, docks, marinas and archeological sites, as well as beach ecologies and the range of coastal species. An increasing water temperature will drive foreign species to penetrate and settle in the Mediterranean Sea.

In the Red Sea, rising water levels will not overwhelm extensive land areas, but more so the narrow recreational beaches and transportation lines along the beaches may be affected, as will coral colonies.

A rising sea level is predicted to severely damage the coastal aquifer, where ground water is exposed to penetrating seawater and undergoes salification. Wells were already shut in areas where seawater has penetrated the aquifer, and 13% of wells have exceeded the water quality standard due to salification over the past years. A 50cm level rise will increase the area of sea water penetration by 1000 meters to the east, and cause an estimated loss of 16.3 million cubic meters per kilometer of beach, or even more in Hadera, Ramat-Gan, Tel-Aviv, Nir-Am and the region between Ashdod and Erez-Shikma, due to excessive water drawing in these areas.[9]

[9] Golan-Angleco I, and Brawer, Y. "Israel's Preparations for Global Climate Changes." *The Ministry of Environmental Protection, The Chief Scientist's Bureau.* Jerusalem, 2008.
http://www.sviva.gov.il/Enviroment/Static/Binaries/ModulKvatzim/p0475_1.pdf

b. Financial Impacts

Final IPCC findings (See chapter 2c) show that following a temperature rise of 3-4 degrees, negative impacts on commodities and services dependent on the ecological system will occur. They also show that there will be a decline in world food production and the possible extinction of more than 40% of world species. If temperature should rise from 4-5 degrees by 2180, global GDP will experience financial losses of nearly 5%.

However, GHG concentration in the atmosphere will have minimal economic impact, as is described and detailed in the following Stern report.

Table SPM.7. Estimated global macro-economic costs in 2030 and 2050. Costs are relative to the baseline for least-cost trajectories towards different long-term stabilisation levels. (Table 5.2)

Stabilisation levels (ppm CO_2-eq)	Median GDP reduction[a] (%)		Range of GDP reduction[b] (%)		Reduction of average annual GDP growth rates (percentage points)[c,e]	
	2030	2050	2030	2050	2030	2050
445 – 535[d]	Not available		< 3	< 5.5	< 0.12	< 0.12
535 – 590	0.6	1.3	0.2 to 2.5	slightly negative to 4	< 0.1	< 0.1
590 – 710	0.2	0.5	-0.6 to 1.2	-1 to 2	< 0.06	< 0.05

Notes:
Values given in this table correspond to the full literature across all baselines and mitigation scenarios that provide GDP numbers.
a) Global GDP based on market exchange rates.
b) The 10th and 90th percentile range of the analysed data are given where applicable. Negative values indicate GDP gain. The first row (445-535ppm CO_2-eq) gives the upper bound estimate of the literature only.
c) The calculation of the reduction of the annual growth rate is based on the average reduction during the assessed period that would result in the indicated GDP decrease by 2030 and 2050 respectively.
d) The number of studies is relatively small and they generally use low baselines. High emissions baselines generally lead to higher costs.
e) The values correspond to the highest estimate for GDP reduction shown in column three.

Likewise, Israel will experience financial implications due to climate change. These implications include damage to ports and beaches, tourism and archeological losses, and damage to infrastructure.

Currently, there is no complete comprehensive data regarding the physical significance and financial cost to the economy. The Ministry of Environmental Protection's Chief Scientist does, however, provide a number of costs in the event where action is not taken.

Financial Implications of non-action:

- Water sources – 450 million NIS a year (by 2020),
- Floods – more than 340 million NIS a year,
- Sea and beaches – at least 6 billion NIS,
- Public health – unknown,
- Agriculture – at least 3 billion NIS a year,
- Biodiversity – unknown,
- Energy economy – unknown.[10]

[10] Golan-Angleco, I and Brawer, Y. "Israel's Preparations for Global Climate Changes," The *Ministry of Environmental Protection. The Chief Scientist's Bureau*. Jerusalem, 2008. http://www.sviva.gov/il/Environment/Static/Binaries/ModulKvatzim/climat_change_0808_1.ppt

The Stern Report on the Economics of Climate Change[i]

Background

The most comprehensive research on the economics of climate change was published at the end of 2006 on a commission by the United Kingdom Treasury and carried out by Sir Nicholas Stern. Stern, former Chief Economist and Senior Vice President of the World Bank, is now a government economic advisor in the UK and was requested to investigate the economic costs of global warming under a "business as usual" (BAU) scenario versus the costs of reducing carbon emissions to stabilize the climate. He concluded that the costs of doing nothing far outweigh the costs of reducing greenhouse gas emissions, going so far as to suggest that BAU will in fact restrict, rather than encourage, future economic growth. He concluded that the worst impacts are still avoidable, but it will require strong collective action in the next 10 to 20 years. **The estimated cost of this action is only 1% of the annual world GDP.**

There will be a long delay between our current actions and tangible climate changes in the future. Despite this delay, any actions made in the next 10 to 20 years will still affect the climate profoundly in the second half of the century, and on into the next.

Stern's analysis shows that, in the meantime, total costs of climate change under a BAU scenario will reduce the standard of living based on consumption per person between 5% and 20%. These costs will bring competitive challenges but also opportunities for growth. Low-carbon energy products are likely to be worth at least $500 billion per year by 2050. Effective policies on global warming can also have positive 'spill over' effects. Reducing air pollution will improve

respiratory health and mortality rates, and preserving forests will support biodiversity. However, the costs of mitigation will rise significantly if future efforts need to become more drastic as a result of contemporary inaction. There is a high price to pay with any delay.

Based on more conservative predictions than the IPCC's regarding temperature rising, Stern estimated the costs of the status quo will be extremely high. Stern suggests that extreme weather events (storms, hurricanes, floods, droughts, heat waves) will cost 0.5%–1% of the world GDP per annum by the middle of the century.

However, Stern suggests adaptation to climate change will also be a fundamental necessity. He estimated that creating new infrastructure and buildings resilient to climate change in developed countries will cost $15 - $150 billion each year (0.05 to 0.5% GDP). In developing countries as well, the costs are likely to range in the billions.

Stern suggests that if markets effectively respond to solid statistics, they will stimulate adaptation among individuals and firms. Governments have a policy-level role to guide effective adaptation in the medium and longer terms, such as by providing high quality climate information and tools for risk management, land use planning and performance standards, long-term policies for climate sensitive public goods (such as natural resource protection), and a financial safety net for the poorest in society. International cooperation and development assistance is also essential in the process.

Stern also examined suitable courses to take in order to promote climate policies and constructed an international framework to follow. International cooperation must cover all aspects of policy to reduce emissions; pricing, technology, the removal of behavioural barriers, and action on emissions from land use.

Sir Nicholas Stern 2007 Six-Point Program[ii]

In addition to his Review on the Economics of Climate Change, Sir Nicholas Stern presented a six-point program at the Royal Economic Society's annual public lecture in November 2007 (prior to the international climate conference in Bali, Indonesia). He also emphasized that in developing a new international climate change agreement, three criteria need to be fulfilled:

- **Effectiveness:** The goal must be appropriate to meet the task at hand (i.e., not overly ambitious and not too weak); that is, the emissions stabilization (reductions) target must be set to a level that sufficiently minimizes the costs.

- **Efficiency**: Market-based instruments should be used to the greatest extent possible to minimize the costs.

- **Equity:** Developed countries have contributed to a greater share of the current GHG concentrations in the atmosphere, but the poorer/developing countries will suffer the consequences of climate change to a greater extent. The rich countries, therefore, have a responsibility to take the lead in reducing GHG emissions.

Sir Nicholas Stern's six-point program falls into two groups of policy elements for global action to reduce greenhouse gas emissions.

1. The first group of three elements focuses on targets and trading, as follows:

- The overall target of a 50% reduction by 2050 (relative to 1990 levels) agreed to at the G-8 Summit in June 2008 is essential if there is to be any chance of keeping temperature increases below 2 to 3°C, the levels at which "dangerous" effects could occur. Nonetheless, equity demands that the reduction target for the rich countries should be at least 80% below 1990 levels by 2050.
- There should be substantial emissions trading between the countries, including between developed and developing nations. This will create an income stream for poorer countries and achieve reductions at the lowest costs.
- The Clean Development Mechanism (CDM) should be reformed to quantify reductions more easily and make the CDM less bureaucratic.

2. The second group focuses on public funding:

- A "coherent, integrated international program" to fight deforestation is needed. A $10 to $15 billion global program could halt up to half of projected deforestation.
- Technological advances for mitigation need to be promoted and shared, and investments in clean technologies are needed.
- "Rich" (developed) countries should adhere to their commitments to the Millennium Development Goals (MDGs) to contribute 0.7% of GDP in aid by 2015, partly to help the developing countries adapt to climate change.

The Millennium Development Goals were set in the year 2000 at the United Nations Millennium Summit to reduce global poverty and improve living conditions by the year 2015. One of the goals, for instance, is to reduce the amount of people who have no access to clean water and sanitation by 50% by 2015. These goals will become more important and more difficult to reach as we begin to feel the impacts of climate change.[iii]

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[i] Her Majesty's Treasury, *Official Website of the Stern Review on the Economics of Climate Change,* http://www.hm-treasury.gov.uk/sternreview_index.htm

[ii] Stern, Nicholas. "Climate Change, Ethics and the Economics of the Global Deal" http://economistsview.typepad.com/economistsview/2007/11/nicholas-stern.html

[iii] United Nations, *The Millennium Development Goals Report 2008*, p. 40. http://www.un.org/millenniumgoals/pdf/The%20Millennium%20Development%20Goals%20Report%202008.pdf.

c. Security Impacts

The projected impacts of climate change (such as more extreme weather events, decreased precipitation, and sea level rise) will put pressure on the Middle East, an already water-scarce region. Climate change is likely to act as a *"threat multiplier,"* decreasing water supply even more and increasing tensions between nations sharing water resources, geography, and political boundaries.[iii] "In fact, the enormously intricate water politics of the [Middle East] region have been aptly described as a `hydro-political security complex."[iii]

As climate impacts become more significant, the following factors will play a role in determining the likelihood for greater conflict or cooperation in this region that already possesses some of the greatest political tensions in the world:

- The existence of water agreements, and their degree of *sustainability,* including the ability of parties to deal with extreme circumstances, such as longer periods of drought;
- The influence of destabilizing economic and political factors, e.g., unemployment and mass migration due to agricultural decline and the large scale flooding of agricultural areas;
- The extent of national economic and political development, including the degree to which local institutional structures and infrastructure exist;
- The ability of a political entity to mitigate and/or adapt to climate change;
- Power relationships between the Parties involved;
- Whether it is politically practical to cooperate (or continue to cooperate) over water resources.

Keeping these factors in mind, climate change provides both challenges and opportunities for cross-border cooperation to remedy and prevent the problems that are already occurring and are projected to intensify. For this reason, water issues have been an important part of all peace talks in the region. As climate change impacts are expected to intensify, the following points highlight unique characteristics of existing water-sharing agreements, as well as anticipated problems and gaps where such agreements do not yet exist:

Water-Sharing Agreements

The Middle Eastern governments believe that a lack of water will constrain their opportunities for development and thus endanger domestic political stability as well as relations with their neighbors. This belief means that efforts have been underway since the early 1950s to achieve agreements over water, despite larger ongoing political tensions or conflicts.[iii]

- **Israeli-Jordanian Peace Treaty and Water Sharing Agreement**

Jordan and Israel signed a Peace Treaty in 1994 that contains a water-sharing provision that aims to achieve a "comprehensive and lasting settlement of all the water problems" between the two countries through mutual recognition of their "rightful allocations" to water from the Jordan River and the Yarmouk River.[iii] It also aims to achieve mutual cooperation in the development of existing and additional water resources. Specifically, it allocates:

- For Israel – 25 million cubic meters (mcm) per year from the Yarmouk River;[iii]
- For Jordan – 40 mcm per year from the Jordan River;[iii]
- Jordan and Israel cooperate to try to find an additional 50 mcm per year of potable water for Jordan and develop a plan within one year (from the time of the Treaty signing) to do so.[iii] This supply for Jordan has not yet been found.

This treaty is reputed to be "one of the most creative water treaties on record," because it has Israel "storing" water for later transfer to Jordan.[iii]

However, Israel and Jordan are already finding it difficult to meet their water-sharing obligations. Tensions occurred in 1999 when a severe drought caused Israel to indicate that it was unable to meet its water delivery schedule to Jordan and, therefore, raised the possibility that it would not allocate its requisite. Jordan, in turn, threatened to take "appropriate actions" against Israel.[iii] More recently, Jordan has been unable to provide Israel with its share of the Yarmouk River, most likely due to over extraction upstream by Syria. These incidents highlight significant weaknesses in the water agreement, and thereby illustrate the need for water-sharing agreements to foresee and address extreme circumstances to help mitigate the potential for conflict.[iii]

Undoubtedly, Israel and Jordan will find it even more difficult to meet treaty obligations in the future given the various predicted climatic changes. In particular, decreased precipitation and evapotranspiration (and/or more extreme weather events) mean that the average storage volume in surface reservoirs could decline by as much as 25 percent by 2100.[iii]

The fact that there is a water-sharing agreement in place is an important factor in considering the two countries' abilities to peacefully allocate and share scarce water resources, in light of projected climate impacts, as well as population and demand growth projections. It might actually help avoid potential conflict in the future. The fact that difficulties already are being faced in fulfilling commitments on both sides, however, raises some questions as to the sustainability of the agreement, given these expected changes. Each country's relative ability to mitigate and adapt to climate change will also affect the sustainability.

More specifically, new demand- and supply-side water management policies are essential to help mitigate and adapt to climate change, continue to meet water-sharing obligations, reduce political tensions, and restore the Lower Jordan River. This is the case, particularly in Jordan, where rural communities and the agricultural sector are important to the support of the Hashemite Kingdom. The late King Hussein of Jordan said "water is the one issue that could drive the nations of this region to war."[iii]

In other words, the overall treaty could be jeopardized due to increased political instability.
In Jordan, 70 percent of water resources are allocated to agriculture and, in Israel, 50 percent of water resources typically are directed toward that sector. Yet, for both countries, agriculture's contribution to Gross Domestic Product (GDP) is no more than 3 percent. Demand-side policy changes are needed to encourage a less water-intensive form of crop production and to fewer exports of such water-intensive crops ("virtual water") from the water-poor Middle East to the relatively water-rich European nations and Gulf States. In addition, alternative investments must be made in support of diversifying farmer incomes away from agriculture, and more toward economically and environmentally sustainable land uses, such as rural-tourism.

The water-sharing agreement also does not contain a provision for including other riparian stakeholders, notably, the Palestinians, Syrians or Lebanese (all of whom share the Jordan Basin), an omission that might lead to additional controversies in the future.

Adding more riparian to the Treaty will likely contribute to making the treaty more sustainable and to fostering broader regional cooperation. Thus, a multilateral water-sharing agreement will almost certainly be required in the future.

- **Israeli-Palestinian Interim Agreement**

In 1995, Israel and the Palestinian Authority (PA) signed an Interim [peace] Agreement (Oslo II Accords).[iii] Due to the already-existing political tensions and the need to share increasingly-scarce water resources, Annex III, Article 40 of the Interim Status Agreement was designed to address water and sewage issues by recognizing Palestinian water rights. It allocates 28.6 mcm per year to the Palestinians for domestic consumption and recognizes that the PA will need approximately 70-80 mcm of water per year in the future. The Palestinians requested more water, making the topic contentious, and the issue was left as one of five major issues to be addressed in the Final Status Negotiations.[iii]

Climate change impacts could likely exacerbate difficulties between Israel and Palestine, particularly if final water agreements are not yet in place. More extreme weather events will mean rainwater will run more quickly over the surface of the land. Consequently, much less water will be absorbed into the groundwater of the shared Mountain Aquifer, which is the main

source of drinking water for Palestinians in the West Bank as well as for many Israelis. Eighty percent of the waters of the Mountain Aquifer are presently consumed by Israel.

Overexploitation is a real concern. If the groundwater resource is over-pumped beyond the "safe yield," this could increase the salinity of the Mountain Aquifer and affect the recharge potential, which ultimately could lead to permanent damage. While the PA is presently restricted from extracting water from the Mountain Aquifer without prior Israeli approval, as water resources become increasingly scarce, the necessity and likelihood of doing so will increase.

Because of domestic and agricultural needs, the PA will be seeking larger amounts of water from the Mountain Aquifer and access for the first time to Jordan River waters. The Lower Jordan River has had all of its fresh water diverted by Israel, Syria and Jordan and little more than sewage today makes its way down the River to the Palestinian West Bank. Climate change is predicted to reduce precipitation in the Jordan Valley even further. It may also turn agriculture practice in Israel, and Israel's water supply to Palestinians **impossible,** leaving insufficient water supply for west bank inhabitants to restore and sustain the river itself.

Independent and joint actions by the two parties will be needed to address climate impacts and water needs. Israel, in particular, will have to make significant reforms in these regards.[iii] At the same time, the PA and Israel remain at odds over the issue of water rights and the basis for allocations. The fact that there is an Interim Agreement in place and discussions over water resources were ongoing throughout the Second Intifada, and since, could signal an opportunity for the two Parties to eventually reach a longer-term, water-sharing agreement.

As noted above, a multilateral arrangement that includes Israel, Palestine, Jordan, Syria and Lebanon would likely ensure a more sustainable agreement. Third parties, such as the United States and/or the European Union should facilitate such an accord.

- **Syria-Jordan and Yarmouk Water Agreements**

Jordan and Syria also have a water allocation agreement.[iii] It has been renegotiated several times under circumstances detrimental to Jordan, such that the Jordanians feel that their interests have been compromised. Consequently, tensions are often high between Jordan and Syria over water allocations of the Yarmouk River and ground water.

The fact that an agreement is in place is valuable, however, the extent of violations and anticipation of a reduction in water availability due to climate change means that such tensions can only be expected to grow, and thereby call into question the sustainability of the agreement.

- **Lack of Water Agreements and Peace Treaties: Syria, Lebanon, and Israel**

Currently, there are no formal agreements between Israel and Syria or between Israel and Lebanon. Both Lebanon and Syria currently have adequate water supplies.[iii] However, with projected climate impacts including reductions in precipitation, altered rainfall distribution patterns, and increased evapotranspiration, as well as projected population growth, available water resources will decline and will likely be insufficient to meet projected demand.

For example, available water resources are expected to decline by 15 % for Lebanon by 2020.[iii] The Litani is no longer expected to flow into the Mediterranean and reports have predicted that Lebanon will be unable to meet local demand in the coming 10-15 years.[iii] With these projected changes, Lebanon might seek to extract more water out of the Hazbani, which is one of the tributaries of the Jordan River that is shared with Israel. This may lead to greater political instability between these two nations. Several years ago, Israel said that Lebanese attempts to divert water were a "casus belli," or a cause for war.[iii] This "incident" required third party intervention to prevent a heightened conflict.

Syria and Israel share the resources of the Jordan River and the Sea of Galilee. Syria, like the other riparian of the Jordan River, is already using about 95 percent or more of its "annual renewable freshwater supply,"[iii] and is expected to experience water shortages by 2020.[iii] With 30 % of the waters of the Sea of Galilee originating in the Golan Heights, the return of the Golan to Syria and the water and related physical security issues at stake are intricately linked.

As climate change becomes a "threat multiplier" by making scarce water resources more so, and by contributing to increased tensions over resources in the region, the lack of formal water-sharing agreements now between these countries could make the possibility of achieving such agreements in the future much more difficult, and could increase the risk of future tensions or conflicts.

Conclusions and Recommendations

Existing water resources in the Middle East are inadequate to meet each country's current internal agricultural, domestic and other requirements, let alone to meet the needs of new transboundary water agreements or the minimum water needs of nature.

The political, economic, and physical security risks that could result from the potential water shortages due to projected climate changes are of such a magnitude that preventive actions must be taken now to protect the security of the region. Food security issues (as they relate to water security and mass migration) are relevant and significant, and may impede stability in the region. Thus, Middle Eastern countries **will have to cooperate** with these diminishing resources in order to prevent additional instability.

Countries that have water-sharing agreements and/or broader "peace" agreements in place might find it easier to cooperate towards sustainable solutions, provided there is the political will to do so. Where no long-term agreements exist, it is important to work towards finalizing such arrangements now, because, with anticipated climate changes, water-sharing arrangements will only become politically more difficult to achieve. Third parties will need to facilitate bilateral and regional long-term solutions.

Other factors, such as each country's level of institutional, economic, and infrastructure development, will determine the extent to which it is affected by the climate and its ability to mitigate and adapt to climate change. Aid agencies, therefore, should tailor assistance programs to recipient Middle East countries with climate change policy objectives in mind. Coping with climate change and acknowledging the threatening crisis presents opportunities for local and international transboundary collaborations, this will improve coping with problems already occurring, subject to worsen.

Countries will also have to act domestically, with short-term and long-term planning that consists of mostly demand-side but also some supply-side water and energy management policies. Demand management policies should be the first option adopted by Middle Eastern countries. This may include using less fresh water for agriculture, recycling wastewater, and finding alternative income support mechanisms for rural communities.

Along these lines, domestic water conservation is critical. It is critical to adopt speedy measures to achieve this goal, such as through government incentives for water conservation policies and technologies (for example waterless toilets and rainwater harvesting). Supply-side options, such as seawater desalination (which is presently promoted throughout the region) are energy intensive, contributing to increased greenhouse gas emissions that further exacerbate climate change. Desalination technology is also not equally affordable to the different countries in the region. Though the region has ample sunshine, it has not made significant investments in solar power. Desalination based on solar energy could be the basis for more sustainable supply-side water management options.

The Israeli hi-tech industry is already focused on developing technologies for water reservation, and these efforts should be expanded. Israel will benefit by developing technologic solutions for clean energy and water conservation, and become a leader coping with global climate change.

Cross-border cooperation for sustainable solutions that involve water conservation technology transfer and joint development of large solar fields, for example, could not only help water security, but also advance political security.

In other parts of the region, polities like Egypt, Jordan and the PA will require external assistance to fully enjoy the Clean Development Mechanism (CDM See chapter 4ciii), which is available to developing nations.

Without combined national, regional, and international commitments to deal with the climate crisis, climate change will become the new and real threat to Middle Eastern security with spillover security implications for the rest of the world.

Other References for Climate and Security Chapter, FoEME, Ladeene Freimuth, et. al.:

[23] Brauch, H G (2007) "Impacts of Global Environmental Change for Water Resources of Israel and its Neighbors: New Security Dangers and Shifting Perceptions", in Shuval, H and Dweik, H (eds), *Water Resources in the Middle East: Israel-Palestinian Water Issues – From Conflict to Cooperation,* Springer, Hexagon Series on Human and Environmental Security and Peace, vol 2, p361

[24] Those living on less than 1 dollar per day

[25] Cartographer/Designer, Otto Simonett, UNEP/GRID –Arendal; 2 million by 2050 figure from National Environmental Trust (2005) *Global Warming in the Middle East and Central Asia*, Washington, DC, p16

[26] National Environmental Trust (2005) *Global Warming in the Middle East and Central Asia*, Washington, DC, p12

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