

THE GLOWA JORDAN RIVER SCENARIO EXERCISE



FUTURE MANAGEMENT OF THE JORDAN RIVER BASIN'S WATER AND LAND RESOURCES UNDER CLIMATE CHANGE

- A Scenario Analysis -

Summary Report, September 2011

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This report summarizes the results of the GLOWA Jordan River scenario process. It is based on the contributions of stakeholders and other experts from Israel, Jordan and the Palestinian Authority participating at six Scenario Panel Meetings between 2006 and 2011. The report was compiled by Janina Onigkeit (CESR) and Robin Twite (IPCRI).

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Please note that the outlines of water strategies as described in this report will be further developed and made available after quantitative evaluation in the beginning of 2012. To obtain a copy of the report please contact J. Onigkeit (onigkeit@usf.uni-kassel.de).

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SUMMARY

This short paper is devoted to a description of the process which led to the formulation of four different potential scenarios for the future management of water and the environment in the Jordan River valley. It describes the scenarios and sets out, in brief, possible strategies for dealing with the impact of global and regional change including climate change.

For the development of the scenarios, the "Story and Simulation" or SAS approach was applied which allows for an integration of regional knowledge in mostly narrative form and quantified information provided by the scientists of the GLOWA Jordan River (GLOWA JR) project.

Six meetings of the Scenario Panel between 2006 and 2011 resulted in the so-called "Scenarios of Regional Development under Global Change". These four Regional Development Scenarios and the respective strategies to deal with the challenges identified under the scenarios can be summarized as follows:

"Willingness & Ability" - Economic growth / multilateral water sharing – a future world in which the region flourishes due to lasting peace and world-wide economic growth. This leads to an early development of a comprehensive regional water master plan and a realization of large scale water projects. Environmental issues and conservation of resources gain acceptance on the medium term. Also, measures to cope with the adverse impacts of climate extremes are taken in a cooperative way so that substantial damages can be avoided.

"Poverty & Peace" - Recession / multilateral water sharing – a future world in which the political situation improves but economic growth does not. "Make peace an economic value" is the premise of the water strategy under this scenario. It allows for modest economic development through region-wide ecotourism which is made possible by allocating sufficient water to this sector and by taking care of natural ecosystems. Water resources can be augmented through cooperation in the execution of mostly small scale projects.

"Modest Hopes" - Economic growth / unilateral dividing of water – a future world in which outside donors invest heavily in the region to prevent deterioration of the political situation. The prosperity under this scenario leads to a politically stable situation in the region with limited informal cooperation (exchange of knowledge / technologies). The focus of water management is on increasing the supply of water by large scale desalination and waste water treatment and re-use, all on a high technical level.

"Suffering of the Weak & the Environment" - Recession / unilateral dividing of water – a future world in which the economic and political situation in the region stagnates or worsens. It represents the most vulnerable future with respect to the climate induced decrease and non-reliability of water resources. The early development and implementation of emergency measures are seen as essential if climate change extremes are to be faced effectively. A combination of inexpensive small scale water options and the full use of the options available to national governments are seen as possible strategies to cope with water scarcity under this scenario.

The strategies under all scenarios agree in that the contribution to be made by desalination, the improved treatment of waste water, the improvement of infrastructure, the adjustment of agricultural practices and other necessary steps, can do much to help meet the challenge of climate change. However, the extent to which they can do so will depend upon the availability of financial resources and the degree of cooperation which exists in the region.



WHAT IS THE GLOWA JORDAN RIVER PROJECT?

The GLOWA Jordan River (GLOWA JR) project is a large interdisciplinary research project devoted to the study of the impact of climate change in the Middle East. Since 2001, scientists from Israel, Jordan and the Palestinian Authority, together with those from Germany, have been working together on an international study of the present situation and the future of the Jordan River basin in the light of the anticipated drop in the water resources of the region caused by climate change. The work has been funded by the German Federal Ministry of Education and Research as part of the GLOWA initiative (Global Change and the Hydrological Cycle) which aims at the development and application of integrative and interdisciplinary methods and models to deal with the complex problem of global change in transboundary watersheds. GLOWA JR has been undertaken with the full support of the Governments of Israel and Jordan and of the Palestinian Authority.

Research undertaken by teams involved in the project has covered a wide range of topics including the hydrology and biodiversity of the region; land use, both present and future; and questions related to soil quality and agriculture. All this work has been undertaken with a view not only to increasing scientific knowledge about the current situation, but also to providing those who must ultimately take decisions about how best to combat climate change with the necessary tools in order to do so effectively. GLOWA JR has involved in its work representatives of all relevant stakeholders from the region, including Water Authorities, Government Ministries, and NGOs. Many project meetings at both regional and national level have been attended not only by scientists active in the project, but also those who, in the world of practical decision making, will determine the future of the Jordan River ba-

sin, its people and its natural resources. Tools have been developed which will assist individuals and organizations in successfully managing the water and other resources of the region.

One of these is the "Water Evaluation and Planning Tool" (WEAP) which is now being used in many parts of the region, including by the Government of Jordan. Next to different national applications of the tool, a regional model has been implemented for the whole Jordan River catchment. Application of the WEAP tool enables those using it to obtain precise information on the water system in the Jordan Basin on both the supply and demand side. It integrates results from the research side of GLOWA JR and uses them to supply practical information. It is designed to support regional water planners in analyzing management options and water allocation schemes so as to respond effectively to climate change and other environmental and socio-economic challenges.

A second tool is the "Story and Simulation" (SAS) approach, which has been introduced to develop and apply alternative scenarios for the future of the region from now until 2050. The scenarios take into account a variety of variables which may drastically impinge on the management of water in the region, such as various alternative political and socio-economic changes which may take place in the region, including potential economic developments and demographic issues.

The aim of the scenario process in GLOWA JR was to elaborate ways how the future of the water- and land resources of the Jordan River region might evolve and how different management strategies might affect the future water situation. Main contributors to the uncertainty of future development are global change issues such as global warming and its impacts on the regional water resources.

THE PROCEDURE OF DEVELOPING THE GLOWA JR SCENARIOS AND WATER STRATEGIES

The aim of the scenario process in GLOWA JR is to elaborate ways how the future of the water- and land resources of the Jordan River region might evolve and how different management strategies might affect the future water situation. Main contributors to the uncertainty of future development are global change issues such as global warming and its impacts on the regional water resources. The so-called "Story and Simulation"¹ or SAS approach was considered as an appropriate method for carrying out the GLOWA JR scenario exercise² for two reasons – the necessity of planning for the longterm in the face of emerging climate change and the opportunity of climate related scientific insights to be made available to stakeholders by the project scientists.

The characteristics of the "Story and Simulation" (SAS) approach

A key aspect of the SAS approach is that it allows for the integration of qualitative region-specific expertise on the water system with data- and model-based quantitative information. This was achieved by involving both, stakeholders and scientists as responsible actors in order to gain new insights by using both kinds of knowledge: Stories in a narrative format provided by stakeholders who are familiar with the situation in the region and the specific way water and land resources are managed as well as scientific information from scientists providing expertise from the respective discipline with which they are engaged.

The SAS approach in GLOWA JR

WHO WAS INVOLVED?

Four different groups of actors were involved in the scenario process:

The Scenario Panel: Stakeholders from the region form the first group which (together with GLOWA scientists from the region) developed storylines in the form of narratives and determined which issues are relevant to be addressed in the scenarios. This group covered a wide variety of perspectives on the water issue and represents also the potential users of the scenarios. The number of stakeholders present at the various meetings averaged 25 (in addition to the project scientists). Among others, the following ministries and NGOs were represented in the scenario process:

ISRAEL

- Israel Water Authority
- Ministry of Agriculture
- Ministry of Environmental Protection

JORDAN

- Ministry of Water and Irrigation incl. Jordan Valley Authority
- Ministry of Agriculture
- Ministry of Planning

PALESTINIAN AUTHORITY

- Palestinian Water Authority
- Ministry of Agriculture
- Ministry of Planning
- Ministry of Local Government
- Environmental Quality Authority

OTHER/NGOs

- FoEME – Friends of the Earth Middle East
- Water User Association, Jordan
- IPCRI – Israel/Palestine Center for Research and Information, Israel
- GIZ-Jordan (former GTZ), Germany
- NCARTT – National Center for Agriculture Research and Technology Transfer, Jordan

Scientists of GLOWA JR as the second group contributed quantified information on the future of water, climate, ecology, and other issues. They provided data and results of simulation studies in the form of policy relevant indicators.

¹ The SAS approach was first described by J. Alcamo (Alcamo (2001): Scenarios as tools for international environmental assessment, available on <http://www.eea.europa.eu/>

² This approach was already applied in other future-related studies e.g. by the Intergovernmental Panel on Climate Change (IPCC) aiming at the generation of greenhouse gas emissions scenarios in order to prepare for the impacts of future climate change.



A **scenario team** coordinated the scenario process. Beside the organization of the Scenario Panel meetings this included the coordination of the scientific input, and the processing of information generated by the Scenario Panel in a form usable by the modeling groups.

A **moderation team** from the company Prospex (Belgium) facilitated the process of scenario development. Their task was the design of the process and to create an open and creative atmosphere which enables the group to achieve results even in conflict-laden situations.

How was the process organized?

Six scenario panel meetings were held in the GLOWA JR region and in Germany between 2006 and 2011:

During the first three of these meetings the focus was on developing the storylines of the so called “Regional Development Scenarios” including quantified assumptions on key socio-economic drivers.

A second set of three meetings was held with the aim to work out strategies to cope with the challenges identified under the four Regional Development Scenarios.

What was the procedure?

DEVELOPMENT OF SCENARIO STORYLINES

The focus here was on identifying the main factors which influence the water system and the relationships between these factors.

- To generate four scenarios the two driving factor dimensions “economy” and “water sharing within the region” were identified as main determinants for the future situation in the Jordan River basin. Four storylines were developed based on combinations of these factors (see Fig. 1).
- Qualitative scenario factors were translated to quantitative model input by (1) applying an innovative approach that uses fuzzy sets as translation keys and (2) considering existing future estimates for key drivers as for example future population growth.
- Model runs were performed to assess the impacts of different socio-economic development pathways but

also of global warming on future water availability, water demand and the pressure on open space in the region.

- In an iterative procedure scientific input was fed back to the storyline development in order to check the consistency of the storylines and to refine them.

WATER MANAGEMENT STRATEGIES UNDER THE REGIONAL DEVELOPMENT SCENARIOS

The aim of developing water management strategies was to evaluate combinations of a variety of water management options in order to cope with the increasing water scarcity resulting from future socio-economic development and changing climate conditions.

- In a first step subregional water strategies were developed in three subregional meetings based on the socio-economic conditions prescribed by the Regional Development Scenarios.
- The second step was to finalize these strategies and to develop a first draft of water management strategies on the regional level using a backcasting procedure by setting a target for the year 2050 and then going backward in time defining measures necessary to achieve this target.
- The final step was to verify the regional water strategies with respect to the overall regional water balance, their ability to cope with climate extremes, and their environmental impacts and how to deal with them.

The scenario storylines and the main aspects of the water management strategies are summarized in the following chapters of this report.



THE SCENARIOS OF REGIONAL DEVELOPMENT UNDER GLOBAL CHANGE

Four alternative scenarios have been developed which will be further described in this document, itself an outline, which will be followed by a full report early in 2012.

Four Alternative Scenarios – a summary

The four scenarios which are more fully described below have been derived from the discussions which took place at the six meetings of the Scenario Panel briefly described above. As the discussions progressed, those taking part in them were able to focus on the variables which might directly influence the response of governments to climate change. As the debate continued, it was possible to ascertain that there were four main possibilities (political and socio-economic alternatives), which might be realized in the coming decades (the period under discussion was from the present to the year 2050).

This short paper cannot by its nature provide full evidence of the way in which the scientific findings of GLOWA JR were used during discussion to provide backing for the conclusions reached. In 2012, there will be available a full account of use made in the scenario meetings of information on projections for water demand, distribution and use as well as assumptions on future demographic and economic development; findings of the GLOWA JR teams on the impact of climate change on hydrology, biodiversity, and other relevant variables.

The first scenario (named **Willingness & Ability**) envisages that all goes well in terms of the political realities of the region and its economic development. If there is a positive political atmosphere and strong economic development, then there will be willingness to cooperate between the countries of the region, and the future, though not devoid of problems, will look hopeful.

The second scenario (named **Poverty & Peace**) has both negative and positive aspects. According to this reading of the future, the region will settle down politically but there will be little or no economic progress. Even where political good will exists, lack of financial resource will have an adverse impact.

A third scenario (named **Modest Hopes**) foresees a future which is less encouraging but still not devoid of hope. It is based on the assumption that the economic development of the region is strong but that the political situation does not improve from that in existence today. While a positive economy can help provide the means to fight the adverse effect of climate change, lack of cooperation is a negative factor.

Finally, the fourth scenario (named **Suffering of the Weak & the Environment**) presents the worst case. Neither political stability nor economic development has taken place and the countries of the region are trying to contain the effects of climate change in isolation and with little in the way of funds to help them.

Having provided a general framework for thinking about the future, those taking part in the exercise proceeded to look at what could be done under the terms of the various scenarios to prevent the worst effects of the long term impact of climate change (as envisaged by the research done as part of the GLOWA JR project).

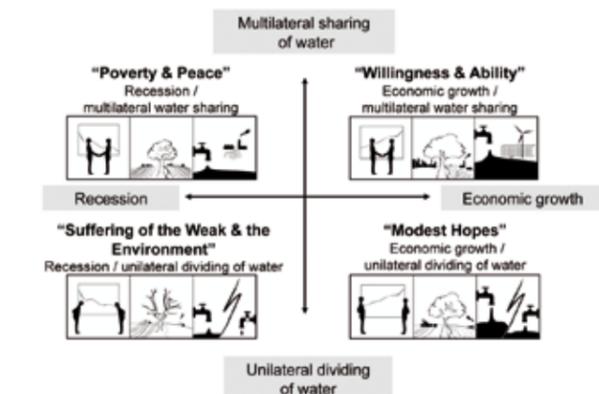


Figure 1: The GLOWA Jordan River Regional Development Scenarios - a schematic presentation

While there was general recognition of the difficulties involved in promoting full cooperation over water and environmental issues in a transboundary region such as the Jordan River basin, it was the opinion of the majority that without such cooperation, the chances of finding an answer to the challenge of climate change would be much diminished.

The scenario exercise represents an exercise in preparing for the uncertainty the future will definitely bring. While it has no pretensions to be definitive, it aims to provoke discussion about the future of the region and stimulate creative thinking. The story lines summarized below provided the basis for the strategic thinking about the future which forms the final section of this paper.

The Four Scenarios

As explained earlier, each of the four alternatives envisaged by participants in the scenario exercise emerged as the result of collective thinking by participants about what the future might possibly bring. None of the resulting “stories” of the future represents a most probable or business-as-usual scenario. The different futures are intended to provoke thinking – they represent the results of collective interaction among a group of highly motivated and experienced individuals with first hand knowledge of the region, its potential and the dangers facing it.

It was on the basis of these “stories” and in the light of the scientific information available to them, that the participants made their strategic suggestions as to possible action for the future in dealing with climate change and other challenges and consequent water scarcity.

WILLINGNESS & ABILITY – THE FIRST SCENARIO



Scenario Characteristics

- Peace
- economic prosperity
- overall water availability increased through high-tech solutions:
 - desalination plants
 - construction of Red Sea/Dead Sea conduit
- more advanced treatment of waste water
- industry and tourism both expand
- pressure on nature increases thanks to population growth, industrial development and increased tourism
- availability of financial resources and an increasing level of public awareness guarantee sustainable development

The following are among the features of this scenario

- Political stability → large amounts of money from international donors for water infrastructure
- fast spread of newest technologies for industry & agriculture, water and solar technology industries
- increasing immigration of Palestinians; families become smaller
- intensification/industrialization of agriculture (more greenhouses)
- high quality treated waste water available
- high production and consumption levels (including tourism) → environmental pollution (“luxury problems”)
- early start of large scale water projects—Red Sea/Dead Sea conduit
- water diverted from agriculture to households and industry
- Palestinian national water carrier from Gaza to Hebron
- investment in all sectors leads to decrease of unemployment rate to below 10 %
- strong tourism industry in Dead Sea area (levels of Dead Sea stabilized)
- increasing environmental awareness and newest technologies → environmental pollution decreases.



The Narrative

2012 - 2025

It is anticipated under this scenario that there is a breakthrough in the peace process in the year 2013. This has an immediate short term effect – an agreement is reached on cross-boundary water issues between Israelis and Palestinians. It forms part of a wider final status agreement. Included in the new agreement on water are provisions for joint cooperation over water distribution and quality, development of new water resources and monitoring of cooperative initiatives. Syria and Lebanon, influenced by the new regional political climate, also enter into agreements with Israel, Jordan and Palestine. Newfound confidence in the stability of the region leads to an increase in donor confidence and, at a regional conference of international donors to the region, billions of dollars are made available for infrastructure, a large percentage of which is set aside for investment in the water sector. Large joint projects make possible the provision of additional water resources to counteract, at least in the short term, the negative effect of climate change and of drought periods, which have become more frequent as a result of climate change.

Palestine. In addition to continued expansion of desalination plants in Israel, large plants are constructed in the Gaza strip and a pipeline constructed from Gaza to the Southern West Bank. Treatment of waste water becomes more sophisticated. Agriculture makes continuous progress. Crop yields increase, partly because the area devoted to crops which are not tolerant of treated waste water decreases rapidly. More intensive agriculture makes it possible to provide land no longer used for agriculture for nature and for areas where biodiversity is protected.

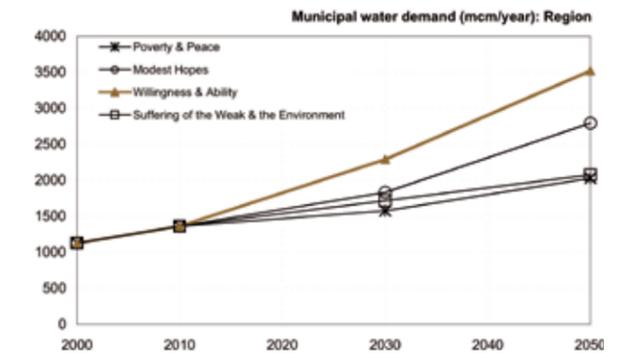


Figure 3: Development of municipal water demand under the four Regional Development Scenarios.

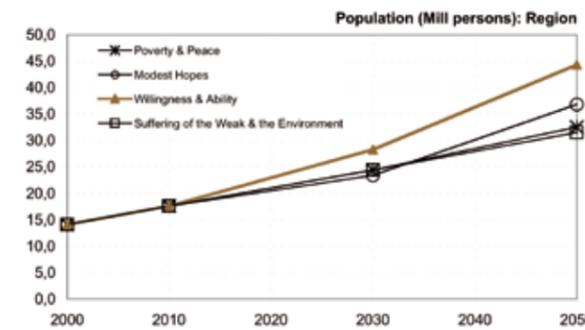


Figure 2: Population development under the four Regional Development Scenarios

2025 - 2040

Thanks to the stability of the region the population increases. There is an influx of returning Palestinians to the Palestinian state. All parts of society are profiting from the improved economic situation and the water sector is no exception. Water technology continues to improve; among new developments are successful experiments in cloud seeding. Funds are found from the international community for the construction of the Red Sea/Dead Sea conduit, which by 2040, will provide water not only for the recovery of the Dead Sea but, after desalination, for Jordan and

Increasing population and rapid development pose challenges. More fresh water is needed for domestic use and to provide for tourists. The extent of natural vegetation decreases due to climate change and the use of land for building and development. There are also problems of maintaining biodiversity in an increasingly prosperous and crowded region. However, the availability of funds and the ability of the countries in the region to cooperate effectively due to the new management structures introduced regionally make it possible to combat these negative developments.

2040 - 2050

The birthrate in Jordan declines as a consequence of increased prosperity. Investment remains high and there is continued migration to cities and tourist centers in the region. There is less than 10 per cent unemployment.

Water demands are satisfied due to the “new” water made available through desalination, waste water treatment and improved technology while mutual trust makes possible the effective management of the water of the Jordan River basin on a cooperative basis.



POVERTY & PEACE – THE SECOND SCENARIO



Scenario Characteristics

- Peaceful development in the region
- region-wide economic stagnation
- sharing of water resources under cooperative management
- slow but steady spread of technology throughout the region
- water scarcity problems remain
- cooperative projects depend on financial support from outside the region and are relatively small scale
- slowly deteriorating environment:
 - soil erosion
 - increased water pollution problems

The following are among the features of this scenario

- Successful peace negotiations stimulate regional economy and immigration
- more equitable sharing of water
- extreme events together with high energy prices lead to economic slow down
- slow exchange of technology, small scale technological solutions
- water conflicts between sectors
- increase of water treatment capacities slow → water pollution problems
- limitations of fresh water for agriculture → low yields → increase of agricultural area → pressures on open land
- use of untreated waste water in agriculture
- increase of waste water treatment capacity and stabilizing water demand → reduction of pollution
- social unrest and exodus of small farmers from land

The Narrative

2012 – 2025

After many years of stalemate, the regional peace process is revived after a decade, in 2020. In the meantime, however, much damage has been done. There is an economic recession which has affected all the countries in the region and the years of conflict have reduced outside investment and destroyed business confidence. There has been a steady increase in population and the high price of fossil fuel has further weakened the local economies which have seen some use of alternative energy, but not on the scale that is needed because of the limited nature of the funds available.

The general malaise has affected the water sector. Poor maintenance has led to the breakdown of many waste water treatment plants and an increasing loss of water through inefficient distribution systems. Climate change has led to more extreme events, droughts and floods, the former being especially severe. From 2021 onwards, a sustained drought which ultimately lasts seven years and is caused by low precipitation has caused many wells to run dry. The Lake Tiberias falls so low that the Israeli national water carrier, already in part superseded by the development of desalination, is out of action for several months because of the failure of the pumping system.

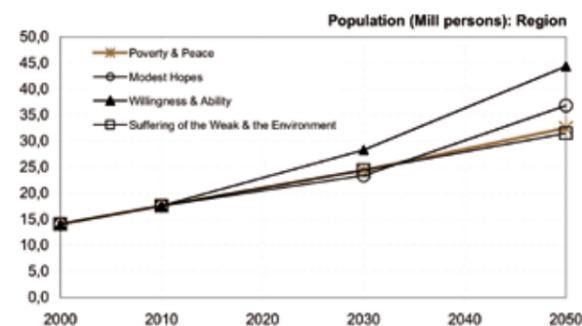


Figure 4: Population development under the four Regional Development Scenarios.

While the Israeli water sector has escaped the worst effects of the deteriorated water situation because of the development of desalination, Israeli agriculture, like that of all the countries of the region, has been adversely affected. Everywhere priority has been given to domestic and industrial water uses.

The revival of the peace process leads to a measure of cooperation between the countries of the region. Small cooperative projects are undertaken and the regional economy begins to revive. A new era of cooperation results in the signing of a water agreement between Israel and Palestine and renewed investment in the water sector by international donors.

2025 - 2040

While the regional economic situation continues to improve, the situation is far from rosy. Population continues to increase due in part to a decision to allow more Palestinians to return to the West Bank and Gaza, and extreme climatic events and their impact are felt more and more as the years pass.

The rise in temperature and reduced precipitation causes problems in meeting demand from domestic consumers. Absence of funding continues to delay the implementation of major schemes for alleviating the situation such as the Red Sea/Dead Sea conduit.

Some of the most severe effects of the economic situation are felt in agriculture. Reduced investment in the sector causes a lack of equipment and of adequate supplies of fertilizer. Sewage treatment plants function poorly and indifferently treated waste water is used in many areas with harmful effects on the resulting crops and risk of disease. Agricultural production falls but the demand for food does not. With crop yields low, food demand growing and the countries of the region unable to afford to import large quantities of staples, certain areas hitherto deemed unfit for cultivation are once more cultivated. This in turn reduces the amount of open space available with harmful effects on the terrestrial biodiversity of the region. Tourism is also badly affected by the poor quality of infrastructure. The continuous decline in the level of the Dead Sea adversely affects ecotourism in particular.

One bright spot is the renewed ability of the countries in the region to cooperate. Cooperative management, sharing of data and the taking of decisions jointly greatly reduces the adverse effects of the poor economic climate.

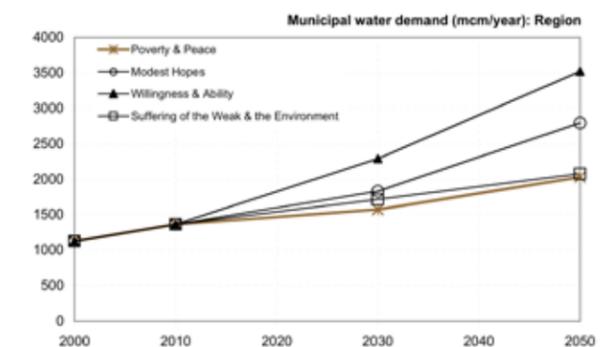


Figure 5: Development of municipal water demand under the four Regional Development Scenarios.

2040 - 2050

The situation continues to be difficult. Lack of funding prevents full use being made of alternative technologies and slows down other much needed steps towards a sustainable future. Social unrest among the poorer sections of the population becomes apparent; among them, local disputes over water resources. While joint management of the water resources of the Basin becomes a reality, this is not in itself enough to solve the problems posed by a variety of adverse factors.



MODEST HOPES – THE THIRD SCENARIO



Scenario Exercise

- No peace agreement
- economic prosperity
- stable conditions in the region
- education, training and capacity building to some extent make up for lack of cooperation
- high-tech solutions partly make up for lack of diminishing fresh water availability:
 - desalination plants
 - irrigation with properly treated waste water
- agriculture becomes profitable
- water level of the Dead Sea continues to drop and the Jordan River is heavily polluted

The following are among the features of this scenario

- International donor money for infrastructure and education at national level
- funding of high tech in PA (focus on agro-technology)
- improved treatment of waste water
- intensive high-tech agriculture but fewer people can live from farming
- industrial agriculture begins to dominate landscape and limits tourism
- price of desalinated water declines due to investment in desalination plants
- higher meat consumption → more land for grazing and feed crops
- lack of cooperation → Dead Sea water level shrinks → Dead Sea shore less attractive for tourism → Jordan River remains polluted

The Narrative

2012 - 2025

The general political climate in the region remains poor. Talks on a possible water agreement between Israel, Jordan and Palestine, fail. The Israeli/Palestinian Joint Water Committee which has been in existence since 1994 ceases to function. Each country develops its own plans and the stable economic climate promotes population growth. International donors (anxious to promote regional calm) seek to head off disputes over water by promoting national rather than cross-border projects. USAID, the EU, the World Bank, the German Government, Japan, the Gulf States, and others provide money to the Palestinian Authority and to Jordan to enable them to unilaterally develop their water resources, but the inability to cooperate holds up the proposed Red Sea/Dead Sea conduit and prevents the restoration of the Jordan River where the flow of water continues to be minimal.

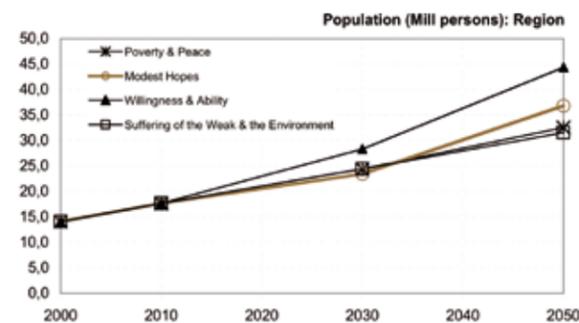


Figure 6: Population development under the four Regional Development Scenarios.

2025 - 2040

Growing population, increasing development especially in the tourist industry (there are 15,000 hotel rooms on the Jordanian side of the Dead Sea by 2030) and more intensive agriculture all put more strain on limited water resources. While international funding has enabled Jordan to open a large desalination plant in Aqaba and Israel has continued to develop its own plants, the poor political climate has restricted the development of desalination in the Gaza Strip.

In spite of this, the gradual increase in the amount of treated waste water available throughout the region and the level of its treatment, together with other technological advances in irrigation and in the protection of aquifers, make it possible to meet domestic demand and to secure the further development of intensive agriculture, especially in Jordan. There is a general increase in environmental awareness throughout the region and in response to this, the proportion of Government expenditure devoted to the environment has greatly increased throughout the region.

In spite of the absence of effective regional cooperation, living standards in the countries of the region continue to advance. By 2030, the GDP of the Palestinian population is 50 % higher compared to 2012.

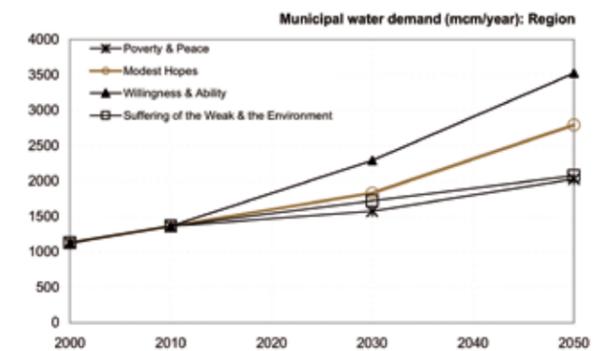
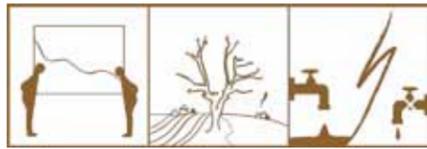


Figure 7: Development of municipal water demand under the four Regional Development Scenarios.

2040 - 2050

The failure to implement major regional environmental projects and the continuing absence of effective managerial cooperation on a day-to-day basis has led to fears that the amount of fresh water available will be insufficient to meet demand. It has also sealed the fate of the Dead Sea, the level of which has fallen drastically, and of the Jordan River, which now dries up in the summer months. The ability to respond to extreme events such as droughts, which have become more frequent, has been seriously impaired.

SUFFERING OF THE WEAK AND THE ENVIRONMENT – THE FOURTH SCENARIO



Scenario Characteristics

- No peace
- no economic growth
- unilateral decisions make it impossible to solve water problems in the region
- water becomes increasingly expensive
- continuous decline in agriculture
- infrastructure deterioration in many parts of the region
- the poor suffer the consequences

The following are among the features of this scenario

- Declining donor support and investments due to political instability
- international donors cautious
- lack of money for maintenance or improvement of water infrastructure
- increasing energy costs / oil prices
- scarcity improves public awareness → water a precious good
- water allocation in favor of domestic sector
- rainfed agriculture becomes increasingly difficult due to decline in precipitation
- donors focus on crisis management
- privatization of water sector → price increase
- Jordan, PA: exodus from land due to dwindling job opportunities in agriculture
- declining tourism due to political tensions and degraded environmental landscape
- decline in area suitable for rainfed agriculture

The Narrative

2012 - 2025

The situation of the region during this period is deplorable. Continuous, and sometimes violent, confrontation between Israelis and Palestinians has severely harmed all parties. The Jordanian Government, though less directly involved, has suffered as a result of regional instability. International donors and investors alike hold back from putting funds into a region where security is limited.

Lack of belief in the long term prospects of the region has deterred investment and discouraged efforts to promote sustainable solutions to environmental problems, including that posed by climate change. While there has been limited progress in the provision of desalinated water, especially in Israel, and the treatment of waste water has increased very slightly, the resultant improvement has been insufficient to provide for the increasing need for water for a growing regional population in an area where climate change has severely reduced precipitation. Agriculture has been severely affected. Rainfed agriculture has become difficult to maintain, especially in periods of prolonged drought which have become more common.

Demand for water for irrigation has increased and has been met in part by using poorly treated waste water. Standards of maintenance of equipment and water supply and distribution systems have declined.

The absence of effective cooperation has meant further damage to the underground aquifers from pollution, the almost complete disappearance of the Jordan River and a massive drop in the level of the Dead Sea. Each country has done its best to promote public awareness about water shortage and handle the increasingly difficult situation but with limited success.

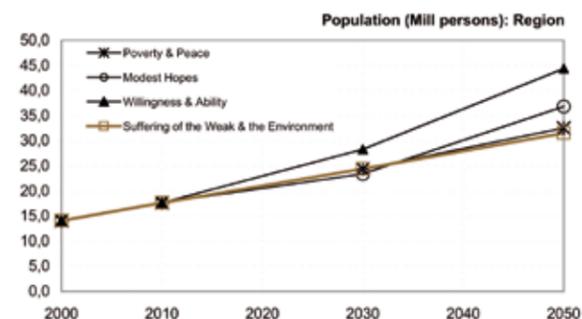


Figure 8: Population development under the four Regional Development Scenarios.



2025 - 2040

Things continue to deteriorate. Visible now are major social impacts resulting from a combination of lack of peace, poor economic progress and the impact of climate change and other negative environmental developments. In those areas where agriculture is predominant, many farmers leave their farms and make for the cities where they swell an increasing number of unemployed.

As far as the water situation goes, efforts to cope with it are, of course, made and limited success achieved, but there is no systematic effort to provide the large amounts of water needed to meet domestic, agricultural and industrial demand in the region as a whole. The decline in security and in the economy does not lead to a drop in population, which continues to increase in all the countries of the region with a consequent demand for more water. Many rural areas become dependent on water supplied by tanker during the summer months and local disputes over well and other water resources become common.

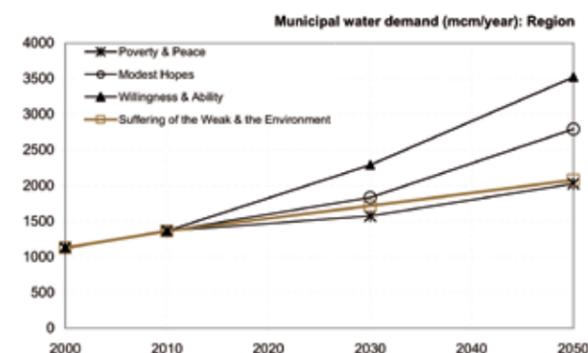
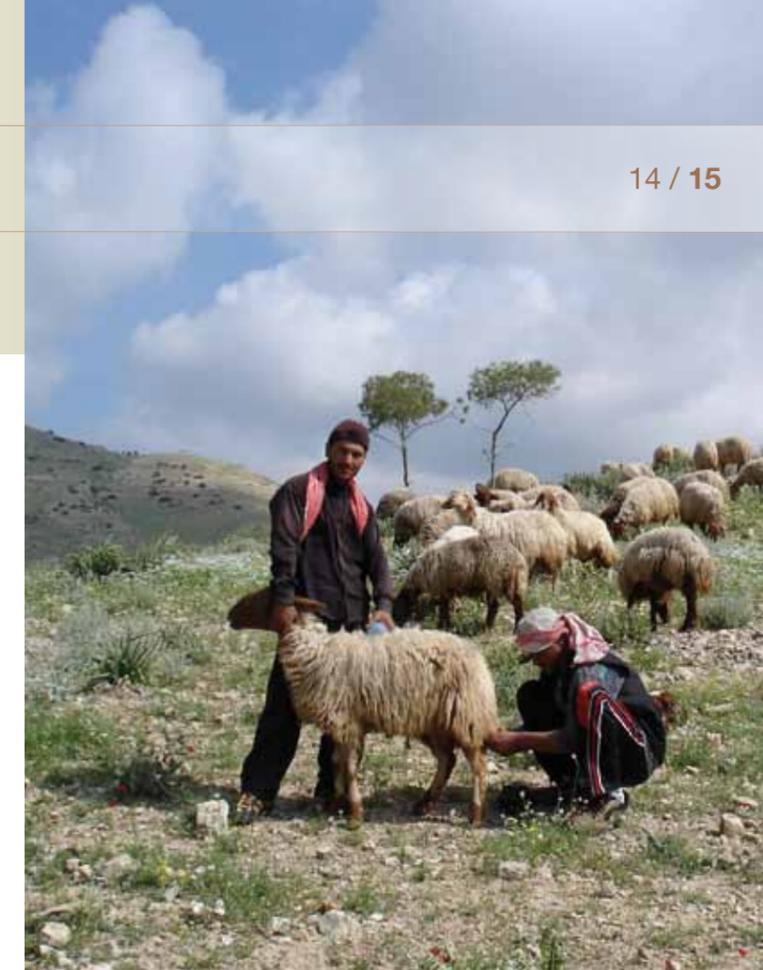


Figure 9: Development of municipal water demand under the four Regional Development Scenarios.



2040 - 2050

There is little improvement and the region continues to languish – it has always suffered from water scarcity and now the situation is much worse than it has ever been. Efforts to purchase water from Turkey, to relaunch plans for major environmental projects, and generally improve the infrastructure have met with little success. Climate change has contributed to the general depression of activity and inability to cooperate has been a major factor in creating a situation that the region as a whole is unable to cope with.



STRATEGIC THINKING – THE FUTURE UNDER DIFFERENT SCENARIOS

The participants in the scenario exercise were asked to consider what they thought were the most likely developments with regard to water management and supply, given the background developments foreseen in the various scenarios.

The characteristics of the water strategies under the four Regional Development Scenarios can be summarized as follows:

Scenario Willingness & Ability: Region wide prosperity & cooperation on water issues from the beginning on lead to an early development of a comprehensive regional water master plan. Together with the necessary financial resources, this results in an early realization of large scale water projects. Environmental issues and conservation of resources gain acceptance in the medium term. Measures to cope with the adverse impacts of climate extremes are taken early and in a cooperative way so that substantial damages can be avoided.

Scenario Poverty & Peace: “Make peace an economic value” is the premise of the water strategy under this scenario. It allows for modest economic development through development of region-wide ecotourism realized in part by allocating sufficient water to this sector and by taking care of natural ecosystems. Water resources can be augmented through cooperation on the basis of small scale projects. Trilateral water management can be realized very early through third party involvement in the beginning (this will help to build trust between parties).

Scenario Modest Hopes: The prosperity envisaged under this scenario leads to a politically stable situation in the region with limited informal cooperation (exchange of knowledge / technologies). The focus of water management is on increasing the supply of water by large scale

Governance, management and education

This section describes all aspects of the water strategies which are related to policy and management decisions in a wide sense. The management of water resources under the four scenarios differs according to the scenario's assumptions on sharing of water resources: accordingly, regional water master plans and agreements on sharing of water resources are assumed under the more cooperative scenarios “Willingness & Ability” and “Poverty &

desalination and waste water treatment and re-use, all on a high technical level.

Scenario Suffering of the Weak & the Environment: This scenario represents the most vulnerable future with respect to climate change and the decrease and non-reliability of future water resources. The first ten years are perceived as critical. The development and implementation of emergency measures are seen as an essential measure to be prepared for future climate extremes. Cooperation is possible on informal / technical level. A combination of inexpensive water options, traditional measures and full use of governance options (regulations & laws to save water and protect resources from pollution) are seen as adequate strategies to cope with future water scarcity.

These characteristics of the strategies can be translated to more specific actions which differ depending on the underlying scenario assumptions. We can distinguish between five issues that could be differently dealt with under the four scenarios:

1. Governance, management & education
2. Infrastructure & “new” water sources
3. Demand management & efficiency
4. Agriculture & environment
5. Adaptation to climate extremes

Below are five sections which briefly set out what future strategies were regarded as possible under the four scenarios.

Please note that in this short report it can only be indicated how the scenario conditions can shape alternative strategies. In the full report – to be published in the beginning of 2012 – the various factors and conclusions will be fully described.

Peace”. Nevertheless, even under the scenarios assuming no cooperation, communication on an informal level (e.g. between the scientific communities of the three parties) remain possible and necessary. Governance, legislation and awareness raising campaigns (all on the national level) are applied to the greatest possible extent especially where financial resources are limited.

Table 1: Future governance, legislation and management under the four scenarios

WILLINGNESS & ABILITY	POVERTY & PEACE	MODEST HOPES	SUFFERING OF THE WEAK...
<p>Short term</p> <ul style="list-style-type: none"> Regional master plan incl. standardized regulations, control, water infrastructure, water pricing, environment Agreement on shared water management <p>Medium term</p> <ul style="list-style-type: none"> Regional center for water management & training Technology transfer (WWT, operation, maintenance, management) <p>Long term</p> <ul style="list-style-type: none"> WWT: Monitoring & valuation program Agreement on water sharing - regional board established Regional cooperation on crop management Regional disaster management plans 	<p>Short term</p> <ul style="list-style-type: none"> Awareness raising from regional perspective Water pricing to realize water saving Regional water management structures (w 3rd party involvement in the beginning) Identification of natural areas with high conservation potential <p>Medium term</p> <ul style="list-style-type: none"> New priority of sectors: 1. domestic, 2. tourism, 3. agriculture, 4. industry Joint monitoring of water quality Joint water pricing Tax incentives and legislation for eco-friendly infrastructure <p>Long term</p> <ul style="list-style-type: none"> Stabilize water allocation for agriculture 	<p>Short term</p> <ul style="list-style-type: none"> National water master plans Limited cooperation on research, education & technology transfer Semi-formal regional management network Funding of research & development (desalination, solar energy, irrigation, WWT) <p>Medium term:</p> <ul style="list-style-type: none"> No changes <p>Long term</p> <ul style="list-style-type: none"> No changes 	<p>Short term</p> <ul style="list-style-type: none"> Public dialogues with end users / stakeholders Cooperation among scientists Legislation & policies for crisis times <p>Medium term</p> <ul style="list-style-type: none"> Awareness programs in schools Involvement of private sector for local desalination plants (B.O.T.) Spread of technologies: remove taxes for water saving technologies Subsidize urban & rural rain water harvesting Legislation to prevent env. damage from TWW use and local desalination <p>Long term</p> <ul style="list-style-type: none"> Regional institute for water & development Informal cooperation between water authorities & scientists

Water supply, new water sources and infrastructure

In view of the increasing water demand and decreasing precipitation an augmentation of water resources is among the main measures to mitigate both, water scarcity and decreasing water reliability. Under the scenarios assuming prosperity (“Willingness & Ability” and “Modest Hopes”) large scale desalination plays a major role in future water supply – differing only in the extent of cooperation in realizing the projects. Small scale local projects

such as urban and rural rain water harvesting prevail under the scenarios assuming a poor economic development (“Poverty & Peace” and “Suffering of the Weak...”). All strategies have in common that both, the urgency and potential of waste water treatment and use is seen and put into practice. The tempo for realizing the projects again depends on the economic strength of the parties but also the level of cooperation between them.

Table 2: The development of water supply and infrastructure under the four scenarios

WILLINGNESS & ABILITY	POVERTY & PEACE	MODEST HOPES	SUFFERING OF THE WEAK...
<p>Short term</p> <ul style="list-style-type: none"> Regional desalination plan Tenders for private sector <p>Med term</p> <ul style="list-style-type: none"> Water purchase from Turkey phase I Additional desalination plants Red Sea/Dead Sea Canal (phase I) <p>Long term</p> <ul style="list-style-type: none"> Water purchase from Turkey phase II Red Sea/Dead Sea Canal final phase Adapt desalination capacity to cover deficits Regional infrastructure established 	<p>Short term</p> <ul style="list-style-type: none"> Rural rain water harvesting, dams and cisterns Expansion of sewage network, treatment, re-use (small scale, decentralized) Small scale (mobile) desalination plants (B.O.T.) <p>Medium term</p> <ul style="list-style-type: none"> Region-wide conveyance system Waste water treated and used in area of need <p>Long term</p> <ul style="list-style-type: none"> Massive increase of urban rain water harvesting 	<p>Short term</p> <ul style="list-style-type: none"> Connection to sewage networks: 80 % Waste water treated: 65 % <p>Medium term</p> <ul style="list-style-type: none"> Connection to sewage networks: 95 % Waste water treated: 90 % Regional desalination capacity: 1500 MCM <p>Long term</p> <ul style="list-style-type: none"> Waste water treated: 100 %, 90 % re-used Regional desalination capacity: 2100 MCM 	<p>Short term</p> <ul style="list-style-type: none"> Use full potential of treated waste water <p>Medium term</p> <ul style="list-style-type: none"> Implementation of low cost waste water treatment (e.g. wetlands) Local scale desalination of brackish water New methods for local desalination of sea water (Jordan, Gaza, Israel) Dew harvesting <p>Long term</p> <ul style="list-style-type: none"> Increased use of brackish water



Demand management and efficiency

The management of the water demand of the different sectors was considered an important option, especially under the economically weak scenarios and the scenarios assuming high environmental awareness. Beside the intro-

duction of price signals, the tightening of existing legislation and the introduction of new legislation and regulation is seen as a measure to stimulate a sustainable handling or conservation of existing water resources.

Table 3: Demand management and changes in efficiency under the four scenarios

WILLINGNESS & ABILITY	POVERTY & PEACE	MODEST HOPES	SUFFERING OF THE WEAK...
Short term <ul style="list-style-type: none"> • Campaigning/training for awareness raising: water & environment Medium term <ul style="list-style-type: none"> • Water saving measures widely realized Long term <ul style="list-style-type: none"> • Highest possible efficiency all users • International center for efficient use of water and land resources 	Short term <ul style="list-style-type: none"> • Water saving across all sectors • Optimized irrigation and cropping patterns Medium term <ul style="list-style-type: none"> • Improvement of infrastructure Long term <ul style="list-style-type: none"> • Reduction of water losses 	Short term <ul style="list-style-type: none"> • Improvements of irrigation supply systems Medium term <ul style="list-style-type: none"> • Improvements in water use efficiency domestically and in agriculture Long term <ul style="list-style-type: none"> • Maximum water use efficiency • Municipal losses < 10 % • Doubling of crop yield/m³ water 	Short term <ul style="list-style-type: none"> • Green roofs, roof gardening • Decrease of domestic water use where possible Medium term <ul style="list-style-type: none"> • Rehabilitate water network in large cities Long term <ul style="list-style-type: none"> • More water saving in domestic sector

Agriculture and environment

Agriculture is the biggest consumer of water and land resources and, because much of it is irrigated, one of the most vulnerable sectors with respect to climate change. On the other hand, it offers opportunities to contribute to the conservation of both kinds of resources, thus freeing water for river rehabilitation or land for the protection of biodiversity of terrestrial ecosystems. In particular, allocating more land to natural ecosystems at the expense of

cultivated area is an option worth to consider both from an economic point of view as well as for conservation of nature and water (as is assumed under the "Willingness & Ability" scenario). From an economic perspective, intact ecosystems are a prerequisite e.g. if the tourism sector is considered as an option for economic development as it is assumed for the "Poverty & Peace" scenario.

Table 4: The future development of agriculture and the environment under the four scenarios

WILLINGNESS & ABILITY	POVERTY & PEACE	MODEST HOPES	SUFFERING OF THE WEAK...
Short term <ul style="list-style-type: none"> • Action plan for nature reserves & regional corridors • Standards for agricultural inputs • Regional institution for environmental research & conservation Medium term <ul style="list-style-type: none"> • Allocation of water to nature • Regular revision of action plan incl. financial analysis Long term <ul style="list-style-type: none"> • Sustainable use of natural resources on regional basis 	Short term <ul style="list-style-type: none"> • Decrease of fresh water demand in agriculture by using treated waste water Medium term <ul style="list-style-type: none"> • Implement network of nature reserves and trained staff (→ ecotourism) • All hotels eco-friendly Long term <ul style="list-style-type: none"> • Establishment of peace parks 	Short term <ul style="list-style-type: none"> • Small increase of irrigated land Medium term <ul style="list-style-type: none"> • Individual projects for stream restoration • Increase of irrigated land Long term <ul style="list-style-type: none"> • Natural water resources rehabilitated (with exception of Dead Sea due to lack in cooperation) • Increase of irrigated land 	Short to medium term <ul style="list-style-type: none"> • Increased use of brackish water • Adjustment of cropping patterns to semi arid climate (dates, olives) Long term <ul style="list-style-type: none"> • More water saving in agricultural sector where possible

Adaptation to climate extremes

Coping with extreme fluctuations in precipitation is one of the key issues of future water management. In general, the scenario with the economic capability to provide large amounts of extra water (either on regional or on national level) will suffer less. Building and protecting water reservoirs (e.g. groundwater or dams), planning of extra water resources (e.g. extra desalination capacity) and limiting

water supply to agriculture (with financial compensation for farmers where this is economically possible) are among the options open for coping especially in drought periods. Extreme rain events have been seen as an opportunity to generate extra water by increasing storage capacities in wadis especially in Palestine and Jordan.

Table 5: Options for adapting to climate extremes (droughts & floods)

WILLINGNESS & ABILITY	POVERTY & PEACE	MODEST HOPES	SUFFERING OF THE WEAK...
<ul style="list-style-type: none"> • Budget for waste water treatment & desalination as permanent and secure sources • Focus on regional drought anticipation & cooperation • Phase out water thirsty crops, introduce drought tolerant crops • Aquifer recharge using treated waste water & desalinated water 	<ul style="list-style-type: none"> • Rain water harvesting: more efficient use of rain periods • Adapt cropping periods in agriculture • Reinforce optimal (minimum requirement) crops • Optimize agricultural practice (e.g. irrigation) • (Virtual) water import • Restructure water pricing in all sectors • Grey water for garden watering in large buildings 	<ul style="list-style-type: none"> • Quicker expansion of desalination capacity • Drought in agriculture: compensation for farmers & alternative production schemes • Rain water harvesting to generate drought reserves 	<ul style="list-style-type: none"> • Awareness raising & increase of water prices • Jordan: prevent groundwater abstraction by farmers, cut summer irrigation in the Jordan Valley • Israel: abandon some agric. areas in the south, reduce to minimum water for agriculture • Small earth dams for flood water harvesting • Use full potential of urban water harvesting & cisterns for rural water harvesting • Drought tolerant crop varieties

CONCLUSION

This short paper illustrates the type of considerations and potential developments which will impinge on the future of the Jordan River basin and the management of its water resources.

The strategic measures presented in the text provide a brief overview. They have been put forward in relation to average renewable water availability and an average climate induced decrease of natural water resources. Whether or to what extent the assumed combinations of measures will be adequate to respond to anticipated changes in precipitation or frequency and severity of extreme events such as droughts and floods will be further dealt with in a final report.

Necessarily missing from an account of this kind are details of the personal interaction between participants from different countries, which formed an important though unquantifiable element in the exercise. All activity which leads to better understanding between administrators and professionals in a region so fraught with conflict are of value in both the short and the long term.

While the main features of the action needed to combat climate change are similar in all circumstances – it is clear that

should the adverse scenarios be realized, the absence of funding and/ or lack of regional cooperation will slow down the ability of the countries of the region to respond. In the worst case scenario, there will be severe problems caused by lack of water for domestic use and agriculture is likely to suffer the most.

All are agreed, however that the contribution to be made by desalination, the improved treatment of waste water, the improvement of infrastructure, the adjustment of agricultural practices and other necessary steps, can do much to help meet the challenge of climate change. However, the extent to which they can do so will depend upon the availability of financial resources and the degree of cooperation which exists in the region. Effective regional management is one of the keys to the future of the Jordan River basin and this, in its turn, depends on long term political developments. It is clear, however, that climate change will diminish precipitation, almost certainly cause more extreme events and impact all aspects of life in the basin. To secure the future of the people of the region demands a cooperative effort from all.

The **GLOWA Jordan River project** is part of a larger research initiative launched by the German Federal Ministry of Education and Research (BMBF) under the title “Global Change in the Hydrological Cycle”.

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