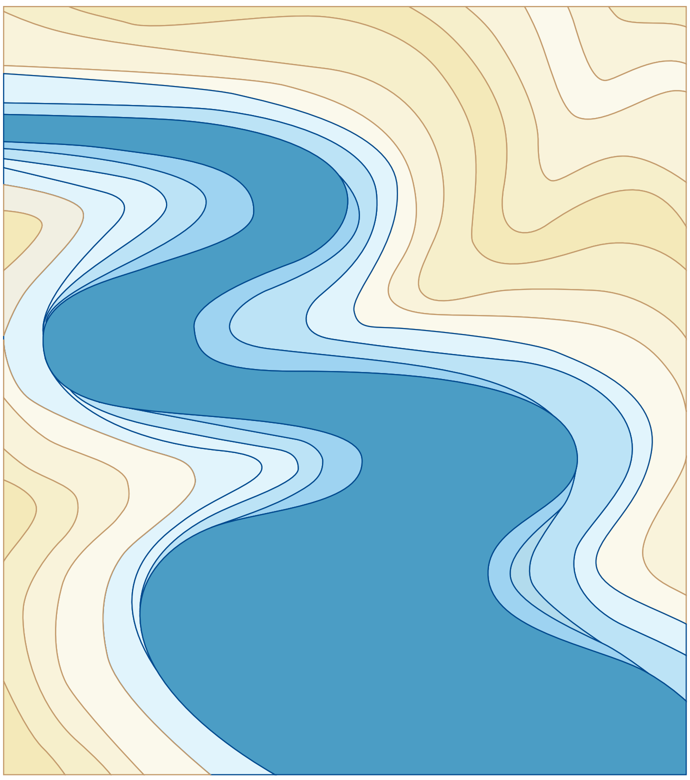
# THE BLUE PEACE

## Rethinking Middle East Water



Strategic Foresight Group

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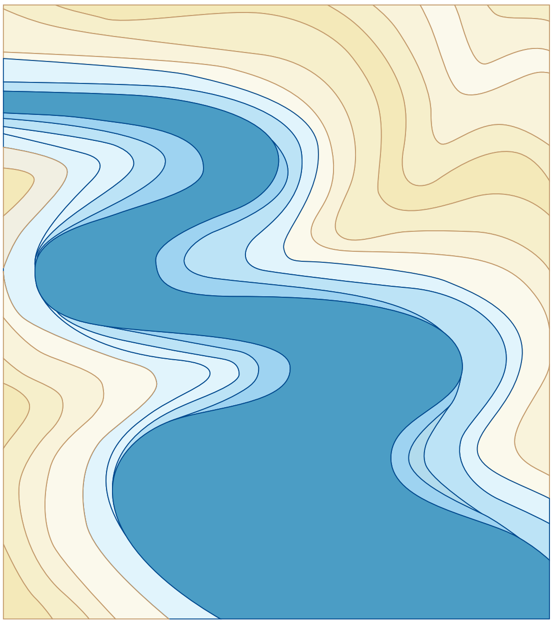

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Strategic Foresight Group

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# PREFACE

The objective of this report is to provide a comprehensive, long-term and regional framework for thinking about water in the Middle East, which can be implemented with specific policy decisions, beginning in the immediate future, by individual countries or small groups of countries without waiting for all the countries in the region to move forward.

Such a framework recognises the potential of water to deliver a new form of peace – the blue peace – while presenting long term scenarios of risks of wars and humanitarian crisis.

The report takes a comprehensive view of rivers, tributaries, lakes and underground water bodies. It is based on the recognition of linkages between watercourses. It is not only impossible for any one country to manage a water body in isolation from other riparian countries but it is also impossible to manage a water body without examining its linkages with other watercourses in the region.

The report takes a long-term view. The countries that are friendly today may be antagonistic tomorrow and the ones which are enemies today may be friends tomorrow. The history of merely last ten years in the Middle East demonstrates how quickly the geopolitical scene changes. The political equations of today cannot be assumed to remain constant during the next decade and beyond. Our vision, therefore, should not be imprisoned by the current context. We have to anticipate alternative political trajectories for the next couple of decades in order to find solutions that are sustainable in the long run.

The report provides a regional perspective. Since watercourses, both surface and underground, do not understand political boundaries, it would be natural to have a regional approach to water management. The nation centric approach is unnatural and therefore unsustainable.

The use of water for farming, settlements and socio-economic development began in the Middle East some 10-12000 years ago. This region today is at the epicentre of a mega arch of hydro insecurity that spreads from Vietnam in the East to Turkey in the West and Kenya in the South. The same region can be a harbinger of a new form of peace – the blue peace – a concept that has to be distinguished from conventional peace, which is normally a state of harmony between wars, and green peace that relates to ecological imperative for constructive relationship between societies. The blue peace concept assures that no two countries that have access to adequate, clean and affordable water would ever go to a war in the twenty-first century.

This report is being presented at a promising time despite appearance of stagnation or even failure in reconciliation initiatives in the region. The relationship between Turkey, Syria, Iraq and Lebanon has dramatically improved in 2-3 years prior to the publication of this report. New interface in trade, transit and telecommunications has benefited poor people in these countries. It can be extended to watercourses. Israel, Jordan and the Palestinian Authority are negotiating with international partners ideas for cooperation including in the water sector. The choice is to build on these positive developments or to focus on unresolved conflicts.

Another choice is to leave water to be managed by the relevant ministries or to recognise its central role in the future of human security and welfare. If the latter choice is made, it would be essential to shift water from the files of ministers of water, irrigation and environment to the agenda of Heads of Governments and States, just as it has happened in the case of terrorism, climate change and international finance. This is essential at the global level, and not merely in the context of the Middle East.

This report is therefore as much about paradigm shifts in global thinking as about the specific details of seasonal variations in the discharge of rivers and demand management with new methods of irrigation and conveyance. It is as much about big ideas as about small actions.

Strategic Foresight Group is immensely grateful to the Governments of Sweden and Switzerland for their sponsorship of this initiative, national institutions in Turkey and Jordan for their additional support, Bibliotheca Alexandrina for translating a shorter version in Arabic and over 100 leaders and experts from across the region for making this report possible. We have acknowledged specific government departments, institutions and individuals in annexes. While expressing our gratitude to all, we take the sole responsibility for its contents, including unintended errors and omissions that cannot be ruled out in a complex document of this nature.

The very fact that so many catalysts and scholars from across the Middle East contributed to this report, and the strong international support that was offered for the process, proves that there is a massive reservoir of goodwill. People of the Middle East do want pragmatic and peaceful solutions to manage one of the most significant humanitarian issues of our time. The challenge before all of us is to tap this latent goodwill and transform it into active and viable canals of constructive policies.

January 2011

**Sundeep Waslekar**
President, Strategic Foresight Group

# FOREWORD

"The Blue Peace – Rethinking Middle East Water" examines present and future water security in the Middle East – Israel, the Palestinian Territories, Jordan, Lebanon, Syria, Iraq and Turkey. This report is a part of a long term initiative steered by the Strategic Foresight Group (SFG) since 2008 in the Middle East in the water sector.

The "Blue Peace" puts forward an innovative approach to engage political leaders, the public and the media in harnessing and managing collaborative solutions for sustainable regional water management, make a path for the evolution of a regional political and diplomatic community in water and create new opportunities for resolving protracted water related conflicts.

It is a result of an extensive consultation process in the seven countries which lasted 18 months. "The Blue Peace" focuses on innovative short, medium and long term recommendations to catalyze improvements in water management.

It is a known fact that water is vital for life and for development. All sectors of the economy use water, directly or indirectly, as an input, a sink for wastewater, and also as part of the social and cultural fabric of communities and nations. The water resource management sector has to face the new global changes that are taking place around the world, and in particular in the Middle East, at a faster rate than ever experienced before: population growth, migration, urbanization, climate change, land-use changes and economic alterations. These factors impact directly on water resources, water services and ecosystems services.

The growing scarcity of water, implications for food security and indeed human security explain why, increasingly, water protection and its optimal use are critically shaping the foreign policy of the Middle Eastern countries and international affairs. In the future, the key geopolitical resource in the Middle East will be water, much more so than oil.

The issue of access to water resources, particularly in lean seasons, will impact the way political relations and alliances are framed in the future, even more significantly than it already does. The costs of failing to manage water are counted in terms of poverty, conflict, impaired growth and lost biodiversity. New political behavioral norms and processes are emerging. What was common sense and vision in the past is no longer the case. What can be agreed upon today and tomorrow is not the same as before. The conditions have changed in a way that the solutions of the past are not effective anymore. The rules of the game are evolving at an unprecedented speed. The response is not easy. It is all about fostering a new diplomacy, the "blue diplomacy" with the objective of fostering the blue peace.

Water-diplomacy is organized according to new political norms and processes, common and consensual policy, laws and institutions for managing the water resources. The centre piece of water diplomacy is to agree on the socio-economic, environmental and political benefits derived from the use of water. The "Blue Peace" report could be a milestone in that endeavor.

In many places, water could be a source of conflict but, at the same time, we believe that water will become a new common challenge, which will bring people and governments together to find innovative solutions to this life-threatening situation.

Fortunately in the Middle-East, good relations and mutual recognition exist among top level water and political actors across boundaries. We are convinced that they will find in the “Blue Peace” a concrete, realistic and consensual road map for a cooperative and productive management of water, including the shared resources.

We hope that it will serve another objective: to foster trust between stakeholders which can go beyond water issues and be the sound basis of a good relationship, preventing future or potential conflicts related to water management. Indeed the concept of “Blue Peace” can help us craft a new future in the Middle East and “blue diplomacy” is the way to go about it.

**Mr. Martin Dahinden**
Director General of the Swiss Agency for Development and Cooperation (SDC)
of the Federal Department of Foreign Affairs, Switzerland

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# Summary of Recommendations

## Rethinking Middle East Water

It is known that the Middle East is a water scarce region. It is easy to build scenarios of acute water stress in the future due to population pressures, economic growth, pollution, drought and climate change. It is also possible to anticipate conflict between countries due to disagreements over shared water resources. Indeed, conventional thinking about water in the Middle East tends to be pessimistic and alarmist. The challenge is to rethink water in the Middle East to treat it as an opportunity for peace and development.

The objective of this study is to redefine the water paradigm in the Middle East, so that water can be harnessed in a way that satisfies the social and economic needs of people. In doing so, water can also transform into an instrument of peace and cooperation. There is a cause and effect relationship between water and peace. While peace is needed for cooperation in water, a collaborative and sustainable approach to water management can build peace.

Any effort to rethink water in any region must begin with an understanding of the current realities. Watercourses, surface as well as underground, do not recognise borders. There are many rivers and aquifers in the Middle East which are spread across two or more countries. However, the management of water resources is essentially a national task. There is no integrated basin or aquifer management system overriding national sovereignty, irrespective of the trans-boundary nature of some of the watercourses. A national approach to the management of water resources often proves inefficient and inadequate when a basin is shared by two or more countries. Also, decision-making at the national level leads to conditions in one basin having an impact on another basin or aquifer. Therefore, an ideal approach would be a regional one, but the political realities at the end of the first decade of the 21st century pose difficult questions about the definition of 'the region' and existence or lack of trust between its constituent states.

The most pragmatic approach would therefore need to be based on something between a nation and a region as a unit of cooperation. It can best be defined by groupings or circles of countries, which have either demonstrated some appreciation of their common future or, whether they like it or not, are so intrinsically linked by the flow of watercourses that they have to take into consideration factors beyond their borders. An approach focussed on circles of countries should be clearly distinguished from an approach based on basin or aquifer management, though circles of cooperation can facilitate integrated basin management for basins within the given circle.

The study limits its scope to cover Israel, the Palestine Territories, Jordan, Lebanon, Syria, Iraq and Turkey. Critics may argue that this is an arbitrary choice of countries, as some other countries in the neighbourhood are closely linked to some of the selected countries. This is a valid argument. However, our objective is to present a set of proposals, which might not meet all criteria for perfection, but which would enable political decision makers to break the current deadlock and enable them to harness water resources for peace and socio-economic development in the region. Therefore, our choice of countries is governed by the potential of opportunities to rethink water. The study reflects our intention to achieve a blend between perfection and pragmatism at the highest possible common denominator. In order to lift the highest possible common denominator even to a higher level, we propose to treat countries covered by the study in distinct Circles of Cooperation.

The concept of Circles of Cooperation has been crafted in the Middle East. HRH Prince Hassan bin Talal of Jordan proposed it at a high level plenary involving senior decision makers and opinion makers from several countries in the region in May 2010. The first such circle would include the northern countries - Turkey, Syria, Iraq, Lebanon and Jordan. The second circle would include Israel and the Palestinian Territories, eventually expanding to Jordan. Cooperation can be introduced in each circle separately. The two circles may choose to intersect, if and when they find the political context appropriate and feasible to do so. At a later stage, the two circles may be together or separately widened to include other countries in the Middle East. In this process, a beginning to construct building blocks of peace and hope can be made without delay.

This approach is based on the hypothesis that water and environment are critical to stability, resilience and progress of societies in the Middle East. It is aimed at developing a common political framework for the future, for sustainable management of water resources across several basins and not a negotiating platform for dividing water resources in any individual river basin or aquifer. This approach treats water as an instrument. It considers peace, human security and socio-economic development as the objectives.

Rethinking water as an opportunity, rather than a problem, is not only necessary but also possible. Instead of waiting for the most perfect political paradigm to appear on one morning, instead of feeling threatened by the enormity of scientific and natural challenges, if decision makers in the Middle East create stepping stones of hope, they will be able to move towards a sustainable future for their people. The report enables such rethinking with its recommendations for short, medium and long term. In this context, it sees short term as a period of five years, medium term as a period of 5-10 years, and long term as ten years and beyond. These recommendations have resulted from wide ranging consultations in the region. They are, therefore, essentially ideas of people in the Middle East. The report merely transforms regional ideas into recommendations for the convenience of decision makers in the Middle East so that they may translate recommendations into actions. Their actions will improve the standard of living of common people, protect the environment, and introduce a new type of peace in the world – the Blue Peace.

## 1. Cooperation Council for Water Resources in the Middle East for the Northern Circle (Short Term):

The idea of Circles of Cooperation would become operational if each circle has a political mechanism to define a common vision, identify priorities to translate the vision into a reality and an institutional architecture to follow up on and implement decisions taken at the political level.

One such Circle of Cooperation could comprise of Turkey, Syria, Iraq, Jordan and Lebanon. Such a grouping would focus on water as a resource in a holistic perspective, rather than treating it as an issue of trans-boundary concern to any particular basin. In the future, if and when peace prevails on terms acceptable to all parties, it may expand horizontally in phases to cover other countries in the region. The European institutions, ASEAN, SAARC were all born with limited number of member countries and later on expanded in a gradual fashion.

It is envisaged that the Cooperation Council may undertake the following and similar functions:

- To evolve a consensus on principles of cooperation.

- To create regional protocols, guidelines and practical measures for standardising measurements of quality and quantity of water resources by upgrading gauging stations, developing common approaches to interpret the data collected from equipment pertaining to water flows, climate and relevant environmental indicators.

- To set goals for restoration and long term sustenance of water bodies from an ecological perspective, similar to EU Framework Directives.

- To develop specific means of combating climate change and drought in a collaborative manner.

- To promote research, development and dissemination of environmentally sensitive and energy efficient water related technologies.

- To facilitate negotiation and creation of joint projects at basin or regional level including common early warning and disaster management systems.

- To prepare the ground for integrated water resource management at the basin level.

In order to implement some of the above mentioned functions, it would be necessary to understand the legal frameworks in all participating countries, attempt to streamline legal architecture within countries, and introduce commonalities between countries. This is not to propose a new international law but rather an agreement on certain principles, which can be used as standard parameters by all countries to render their own laws effective. It may be also necessary to undertake either joint or independent assessment of availability of resources, long term supply and demand projections, and needs of consumers in the region. The Cooperation Council may decide on the importance of such tasks and authorise appropriate bodies to implement them. The Cooperation Council may also decide if such tasks are viable in short term or if they would be better addressed in the distant future once the member countries gain experience in working together in easily agreeable issues.

The Cooperation Council as envisaged here should be supported with funds from the member countries, as well as international partners. The quantum and proportion of the contribution by the countries in the region may be determined through mutual agreement. International donors may contribute agreed proportions in the early phase to enable neutrality and independence of the endeavour but there should be an in-built mechanism to reduce their contribution in a gradual manner.

## 2. Integrated Water Resource Management (IWRM) for Small Cross Border Rivers in the Northern Circle (Medium Term):

Once a Cooperation Council for sustainable water management is established and it succeeds in creating common measurement standards and common goals for ecological sustenance of all rivers, the countries sharing specific cross-border rivers can consider advancing their cooperation to the basin level. Several smaller rivers are shared by two or more countries, and are used extensively by all riparians for irrigation purposes and domestic water supply. This results in a strain on water sources due to increased development activity and discharge of untreated wastewater into the river by upstream countries, making downstream use problematic. There is a need for basin wide joint watershed development programmes. Areas for coordination and cooperation, where information is currently lacking are - ground water mapping, wastewater treatment facilities, implementation of modern irrigation methods, joint projects for rain water harvesting and early warning systems.

The inception stage (2-3 years) can create integrated data management systems for the basin, from all the countries involved. This should include a comprehensive and coordinated database considering all socio-economic aspects of water use. Mathematical modelling could be used to evaluate the surface and groundwater resources. An assessment of the situation prevailing in the basin from all sides regarding water use, water quality, and water legislation would need to be carried out.

The development phase (3-5 years) would involve projects on the ground such as introduction of modern irrigation practices and efficient management of water flows and quality.

The institutional phase (beyond 5 years) would involve establishing a joint river basin commission, with representatives of governments and local authorities creating an institutional architecture in the form of an umbrella organisation supported by various joint technical committees for the participating countries to manage the basin jointly.

Some of the rivers for early action in this context could be the El Kebir River between Lebanon and Syria, the Yarmouk River between Syria and Jordan, or the Orontes (Assi) between Lebanon, Syria and Turkey.

Any proposal for integrated basin management should essentially originate jointly from the riparian countries, and not from external actors. The riparian countries may decide to approach international organisations for technical or financial input once they have assessed the available resources with them and identified the gaps in management and technical know-how. For instance, Lebanon and Syria, as well as Jordan and Syria have several bilateral mechanisms for discussing trans-boundary rivers. They can decide at any stage, and particularly once common goals and standards are introduced through a regional institution or entity, to explore the joint management of a shared river basin. Once they have bilaterally conducted preliminary talks and need assessments, they can approach external supporters.

### 3. Cooperation in the Euphrates Tigris Basin (Medium Term):

Once common goals, measurement standards, and gauging equipment are agreed to by all countries in the northern circle, it will be easy for Turkey, Syria and Iraq to introduce measures for basin level cooperation for long term sustenance of the Euphrates Tigris Basin (ET Basin) in a way that protects the interests of the three countries, their future generations and their environment. Once measures have been decided upon, any treaty will have to be ratified by parliaments and formalized by governments in each country. There are several mechanisms for bilateral and trilateral interaction between the three countries. The governments have used these mechanisms for exploring collaborative ideas in principle, reaching agreements of an ad hoc nature, and to build confidence. In the past many of these agreements and decisions have remained only on paper. However, there are three reasons for hope in the future.

First, political relations between the three countries have been improving since 2008 with several cooperation agreements on trade, transit and telecommunications.

Second, there is a growing awareness in the governments and civil societies of all the three countries that the threat of climate change and drought is serious, and combating climate change needs a collaborative approach.

Third, if a Cooperation Council is established for collaborative and sustainable water management, it will provide a politically convenient framework for basin level cooperation.

## 4. De-centralized Water Management in the Palestine Territories (Short Term):

Technology is evolving at an extremely fast pace. Small scale water treatment and desalination plants, including some run by solar power or other alternative fuels, are being developed and introduced in many parts of the world. Some of them can be introduced for the Palestinian Territories, considering the financial and political constraints on operating large plants in these territories. The West Bank currently has one functional wastewater treatment plant (out of 5 plants in total) but this plant, located in Al-Bireh, produces poor quality effluent which cannot be re-used in agriculture.

Decentralized wastewater treatment plants provide small-scale solutions to wastewater management and simultaneously prove to be a source of income for the poorest of the poor. They reduce freshwater consumption, as well as the costs associated with cesspit discharge. Other advantages include savings in freshwater purchase, insecticides and fertilizers. The main cause for concern is that any decentralized system will require a proper regulatory framework and regular maintenance and monitoring to minimise risks. It will be necessary to establish a mechanism to monitor and manage the discharge of sewage, something relatively easier to do for a large plant at one location, rather than several small plants at multiple locations.

## 5. Confidence Building Initiative between Israel and the Palestinian Authority (PA) (Short Term):

There is a fundamental misunderstanding between water experts in Israel and the Palestinian Territories on the data pertaining to the availability of water, withdrawal of water from aquifers by both the parties, functioning of the Joint Water Committee (JWC), water infrastructure and pollution control. The experts from both sides have been presenting conflicting perspectives and information with regards to these issues.

However, some experts from Israel and the Palestinian Territories agree to certain principles in the form of the Geneva Initiative Annexure 2. The Annexure calls for fair management of water resources by equitable participation of both parties in the management process. It is now recommended to build on the Geneva Initiative Annexure, and to move from a non-governmental framework to a formal interaction between heads of the Water Authority of Israel and the PA, along with senior political representatives on both sides. Such an interaction should be authorised by both the Prime Ministers for it to be meaningful. The objective of the interaction should be to have a frank and transparent discussion on differing perspectives, assessment of the real situation on the ground and clarity on the functioning of the JWC. Such an interaction for achieving clarity on major policy issues is to be distinguished from interactions on operational issues that in any case take place under the auspices of the JWC or under a trilateral technical level forum between Israel, PA and the United States which was strengthened to a quarterly meeting in late 2010. The proposed interaction should be observed by the Quartet and other members of the international community and treated as a Confidence Building Initiative.

If the two parties are in agreement on the facts, they may then decide to move to a discussion on the solutions, if and when the official peace process allows them to do so. If the peace process establishes another type of mechanism for addressing the water issue, or upgrades the Israel-PA-US technical forum to a political level, the confidence-building measure proposed here, along with the Geneva Initiative Annexure 2, will provide a sound foundation for the mainstream talks.

## 6. Red-Dead Sea Canal (Long Term):

The Red-Dead Sea Canal (RDC) is a joint Israeli-Palestinian-Jordanian venture that aims to build a 112 mile pipeline from the Red Sea to the Dead Sea. The pipeline will transfer an estimated 1.8-2 BCM of seawater annually. Half of this water is intended to replenish the fast depleting Dead Sea, where the water level is dropping by one metre every year. The other half will be used in a desalination plant constructed at the Dead Sea and will serve as an additional supply of water for all three of the partner countries mentioned above. The desalination plant will use hydro-power generated by the 400 metre drop from the Red Sea to the lowest point on earth. Much information on this project is available in the public domain. While there is an immediate interest in the project by some of the key stakeholders, financial and environmental implications render it to be a medium to long term measure.

Several feasibility studies to assess economic and environmental aspects of the RDC project are underway and should be completed by end of 2011. The World Bank is the co-sponsor and coordinator of the feasibility studies. Other donors include France, Sweden, Japan, Italy, Netherlands, USA, Greece and South Korea.

In September 2009, Jordan announced that it would embark on a unilateral large-scale desalination project without Israel and the Palestinian Territories, as its water problems were worsening. Jordan's National Red Sea Project (JRSP) would bring 70 MCM of water annually to Jordan. The cost for the first stage of the project alone is estimated at $2 billion and Jordan is still in the process of acquiring funding for the first phase. Sometimes analysts fail to distinguish between the RDC Canal and JRSP. These are two separate projects. While the former is proposed to be a trilateral venture, the latter is a Jordanian national endeavour. However, the comparison between the two projects is relevant to the extent that financing difficulties for JRSP indicate potential financial problems for the much more ambitious RDC Canal.

## 7. Joint Desalination Plants (Long Term – All Circles):

Most of the countries covered in this study are exploring the option of desalinated water that will supplement their freshwater supply, but their plans are mostly confined to national plants. Joint desalination projects, owned by two or more countries, will allow for an exchange of information and cooperation; facilitate the process of funding and provide a strong disincentive to the destruction of water infrastructure in times of conflict. Joint ownership of desalination plants makes sense from a financial and technical perspective, but it will encounter political obstacles.

Desalination technology is fast evolving. The present technology is highly energy intensive. There are indications that in a few years new technology driven by solar power or conversion of garbage into energy might be available. Developments in nano-technology may reduce the cost of desalination plants by more than 50 per cent. It would be profitable to investigate development and application of new technologies jointly rather than individually at least within each circle.

National governments alone may not agree to joint plants. Donor agencies should urge the World Bank to convene a meeting of all financing institutions to discuss the manner in which international funding can be made conditional to joint ownership and management of desalination plants in the region to the maximum possible extent, without compromising the technical merit of projects. Since the new energy efficient, low cost desalination plants will depend on external technology and financial assistance, donors can play a constructive role in fostering a collaborative agenda.

## 8. Export of Water of Turkish National Rivers to the Jordan Valley (Long Term – Intersection of Circles):

Turkey and Israel have examined the export of water from the Manavgat River in Turkey to Israel. Separate pipelines and receiving stations have already been built from the river to the coast where the water can then be loaded onto tankers, ready for export. An alternative option to the tankers could also be to build a low lying underwater pipeline, since the average depth of the Mediterranean Sea is only 1500 metres.

In January 2004, an agreement in principle was signed for Israel to purchase 50 MCM of water annually for 20 years from the Manavgat River; however the deal fell through due to disagreements on the cost of water and transportation.

Until the Gaza crisis of December 2008, Turkey and Israel enjoyed cordial relations when an agreement of this nature was possible. However, since then relations between the two countries have been strained and much worsened following a conflict over a Turkish humanitarian aid shipment to Gaza in June 2010. It is possible to envisage an improvement in the relationship which would make discussion on the export of Turkish national water to Israel possible sometime in the future. However, any substantial amount of export would attract media attention. The Turkish public opinion, despite improvements in the relationship in future, may not allow the export, unless Israel agrees to enter into a fair water sharing agreement with the Palestinian Authority and Jordan.

Also, a scientific feasibility study needs to be undertaken that will examine the approximate availability of water for export from the Seyhan-Ceyhan, Manavgat and other national rivers beyond 2020. This study would have to take into account growing demand, climate change, snow melt, and cost of the water if water stations are to be built. The study should particularly examine water budget of national rivers in the lean season. The water discharge in the nine lean months from June to February almost equals the water discharge in three wet months from March to May. Therefore, it would be necessary to determine if the water discharge in the winter months (especially around December-February) would be sufficient to enable Turkey to export water, whereas there may not be much problem in the wet months. The study will need to examine the best method and route for transport of water from Turkey to the Jordan Valley countries. The feasibility study could be conducted by the State Hydraulic Works (DSI) in Turkey with technical support from external experts.

## 9. Lake Kinneret (Tiberias) as Regional Commons (Long Term – Intersection of Circles):

Israel occupied the Golan Heights in Syria in the 1967 war. In the last several years, there have been many secret talks between Israel and Syria to normalise relations. There have been near agreements but they have always floundered on the issue of control of Lake Kinneret (Tiberias). In order to break the deadlock, it would be essential to declare Lake Kinneret (Tiberias) and connected water bodies as Regional Commons, to be governed jointly by Israel and Syria with the objective of long term preservation of water resources and environment. It would be unrealistic to expect that Israel will voluntarily withdraw from Syria. It would be equally unrealistic to expect that Syria would normalise relations with Israel unless and until Israel frees the shoreline of the Lake Kinneret (Tiberias) on the Syrian side. The status quo is bound to lead to gradual depletion of water resources and with it, prospects for peace and stability. Alternatively, joint management of water resources and environment should be introduced so that neither side has to give up its core interests and both sides compromise in the interest of their future generations and environment. The international community can support such an agreement with diplomatic support and financial and technical input.

Declaration of the water bodies as Regional Commons would involve introducing goals for restoration and sustenance of water bodies within a certain time frame, with agreed responsibilities for all parties. This is an ambitious political task for both sides. However, both Israel and Syria have attempted exploring a compromise on many occasions.

There is a latent political will on both sides, though the current political climate is not ready to accept such a concept. This study proposes that instead of waiting for the correct political moment, it would be ideal to create a network of experts and prepare a set of policy recommendations which can be presented at the political level at an opportune moment. The network of experts at a high level with informal endorsement by the policy makers, can also prepare alternative master plans and a menu of solutions.

There will be legal and political difficulties for Syrian and Israeli nationals to engage in dialogue even of an academic nature. However, if the authorities see a merit in expert-level exploration, Syrians resident overseas can engage with Israeli experts. This method has been used in the past. Therefore, empirical evidence suggests that methodology is not a problem, if there is sufficient political will.

Creating such a network may not serve any immediate purpose. However, it will help save time when a political opportunity arises. When the parties are ready to make peace, intellectual infrastructure in the form of plans and trajectories will be ready and available to policy makers. It is a question of harnessing political will at the opportune time to transform it into an opportunity for the people and ecology of the region.

### 10. Demand Management (Short Term - All Circles):

Most countries in the Middle East have some of the highest population growth rates in the world. Growing population combined with an increased standard of living will lead to a growing demand for water. Hence there is a need to put in place measures that will mitigate or control some of this growing water demand.

Some of the measures included in this paper are:

- Modernization of irrigation methods including drip irrigation, changing cropping patterns and the use of treated wastewater.
- Better and more efficient water infrastructure to reduce water losses through pipe leakages.
- Measures to reduce water pollution by the industrial and urban sectors.
- Implementation of a tariff structure in the domestic sector.
- Comprehensive and total retro-fitting of water infrastructure.

This is not an exhaustive list and further measures are included in the paper. Demand management measures can reduce total demand substantially and can make a huge difference to future water deficit, water pollution and water conservation efforts.

## Conclusion:

The recommendations made above are presented in sequential order in each Circle of Cooperation. Recommendations 1 to 3 are for the Northern Circle, respectively short and medium term. Recommendations 4 and 5 are for the Israel-Palestine-Jordan Circle, for the short term. Recommendations

6 to 9 are for within circles or for the intersection of circles and viable only in the long term, though feasibility studies and track two dialogues can be initiated in the short term. Recommendation 10 is for all circles and can be implemented in the short term.

A gradual implementation of most or all recommendations will help create a virtuous cycle of peace and cooperation. Several of the recommendations depend on the political will of the parties in the region.

This study looks at the future assuming the numerous ways in which political equations prevailing in 2011 can change, and therefore proposes solutions on a number of different hypotheses. While short term solutions will depend on the current political and environmental dynamics, medium term and long term solutions are crafted taking into account possibilities that may seem impossible today. Only 15 years ago, in the aftermath of the Oslo Accords and half a decade before the emergence of Al Qaeda, the kind of relations that existed in the Middle East, as well as between some of the states in the region with important external players were significantly different from the nature of these relations at present. Indeed relations between some of the countries in the broader region have undergone fundamental changes in a matter of last two years. It would be naïve to assume that the political dynamics of 2011 will remain static until 2016 or 2021. Climatic factors are also prone to changes, sometimes much faster than expected. Therefore, consideration of solutions to water security, which depends on ever changing politics and climate, should consider the realities of 2011 as those that may or may not prevail in the next decade. It would be therefore useful to consider strategies that are not trapped in the existing political and environmental prism. The leaders who have the vision to design options that are not confined to the present realities often tend to influence the future of their societies. Such leaders are known as statesmen. If the Middle East addresses its statesmanship deficit, it will automatically solve the problem of water and peace deficit.

## Recommendations

| Short Term<br>Intra Circle | Medium Term<br>Intra Circle | Long Term<br>Intra Circle | Long Term<br>Inter Circle |
|---|---|---|---|
| Cooperation Council in the Northern Circle | Integrated River Basin Management in the Northern Circle | Joint Desalination Plants | Turkish National Water for Jordan Valley |
| Decentralised Water Management in the Palestine Territories | Cooperation in Euphrates-Tigris Basin | Red-Dead Sea Canal | Lake Kinneret (Tiberias) as Regional Commons |
| Confidence Building Initiatives between Israel and the PA | | | |
| Demand Management | | | |

# OVERVIEW

## Introduction

This study examines future water security in the Middle East – Israel, the Palestinian Territories (PT), Jordan, Lebanon, Syria, Iraq and Turkey. The Middle East is the most water scarce region in the world. With rivers, lakes and groundwater shared across borders, countries in the Middle East are bound by a common problem that in turn will require a common solution.

The underlying philosophy of this study is that water should be treated as an instrument of socio-economic development, cooperation and peace. It recognises the importance of water in both national and trans-boundary contexts. It emphasises that the problem of water security requires a combination of solutions including some of a technical nature and some of political nature. Part I proposes principles and methods of achieving water security. Part II provides long term scenarios for each country. The choice of a country, rather than a river basin or aquifer as the unit of analysis was made for practical reasons of availability of data and also because of the political reality in 2011, that the State is the main organ of society and any decisions pertaining to a shared river basin or aquifer would have to be taken by the representatives of the concerned states.

While the region faces many similar problems, there are several differences that have been highlighted during the course of the study. The main supply of freshwater in the northern countries of Turkey, Lebanon, Syria and Iraq are surface water bodies, while the main supply in the southern countries of Jordan, the Palestinian Territories and Israel are groundwater resources. The supply of water also varies on a seasonal basis with some countries experiencing high rainfall in the winter months, and others in summer months. Thus, any supply-demand situation needs to be considered on a seasonal basis and not on an annual basis. Most technical studies have made their calculations on an annual basis and have proposed solutions based on these statistics. This is very misguiding for policy makers. The solutions proposed in this study take into account the underlying importance of seasonal variations of supply and internal requirements of the countries.

Transboundary waters connect two or more countries together. The Jordan River is shared by five riparians – Lebanon, Syria, Israel, Jordan and the PT. Parts of the Jordan River also weave an intricate web of conflict and cooperation amongst the various parties in the region. Lake Kinneret or Tiberias for instance offers several connections to both the Upper and Lower Jordan River states. Syria and Israel are involved in a dispute over the Golan Heights and this area can have an effect on both the flow and the security of Lake Kinneret (Tiberias). In the Upper Jordan River, Israel and Lebanon have had a long standing dispute over the Hasbani River. The Jordanians, Israelis and the Palestinians on the other hand are concerned about the amount of water released from Lake Kinneret (Tiberias) and the effect that this can have on the flow of the Lower Jordan River. Water agreements between Syria and Israel will have an impact on the overall supply to the lake, and in turn the fate of the lake will determine the water situation in the lower riparian territories of Jordan and the West Bank.

The flow of the Yarmouk River, the largest tributary of the Jordan River, illustrates the complex relationship between Israel and its Arab neighbours. Efforts by Syria to increase the current flow of the Yarmouk can result in better relations with Jordan, but this could also mean more water for Israel once the Yarmouk joins the Lower Jordan River. As a consequence, the fate of the Yarmouk River is determined not only by agreements between Syria and Jordan, but also by Syria's relations with Israel and its willingness to share water with Israel.

Moreover, transboundary water issues exist not only between Israel and its Arab neighbours but also between Arab countries. The Yarmouk River which is shared by Syria and Jordan has been an issue of contention, over the amount of water allocated to them and the amount that is actually being extracted for use. Over extraction on either side not only affects the availability of water and violates previous agreements, but it also affects the flow of water down the Jordan River and the quality of the Dead Sea.

The Disi Aquifer located across the border of Jordan and Saudi Arabia is another water source whose fate determines relations between at least two countries, maybe more. The fossil aquifer has a fixed yield and cannot be replenished. With Jordan's growing water crisis and its insatiable need for potable water, Saudi Arabia has expressed its concern for the safety of this joint water resource. If Jordan is unable to secure its supply of water from proposed projects, one of which is the Red-Dead Sea canal, the chances of overuse in the Disi Aquifer increases.

Water bodies flow between Arab countries and other states as well. Water sharing agreements over the Euphrates River have long been an issue of contention between Turkey, Syria and Iraq. Turkey does not recognise the Euphrates as an international river until it reaches the Iraq-Iran border as this is the only time that the river actually forms a border between two adjoining nations. However, Turkey recognises Euphrates and Tigris as trans-boundary rivers. This viewpoint is not shared by the two lower riparians of the Euphrates, Syria and Iraq, and has been the cause of decades of disagreement. While several bilateral and fewer trilateral meetings have been conducted, no formal agreements have been reached. Turkey's critics argue that its South-Eastern Anatolia Project (GAP) would decrease the flow of water running from Turkey to Syria, and this in turn would have a direct impact on water agreements between Syria and Iraq over the Euphrates.

There is also tension between Iraq and Iran over the Tigris River and its tributaries. Most of the larger tributaries that feed the Tigris in Iraq originate in Iran. Iranian development projects in the future could further reduce the flow of these tributaries and in turn change the course of Iraq's future water plans - both internal as well as international. In addition, salt-water intrusion in the Shatt Al-Arab could prove crippling for both Iraq and Iran in the future. On the other hand, Iran could take a decision to supply extra water to Iraq and even Jordan purely for political consideration. Iran is already in discussion with some of the smaller Gulf States for the export of Iranian water to them.

Transboundary water issues will take a serious turn when water supplies dwindle and populations multiply. Water has the potential to become both the cause of conflict - such as the disagreement over the Jordan headwaters before the 1967 war - as well as the effect of conflict - such as the destruction of water infrastructure during the 2006 Israel-Hezbollah war. On the other hand, water is also closely linked with the peace process and can be an instrument of cooperation - for instance the Johnston Plan of 1955 - and a consequence of cooperation between nations - such as the Wadi Araba accord between Israel and Jordan in 1994.

Having underscored the regional nature of water problems in the Middle East, it is also important to acknowledge that all of the countries covered by this study potentially face the problem of social unrest as a consequence of water shortage. In order for a regional outlook towards water to succeed, it is important to address water problems at the national level as well.

Internal migration of people from water deficit areas to relatively water stable areas can cause social friction and administrative challenges. In Iraq, the debilitating drought has further damaged the Iraqi marshlands and left close to a million Iraqis without adequate subsistence, thereby forcing them to leave in search of employment, worsening the internal refugee situation in Iraq. The Iraqi refugee situation has also put a strain on the internal water resource management in Syria, Jordan and to some extent Lebanon with roughly one million, 500,000 and 40,000 refugees respectively.

Deteriorating health conditions due to poor water quality can cause water-borne diseases and increase human fatality. Sanitation conditions in the Palestinian Territories are very poor with only around 45 per cent of the population connected to the sewerage network. Gaza water is contaminated with pollutants where only 5-10 per cent of the water is considered suitable for drinking.[1]

Fluctuations or inflation in the price of water due to scarcity can put severe pressure on low-income groups, especially in poorer societies, and encourage illegal activities and mismanagement of water supplies. Unmonitored pumping has reduced groundwater levels and the quality of freshwater in Lebanon, Syria and the PT. Illegal pumping also makes accurate assessments and adequate water-planning for the future extremely difficult.

Tackling the problem of water shortage at the national level, involves internal as well as bilateral or multilateral measures that can improve both demand and management. Water autarky or unilateral utilization of water sources does not offer a long-term sustainable solution.

Apart from regional and national concerns it is also important to consider the future of the environment and the ecological systems around these resources. Climactic changes and prolonged periods of drought affect the entire region. Many countries in this study are extracting more freshwater than is sustainable, which is leading to the desiccation of rivers, lakes, groundwater and other natural water features. Almost 90 per cent of the lower Jordan River is diverted by Israeli, Syrian and Jordanian dams and development projects. The historical Dead Sea is shrinking by more than one metre every year due to a lack of water supply and could be reduced to a lake 20 years from now. The Iraqi marshlands, home to a unique variety of animal and plant species, have been severely affected by development projects instituted by the late Saddam Hussein and have shrunk considerably since the 1980s. Wastage, inefficient use and pollution of water resources is leading to severe environmental degradation in the Middle East and if measures are not taken immediately, this will change the very constitution and ecological landscape of the region in the future.

While examining the issue of water and areas for potential cooperation it is imperative to emphasize the importance of time. The prospects for solutions get weaker every year due to rapidly dwindling water resources. These resources are extremely susceptible to demand increases that come naturally with a rapidly increasing population, damage from over-pumping, pollution and the effects of climate change. A golden opportunity was missed 20 years ago, when a plan proposed by the late Turkish President Ozal offering Turkish national water to the rest of the region was rejected. In the late 1980s, a surplus of 16 BCM was available in the Turkish Seyhan-Ceyhan basin; today that same amount is no longer available. The water in this region has dwindled as Turkey has several development projects and national concerns which have arisen over the years and it is currently being wooed by requests for freshwater from other

Mediterranean and North African countries as well. This aborted plan stands as an example of missed opportunities. Every year we lose precious resources and golden opportunities, and with a diminishing availability of freshwater and growing conflicting interests, water cooperation is up against a battle with time.

## Present and Future Water Balance

The country analysis in Part II provides an overview of likely water balance over the coming decades, based on alternative scenarios. While some drivers of change, such as an increase in demand driven by population increase and economic growth are common, some drivers are unique to each country. These include both positive and negative factors including extraordinary technological breakthroughs, success in mitigating wastage of water, military occupation, war and drought. Over extraction of groundwater resources, drought and pollution can create a chronic deficit. The future balances are calculated based on a country's ability to effectively harness and manage their existing water availability, the production of marginal water, and assumptions based on future changes in geo-politics in the region.

The key issues for the future vary from one country to another. If Israel receives adequate rain, is able to manage demand and achieves all goals set for marginal water in the next 10 years, it will not face a deficit in 2020 in spite of a growing population and scarce freshwater resources, and could potentially have a small surplus. If however, Israel suffers another severe drought period or cedes freshwater resources to an independent Palestinian state, it may face a marginal or severe deficit. Israel's strategy of ensuring water security for its 8.3 million people in 2020 is dependant on efficient demand management and creation of wastewater and desalinated water on a large scale. This assumes massive energy consumption and financial investments. It also ignores the risk of drought and climate change. Since in reality Israel has been facing recurring drought, the most realistic scenario is that it will experience a marginal surplus or a marginal deficit, with low per capita consumption.

In the case of the Palestinian Territories, efficient demand management, capacity creation in marginal water and independence from Israel will alleviate the degree of deficit but at a low level of per capita

Fig A: Current Water Balance by Country 2010 (MCM/year)

| | Total Renewable Fresh Water | Fresh Water Used | Marginal Water | Total Supply | Demand | Range of Deficit/ Surplus |
|---|---|---|---|---|---|---|
| **Israel** | 1,300 | 1,300 | 835 | 2135 | 2100 | +35 |
| **PT** | 249.5 | 249.5 | 28.2 | 277.7 | 488 | -210 |
| **Jordan** | 550 | 550 | 249 | 799 | 1496 | -697 |
| **Lebanon** | 2,550 | 1,300 | - | 1,300 | 1343 | -43 |
| **Syria** | 17,000 | 17,000 | 550 | 17,550 | 19,000 | -1,450 |
| **Iraq** | 57,000 | 57,000 | - | 57,000 | 55,000 | +2,000 |
| **Turkey** | 112,000 | 44,800 | 2,200 | 47,000 | 46,000 | +1,000 |

*Source: Country Reports in Part II*

consumption below 100 cubic metres.

Jordan, like Israel, plans to meet its water security challenge through efficient demand management and strategic projects in desalination. As its freshwater sources are declining, it will experience a deficit of over 500 MCM in 2020, which will reduce by 2030 once the Red-Dead Sea Canal is operational. However, climate change and drought can upset the present estimates.

Though Lebanon has abundant rainfall and sufficient freshwater at present. It can reduce the risk of deficit with capacity creation and efficiency in storage, conveyance system and demand management.

Syria is facing a serious problem of reduction in its available water resources due to climate change, variations in precipitation levels, pollution and related factors. Syria plans to develop additional water capabilities, utilise available storage facilities as well as introduce demand management policies and curb excessive utilization. The implementation of this strategy is difficult to assess due to secrecy regarding data on water resources.

Years of war have destroyed Iraq's water infrastructure, transportation systems and storage facilities. The country, with the aid of international agencies has begun improving these facilities, as well as investing in marginal water projects and demand management, and slowly increasing the amount of water provided to all sectors. Iraq is facing a problem of decrease in availability in the future, much like Jordan and Syria, due to climate change, environmental degradation, pollution and inefficiency. However it must be considered that if all plans for modernization succeed and demand management policies are put into place, Iraq could have a surplus of water. It is difficult to estimate by when this might occur, and by how much.

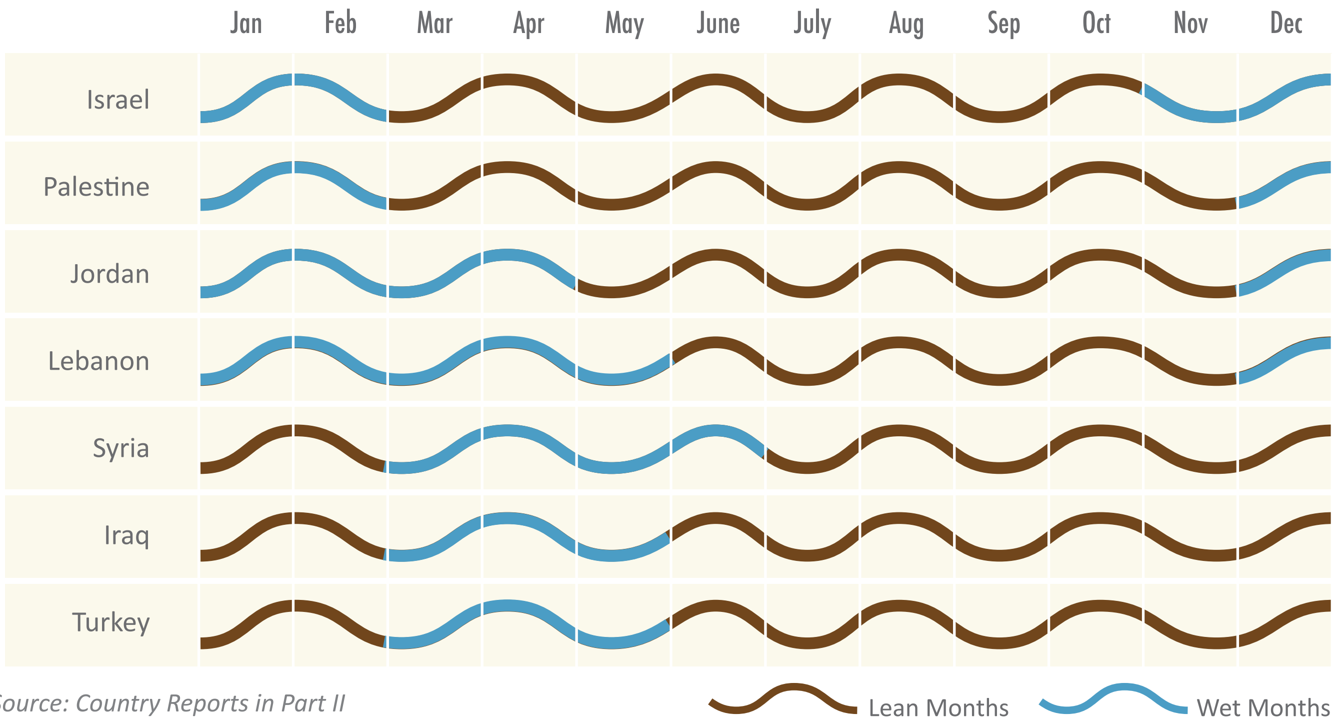
Turkey has extremely ambitious plans to ensure that adequate water is supplied to all sectors by 2023. The positive balance for 2020 is currently calculated on a utilization rate of 50 per cent, which is more than the projected demand. If the government plans of tapping into and harnessing all available freshwater, improving and increasing storage facilities, introducing proper methods of demand management and increasing agricultural efficiency to utilize less water succeed, there will be a greater positive balance in the future. The availability could be lower in the future due to an increase in population, as well as a possibility of more water being released down the Euphrates/Tigris Rivers to Iraq and Syria, either on an ad-hoc basis or on a permanent basis in the event of an agreement. After tending to its national requirements, Turkey will have some surplus to explore the possibilities of exporting water.

Thus, all countries covered by this study can shift from the present situation of declining water resources to a scenario of adequate resources with efficient demand and supply management, storage, creation of wastewater treatment and desalination capacity and goal-oriented sustainable management of watercourses, including restoration of depleting courses where possible. Such a prospect depends on the hope that climate change and drought would not deliver huge shocks on countries cooperating with each other to develop common approaches and cooperation for optimum utilisation of water. This in turn requires a new mindset that treats water as an opportunity for socio-economic development and international cooperation rather than as a threat. Rethinking water in the Middle East is a challenge, but one with prospects of highly beneficial rewards.

## Seasonal Variations

Conventional estimates of water flows are made on the basis of an annual average in an average year. In

Fig B: Seasonal Variations – Lean Months and Wet Months




*Source: Country Reports in Part II*

reality, there are wet and dry years. There are also seasonal variations within a year. Most rivers in Turkey experience 50 per cent of their discharge in three or four wet months and the remaining 50 per cent in eight or nine lean months. Thus, average monthly flow of a river in some of the leanest months can be 3-5 per cent of the annual flow. In Syria, Lebanon and Iraq, the ratio is often 30:70 for lean and wet months. In other words, six or seven lean months have only 30 per cent of the annual flow and the leanest months can have only 3-5 per cent per month of the annual flow. The situation in Jordan, also affecting Israel and the Palestinian Territories, is the worst. The lean period flow of Lower Jordan River is less than 10 per cent of the annual flow or monthly 1-3 per cent of the annual average in some of the leanest months. The river almost does not exist for almost six out of 12 months of a year. The average flow in the leanest month can be only 1 MCM per month.

In Israel and the Palestine Territories, wet and dry months vary between the north and south considerably. The north has four wet months during the winter season with up to 950 mm of rainfall annually, while the Negev Desert in the south receives hardly any water in the winter with 25 mm of measured rainfall throughout the year. The winter rainfall months start mid-December and end around mid-March, giving three months of rainfall.

On an average Jordan experiences five wet months and seven lean months in a year. However, certain rivers like the Yarmouk (when measured at the lower point - Adasiya) and the Zarqa experience nine lean months.

Figure B only includes major rivers like the Litani and the Orontes in Lebanon, and does not take into account discharge of smaller rivers.

In case of Syria, information mainly derived from the Euphrates flow measured at Tabqa station. In case of

Iraq, information is derived from the Euphrates flow measured at Mosul Station. Both Syria and Iraq are large countries and the situation may vary from one part of the country to another.

On an average, Turkey experiences four wet months and eight lean months. Rivers like the Euphrates in Turkey represent this in their flow. However, the Ceyhan River experiences three wet months only and only two wet months at the Misis Kopru Station.

For Israel and Palestine, lean and wet months are measured by rainfall since most of the water resources are groundwater reserves. For the rest of the countries, lean and wet months are indicated after observing the seasonal flows of major rivers. The average flow of most rivers declines by 30-50 per cent in an average drought year as compared to an average wet year. With drought or at least dry years being a frequent phenomenon, the crisis facing the region by 2020 will be much more serious than reflected in much of the published analysis. The actual flow in the lean period in dry year can be about 25 per cent or less of the annual flow in a wet year.

Any strategy for water security must take into account lean season flows in lean years. Using average or wet year annual statistics can be a successful propaganda strategy, good for short term politics, but not very helpful for effective water management policies in the long term. There is no doubt that rethinking water holds promise, but it must take into account the harsh realities of challenging periods in the most difficult years.

# PART I

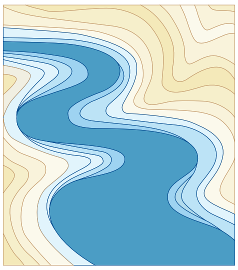
## Objectives and Strategies

# 1 Objectives – Why Water, Why Now?

Declining water availability in almost all countries in the seven countries covered by the scope of this study underlines the urgency of rethinking Middle East water. While it is generally agreed that water security needs to be improved across the region, it is necessary to define specific objectives so that goals can be set and strategies can be formulated.

The objectives in this report indicate priorities, and not the totality of the water scenario in the Middle East. It can be rationally argued that many more objectives could be pursued. However, political energy and financial resources available to pursue any set of goals are limited anywhere in the world. It is therefore essential to focus on certain priorities, while recognising that others may perceive some other objectives to be of greater importance.





# 1. Sustenance and Replenishment of Rivers

Several of the main rivers that run their course through various countries under study are experiencing a drop in flow levels, as well as an increased risk of pollution. An important goal of any rethinking process has to be to replenish and sustain watercourses.

The Jordan River is expected to be affected to a great extent and may shrink by almost 80 per cent by the end of the century, as per a climate change study by the International Institute for Sustainable Development (IISD)[2]. Since nobody can predict the future, whether the river loses 80 per cent of its flow by 2100 or somewhat less or more or somewhat earlier or later is a matter of detail. Technical experts can debate it as long as they wish but it does not change the basic reality that the river is facing grave threat today, as well as tomorrow. The Jordan River feeds Jordan, Israel, the West Bank and Syria to some extent. Precipitation in the Jordan River Valley ranges from less than 50 mm/year in the south near the Red Sea, to almost 600 mm/year in the northern highlands of the West Bank. The IISD report quotes climate change as one of the main factors for the dramatic decrease in the content of the Jordan River. However, excessive use of this river is another cause for the extreme dip in its annual flow.

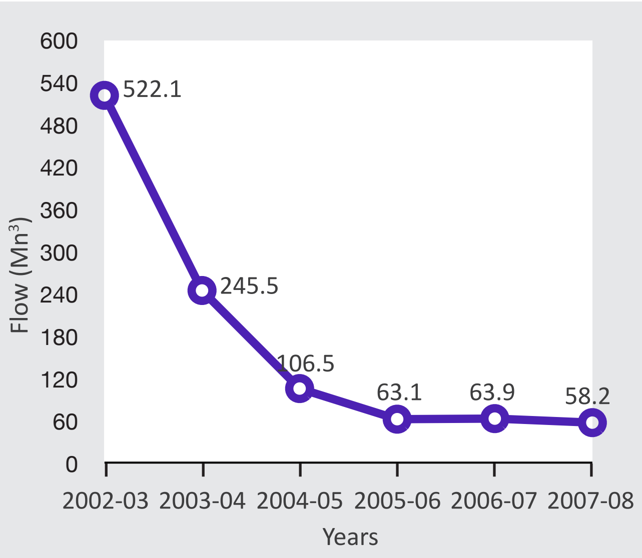
Several of the important tributaries that supply the Jordan River are located in Syria, Israel, Jordan and Lebanon. Excessive dam building and commercial activity on the Jordan River, Yarmouk River and Zarqa River have severely depleted the amount of water flowing in both tributaries feeding the Jordan River, as well as the main river itself. In addition, due to the increased height of the gate at the south of Lake Kinneret (Tiberias), most of the water flow from the Upper Jordan River to the Lower Jordan River has been blocked. In the 1960s, the flow of the Jordan River at the Dead Sea was measured at 1,300 MCM/year; today the flow at the Dead Sea measures about 100-200 MCM in a wet year and much less in dry years. In the lean period, it is barely 10-20 MCM over half the year. This means that there is virtually no inflow into the Dead Sea for a large part of the year. Any decrease in flow due to excessive use or pollution adversely affects the livelihood of millions of people who depend on the river for sustenance. The over extraction has also resulted in increased salinity, and most of the water in the lower reaches of the Lower Jordan River is extremely brackish and cannot be used, even for irrigation.

The decrease in outflow is not only affecting communities that live along the lower banks of the river, but it is also proving environmentally disastrous for the Dead Sea and its surrounding ecology. An 80 or even 40 per cent further reduction in this supply will prove unsustainable for its future, and will turn the Jordan River into a completely dry belt for almost half of year. Since the flow in the dry season is barely 10-20 per cent of the annual flow, there will no water at all for most of the year and this will happen much before the end of the century.

The Zarqa River is extensively used to meet the demand in one of the most densely populated areas in Jordan. The river is controlled by the King Talal Dam and feeds the KAC (King Abdullah Canal) along with the Yarmouk. Withdrawals from the Zarqa-Amman groundwater basin have reduced base flows in this river to such an extent that most of its summer flow comprises of mainly treated wastewater, as opposed to freshwater. The Zarqa Governorate houses 52 per cent of Jordan's industrial plants and is an area of environmental concern for the country.

The Yarmouk River, which originates at the border of Jordan and Syria, has a number of dams and development projects along its banks, and its mean annual flow into the Jordan River is considerably less than the stipulated amount. Experts in Jordan argue that Syria has constructed anywhere between 27-42 medium size dams along the upper Yarmouk, which have a combined capacity of 250 MCM of water, but it is unclear whether Syria is extracting enough water to fill all the dams to their full capacity. Moreover, the Jordanian and Syrian sources present conflicting estimates of the number of dams on the Syrian side. However, there is no disagreement over the fact that the river discharge is on decline. Figure 1-a indicates the steep decline in annual flow of the Yarmouk River since 2002.

Fig 1-a: Flow of the Yarmouk River




*Source: Eng. Zafer Alem*

In Iraq, the Tigris River is fed by several tributaries, which contribute a little over 32 BCM to the total availability of the river. Of these tributaries, the Lesser Zab and the Diyala are two major rivers which originate in Iran and supply Iraq with over 10 BCM annually of fresh water. The Diyala River and the surrounding valley located between Baghdad and Mosul is an extremely fertile region. With recent dam and industrial development in Iran, the Diyala is a potential source of tension between these two countries.

The main problem faced by the Tigris River in Iraq is one of acute pollution, especially when it flows through Baghdad. The quality of the Tigris River water is very good at the Turkish/Iraqi border line with salinity levels less than 350 ppm, and starts to deteriorate gradually southward where the salinity rises to exceed the level of 2500 ppm. The main deterioration starts from the junction point of where the Diyala meets the Tigris, and is due to the input of untreated highly chemical water flowing in from the main sewage treatment plants which serve Baghdad. Pollution in the river is caused by all sectors – agricultural, industrial and municipal. There are a number of large pumping stations along the Tigris near Baghdad that discharge drainage water from agricultural areas directly into the river. There are also a number of sewage pipes connected to the storm drainage network discharging directly into the main river. The condition of the Euphrates appears to be fairly good, though the southern part of this river in Iraq is unfit for consumption, with salinity of over 3000 ppm.

There are also some old drains crossing heavily polluted areas, carrying all kinds of effluents directly into the rivers and private waste disposal agencies that unload sewage from houses into the main river, the Tigris. Baghdad has a rapidly developing industrial sector which adds to the level of pollution in the river. Certain measures have been taken to study the problem in depth and limit the effects, but pollution in the Tigris River still remains a major impediment to freshwater availability in Iraq. The long term flows of Tigris and Euphrates is declining on account of natural as well as man-made factors. According to IISD, the Euphrates River may shrink by 30 per cent by 2100 on account of climate change only.

Both the Tigris and Euphrates Rivers join together 57 km above Basra city, to form the 180 km long Shatt Al-Arab water way which has a catchment area of about 35200 km$^2$. Its most important tributary is the

Karon River from Iran. The total volume which used to flow into the Shatt was about 35 BCM, including 14 BCM from the Karon River. Today the volume of water flowing into this delta is much less due to a decrease in volume of the Tigris, Euphrates and Karon River. The Shatt Al-Arab is the only major navigable waterway in Iraq and as it is shared with Iran, has substantial bilateral implications.

There are indications that the decrease in flow has led to the salt water from the Persian Gulf to seep into the Delta, mixing with freshwater. The water in the Shatt Al-Arab area is extremely saline with chlorine levels of over 600 ppm, when levels over 250 ppm are considered unsuitable for drinking, but may be used for other purposes. While there is no major cause for concern at present, in the future with a 30 per cent reduction in freshwater flowing down the rivers to the Shatt Al-Arab, the salinity levels will rise rendering the water completely unfit for consumption, and changing the nature of the delta.

Analysis of the conditions of the water resources in the Barada Basin indicates severe shortage facing the city of Damascus in the future. Frequent droughts during the past twenty years, over-pumping from the wells and the wide spread pollution have caused a sharp drop in the quality and quantity of groundwater. Since 2000, available water resources were insufficient to meet the domestic water demand for the Damascus area and much less for irrigation. The Barada River almost dried up during this period which led to further over-pumping from underground water resources at a depth of 100 metres. The remaining water needs were met by the Fijeh spring, but this source also began drying up due to excessive use. After successive wet seasons in the early 2000s, the Barada River began flowing at full capacity, till the 2007-08 drought which once again had an adverse impact on the flow of water. Monitoring the quality and quantity of groundwater resources in the Barada and Awaj basin has indicated increasing deterioration. It has been observed that that there is a contamination of nitrates, nitrites and sulphates, in addition to a high concentration of dissolved salts. This may be attributed to the excessive use of fertilizers, irrigation with sewage water, septic tanks which are inadequately sealed, and the lack of observing a reservation distance around the wells.

A drastic drop in water levels in Lake Kinneret (Tiberias), especially during drought years has been a major concern for Israel. After the 1998-2001 drought, the water level in the lake dropped to 214 metres below sea level - two metres below the demarcated 'Lower' Red Line. Such a line indicates a level below which the environmental equilibrium of a water body is disrupted. (At this level the concentration of pollutants rises to undesirable levels). During the 2005-2008 drought, the water level once again dropped a further 0.05 metres to -214.05 metres. In recent years Israel has demarcated a Black Line. If the water level reaches this line during future years of drought, the lake is not only exposed to the harmful effects of pollution but the pumps will no longer be able to transmit water to the National Water Carrier. Salinity of Lake Kinneret (Tiberias) is also a major concern for Israel. The levels of salinity in the lake fluctuate dramatically.[3] The water from the lake is transported to the centre and the south of Israel for irrigation. A high level of salts deposited on the ground could reduce the productivity of the soil and increase the salinity of the local groundwater aquifers in these areas. The lake constitutes roughly 40 per cent of Israel's total freshwater supply. It is therefore imperative to keep the salinity of the lake as low as possible. This includes maintaining a limit on over-pumping water from the lake.

The depletion of major water sources in almost every country is already taking place. It is expected to get worse in the next few decades. It is therefore important to introduce measures that will monitor and control excessive use of these freshwater resources, introduce regulation to restrain dumping of domestic, industrial and agricultural waste and prepare for potential climatic risks in the future. While it is important to increase freshwater supply, it is equally important to put in place measures that sustain the existing rivers and basins. Saving rivers and lakes must be a top priority at the national and regional level.

## 2. Saving Groundwater Aquifers

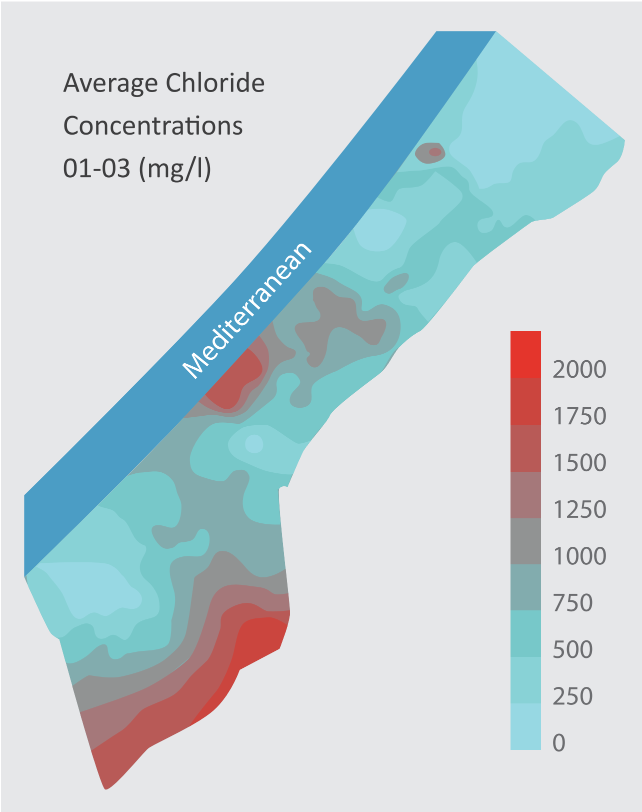
It is not only surface water sources which face the risk of depletion. Groundwater is also threatened significantly. Groundwater aquifers constitute 33 per cent of total freshwater resources in Jordan, 60 per cent of freshwater resources in Israel and 100 per cent of freshwater resources in the Palestinian Territories. Although the overall contribution of groundwater to total freshwater resources in Syria and Lebanon is relatively much smaller, these sources are significant and will be more so in the future.

The Coastal Aquifer shared by Israel and the Gaza was once the main source of drinking water in the country but industrial activities, urban development and the use of chemical fertilizers along the aquifer's surface have resulted in contamination of the groundwater. Situated on the western coast of the country, overlooking the Mediterranean, the Coastal Aquifer was one of the first areas in Israel to experience rapid development. As a majority of Israel's main cities, ports and population centres are located on the surface of this aquifer, it has already experienced the effects of over-pumping, salt-water intrusion and pollution.

The total median recharge from rainfall for the last 15 years has been 221 MCM per year for the Coastal Aquifer. However, in reality, in many years the recharge is much less because of poor rains and over-pumping. Excessive pumping of the Coastal Aquifer has increased the potency of pollutants, and if not controlled immediately, over-pumping will lead to salt water intrusion from the Mediterranean coast. Excessive level of salts in the water can render all of Gaza's Coastal Aquifer water 'unsuitable for drinking' in the near future.

The Palestinian and Israeli experts accuse the other side of excessive pumping from the Mountain Aquifer. The *karstic*[4] nature of the Mountain Aquifer combined with over-pumping will increase its susceptibility to pollutants in the future. There are indications that over-pumping has led to an irreversible drop in aquifer levels in the West Bank, as reflected in the drying of several wells though reliable numbers of such wells for 2010 could not be obtained.

Fig 1-b: Chloride Concentration in the Gaza Coastal Aquifer




*Source: Dr. Yousef Mayla and Dr. Eilon Adar*

Inadequate waste management will also increase the chances of contamination in the Mountain Aquifer. There are a high number of open waste areas currently in the West Bank and efforts in wastewater treatment are extremely underdeveloped. According to Friends of the Earth Middle East (FoEME) a serious risk is posed to the quality of the aquifer by 40 per cent of waste produced in the West Bank for which there is no planned or funded solution. The waste originating in the governorates of Tulkarem, Nablus, Qalqiliya, Salfit and Hebron, could seep into the porous layers of the Mountain Aquifer and prove extremely harmful to future clean water supplies for both Israelis and Palestinians. Hence, efforts to increase wastewater treatment in the West Bank and adequate waste management are essential to save the quality of the water in the aquifer and future water availability.

In Jordan, groundwater resources are distributed among 12 major basins, ten of which are renewable groundwater aquifers and two, located in the southeast, are fossil aquifers which are renewable only after several hundred years. At present, most of these groundwater resources are exploited to maximum capacity. Out of the 12 groundwater basins, six are being over exploited, four are balanced and only two are under exploited. Jordan's Disi fossil aquifer, which it shares with Saudi Arabia, has raised a fair amount of concern in recent years. The Disi Aquifer has a fixed and non-renewable capacity of roughly 124 MCM per year which will last for the next 100 years; however a large amount of this water is already being exploited for irrigation and domestic use. Mismanagement of the Disi fossil Aquifer can lead to irreparable damage.

The main reason for the contamination of these groundwater resources is over-exploitation. Utilization of more than the stipulated safe yield of water in these aquifers makes them susceptible to salt-water intrusion and excessive amounts of nitrates, chlorides and waste materials from the soil. While other countries mentioned in this report exploit an average of 50-60 per cent of their total freshwater resources, the annual exploitation of groundwater resources in Israel, the Palestinian Territories, and certain aquifers in Jordan is over 100 per cent of their annual safe yield.

### Fig 1-c: Route of Water from Disi Aquifer to Amman


*Source: Eng. Zafer Alem*

Some countries including the Palestine Territories, Syria and Lebanon face the problem of illegal and unmonitored pumping of water from wells. One of the biggest problems facing Syria is the hundreds of unlicensed private wells, mainly around the Greater Damascus region that are pumping water for domestic use. These wells are privately owned and it is becoming increasingly difficult to determine the amount of water being pumped from them and the extent to which this is affecting the groundwater quality. The Ministry of Environment has recently set up systems to conduct research on the number of wells and implement restoration measures accordingly. Currently there are over 200,000 wells around Greater Damascus, of which about 25 per cent are estimated to be unlicensed. Lebanon faces a similar problem. Groundwater abstraction through wells is largely unlicensed. While groundwater constitutes less than 7 per cent of total freshwater resources in Syria, 56 per cent of the agricultural area is irrigated by this water. Similarly in Lebanon, it is estimated that about 45 per cent of the water extracted from largely unlicensed wells is used in irrigation.

Lastly, climate change poses a very real threat to groundwater reserves in many of these countries, particularly groundwater aquifers that are situated along the coast. The Coastal Aquifer in Israel and the Gaza Strip is situated along the Mediterranean, as are some aquifers in Lebanon. Rising sea levels, a potential consequence of climate change, puts these aquifers at risk of salt-water intrusion and subsequently the deterioration of groundwater resources. Saving the aquifers from pollution, over exploitation and climate change is an urgent need. It will require systematic analysis of the problem and effective response strategies.

## 3. Managing Demand and Sectoral Inefficiency

With an increase in population and economic growth, demand for water is bound to increase. One of the largest problems in these countries is Unaccounted for Water (UFW) or water lost through pipe leakages and illegal extraction.

Jordan, with an unsustainable utilization rate of over 100 per cent, is losing almost 35 per cent of its water to bad systems and old pipes. The Water Authority has privatized the networks, introduced better monitoring in private homes, schools and similar places and created the Greater Amman project to reduce unaccounted for water loss. Yet a lot more investment is required to repair and improve the main pipelines that carry the water to the cities and towns to ensure that leakages and loss is kept at a minimum.

The loss of unaccounted for water in Lebanon stands at about 40 per cent of the total supply to the population. While the country receives high rainfall and has an abundant supply of freshwater resources, currently about 85 per cent of the total population is connected to water pipelines. Much of the transportation systems and networks in the southern part of the country were destroyed in the 2006 War, and are still not running at full capacity. Syria faces some of the worst problems in terms of bad water systems and in certain parts of the country loses almost 60 per cent of its water.

The experience of Israel proves that demand management measures could save up to 10-15 per cent of overall water usage. It has rigorously formulated and implemented measures for optimizing efficient water usage in each sector.

## 4. Storage Management

Realizing that the region is water scarce, prone to severe climactic changes and seasonal variations, Syria, Turkey, Jordan and Iraq have constructed large scale dams over the last three decades. These dams can be filled during years of high rainfall and precipitation, to counter the dry summer months and periods of inadequate rainfall or drought. However, despite huge investments most of these countries utilize less than 60 per cent of their total dam capacity. In some cases it is unclear what the dynamic capacity[5] is in each dam, and thus difficult to determine what amount of water can be effectively released and used from each dam. If these countries were to effectively utilize their storage facilities it could prove useful in mitigating future water deficit, and could be combined with other forms of demand management to ensure sustained supply for the future.

In Israel or the Palestinian Territories, there is no potential for building large scale dams, yet with the growing needs and water deficit that these countries are facing, they could consider smaller community based measures such as water harvesting.

While Jordan has ten large dams with a combined capacity of 337 MCM, the actual quantity of water stored is a little over 100 MCM. Approximately 92 per cent of the rainfall evaporates, and about 80 per cent of the country receives less than 100 mm/year. Rainfall is the highest in the Northern and Southern Highlands, where most of the country's rivers and wadis originate. In seasons of high rainfall, the amount of water received can be 600 mm/year. Almost 90 per cent of the population lives in the Northern provinces, due to the concentration of water resources. Most of the larger dams are located in this region. In 2009, the Ministry of Water and Irrigation announced plans to add five new dams by 2020, with a combined capacity of 15 MCM.

Lebanon has only one large reservoir with a capacity of 220 MCM, but the volume stored varies from season to season. The mountainous terrain in Lebanon makes it difficult to build large scale dams and transport water from them, but the government has recently begun exploring the option of building 28 smaller dams and storage facilities throughout the country to capture up to 900 MCM of water.

Syria currently has about 160 dams scattered throughout the country with a combined storage capacity of approximately 19.6 billion cubic metres of water, which would easily accommodate the current demand. Yet most of these dams are not in use, with the exception of a few of the larger ones such as the Lake Assad reservoir with the Tabqa Dam, and the Fourat on the Euphrates. Fourat is the largest and has a total storage capacity of 14 BCM, and is used for agricultural purposes in the northern belt. There is very little data available on the extent of use of the other dams, and thus it is difficult to determine what more needs to be done in this area of storage management.

Iraq had some of the largest dams in the region, and a combined capacity of a little over 50 BCM. The two largest dams, the Mosul on the Tigris and the Haditha on the Euphrates can hold over 10 BCM and 7 BCM of water respectively, and have the capacity to irrigate a combined area of three million hectares of land. Most of the other dams in the country were destroyed during both the Gulf Wars and some of them are currently under reconstruction. Iraq is different from all the other countries under study as several of the problems they face are due to the years of war.

Turkey has almost 2000 small dams and water storage facilities, of which the largest 260 dams have a combined capacity of 140 BCM of water. Some of these dams are underutilized. One of Turkey's major problems is internal disparities regarding water availability. Several big cities, including the capital Ankara, is located far away from a fresh water source, and these cities face water cuts during the summer months. One of the government's initiatives for the future is to harness and utilize all the available freshwater, which amounts to 112 BCM annually. This is mainly to boost industry, especially in the eastern part and also to ensure that water is supplied to people. If most dams were to be filled during periods of high rainfall it would help Turkey's growing needs. What is important to keep in mind here is that Turkey's water use is centred on achieving energy security, and a number of these dams in the eastern part are used to generate hydro-power and the water is not supplied to the population.

As discussed, several water stressed nations have embarked upon dam building activity as a potential solution. These dams are useful for irrigation and other agricultural purposes, industrial needs, generation of power, as well as for storage of water during dry months. Environmentalists oppose large dams for a number of reasons. Besides building new dams, it is important to use the present dams efficiently. It is also important that all these countries introduce community based methods of water collection and storage, especially in highly populated areas. Water harvesting, as well as community and home based storage could be employed and used for non-domestic purposes, which will save the needs for transportation and supply from far off areas.

## 5. Optimization and Coordination of Marginal Water

In order to supplement renewable fresh water availability, many countries have embarked upon projects in marginal water - desalination and wastewater treatment. The Middle East leads in global desalination demand. GCC countries (not covered by this study) had invested $15.5 billion by 2010 in desalination. Desalination can be used to supplement freshwater supply in domestic consumption, while wastewater treatment provides a reasonable alternative to freshwater for irrigation and industrial use. Wastewater treatment is also an integral component in sanitation and it helps prevent pollution of freshwater resources. Efforts to build on marginal water sources are necessary for all countries in this study. However, the construction and maintenance of desalination and wastewater treatment plants is extremely expensive and requires long term planning. In order to ensure optimum use of additional or marginal water it is important to have a coordinated effort between countries. Cooperation in the sharing of technology, expertise and information, as well as joint funding and easing of certain import restrictions will aid in optimising marginal water production.

Israel is currently a leading country in the field of marginal water production. Israel's desalination plant at Ashkelon, with a capacity of 100 MCM/year, is one of the largest in the world using reverse-osmosis technology. It is also planning a desalination plant with a capacity of 200 MCM in Shafdan.

The Palestinian Territories are in dire need of additional water resources. At present the West Bank does not produce any desalinated water. An Israeli plan to create a desalination plant in Hadera that would export 50 MCM/year to the West Bank was proposed but the plan fell through due to an Israeli-Palestinian disagreement over the use of sea water from the commonly shared Mediterranean Coast. In the future jointly owned desalination plants by Israeli and Palestinian companies may be established as and when the political framework permits such collaboration. People in Gaza have small desalination plants at the household level.

The quality of wastewater treatment in Gaza is poor. The Gaza treatment plant has been overloaded beyond capacity and only 60 per cent of Gazan households are connected to the sewerage network. There are three existing wastewater treatment plants that function intermittently, where little sewage is treated and most is returned raw to lagoons, wadis and the sea. In the West Bank, four towns have wastewater treatment facilities, but only one is functioning. At present only 31 per cent of Palestinians in the West Bank are connected to a sewerage network.

Jordan is embarking on two large scale desalination projects with similar names and objectives that aim to desalinate seawater from the Red Sea in order to provide Amman and other populated areas in Jordan with drinking water. In October 2009, Jordan announced its intention to go forward with a National Red Sea project. It aims to provide Jordan with 70 MCM of desalinated water every year for the next 25-30 years. Jordan has also expressed interest in a Red-Dead Sea Canal project which has a strong desalination component. The feasibility study for this project is underway.

Currently, Jordan treats 93 per cent of its wastewater. In 2002, Jordan had 19 wastewater treatment plants and produced 73.5 MCM of effluent or treated wastewater. In 2010, this amount was 179 MCM and in 2020 it is projected to be 245 MCM. Wastewater treatment is essential in Jordan as it could help reduce the amount of pollution in surface and groundwater sources.

Efforts to develop marginal water or additional water resources have probably been the lowest in Lebanon, but the policy circles are beginning to examine this option.

In terms of wastewater treatment, Lebanon is currently generating a little over 300 MCM of wastewater a year, which if effectively treated could serve to lessen the future stress situation. In the late 1990s, the Ministry of Environment proposed the building of 35 wastewater treatment plants to re-use the water, but till date there is only one large scale plant which is fully operational at Ghadir, south of Beirut. Of the rest, seven are still under construction and the remaining have yet to secure funding. A few small scale community plants have been operational since 2001, but do not affect the overall water balance.  Only a small percent of the wastewater is being reused which amounts to 210 MCM. It is hoped that if all the plants do become operational by 2020, then the total amount of treated wastewater will add an additional 300 MCM of water to the overall availability. It is also projected that the amount of wastewater generated will increase and double within the next twenty years by 2030.

Syria is taking steps to embark upon desalination projects. According to Syria's Scientific National Commission and other experts, desalination through the reverse osmosis process would be the best and most cost effective method for Syria to combat future water problems. Studies have shown preference for brackish water desalination and the best location for such plants would be east of Hama for a large scale plant and several smaller ones in the Al-Badia and Al-Jezirah region. Syria has an adequate source of energy for desalination plants but funding is a major obstacle.

Currently only 40 per cent of Syria's wastewater is treated, which produces 825 MCM of water that can be used. In November 2009, Syria announced plans to build two treatment plants with help from Qatar.  The first of these plants would be built in Jaramana and the second in Suwedha, both towns expect to see a large rise in population in the next few decades.

Iraq has 13 major wastewater treatment plants (WWTP). Two of the largest are located around Baghdad and could potentially serve a population of almost three million. These large plants have a combined capacity of generating close to 700 MCM of treated wastewater annually. Due to the war and subsequent problems however, these plants are running at less than quarter of their capacities. As a result, several of the sewage plants connected to these treatment plants are gathering sewage and allowing it to flow into the Tigris, polluting the river water. After the 2003 invasion, around 300,000 tonnes of raw sewage was dumped into the Tigris everyday. If the existing and future plans are completed by 2020, this 700 MCM of water could be re-used in irrigation, which would be extremely beneficial to Iraq's large agricultural sector. Iraq has a substantial amount of freshwater and may not require desalination efforts as much as it requires better pipes, water connections, treatment plants and adequate sanitation. In the case of Iraq, both international as well as regional cooperation is required in order to restore its infrastructure to its pre-war capabilities.

There is a need to optimize wastewater treatment and research the desalination potential in many of the countries under study. But optimization is not simply an internal process. It requires sharing and coordination of information across borders. Some of the countries have realized the importance of investing in desalination as one of the efforts towards supplementing their water supply, and have begun exploring joint projects.

## 6. Containing Environmental Degradation

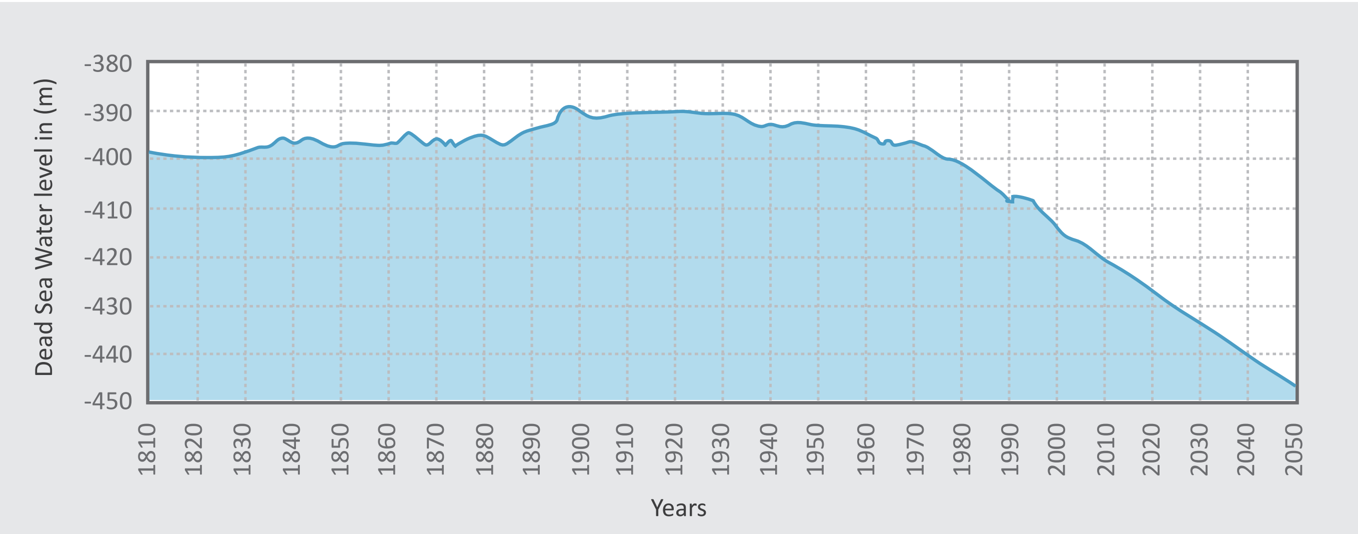
Water shortage in the Middle East has led to gradual environmental degradation on many fronts. Human activities have resulted in the deterioration of natural habitats and the destruction of the ecosystems that depend on them for survival. If measures are not taken, the process could result in an environmental disaster and the effects will be irreversible in the future.

Till the 1960s, the water level in the Dead Sea remained at 390 metres below sea level. However, in the last 40 years, between the 1960s and 2007 the water level dropped down to 420 metres below sea level. Now, the level continues to decrease by one metre every year. The sea isn't just sinking further and further below the earth's surface, it is shrinking as well. The water surface area is down a third, from 950 square kilometres to 637 square kilometres. At this rate, within 50 years the Dead Sea will be reduced to a lake, and will eventually disappear altogether. Known for its high mineral content that has marked it as a popular tourist destination, its anomalous reputation as the lowest spot on dry land and most importantly its cultural significance to the region, the Dead Sea is in serious danger of disappearing.

Figure 1-e shows the difference in surface area of the Dead Sea between the years 1960, 2000 and the expected surface in 2050 if no action to save the sea is taken.

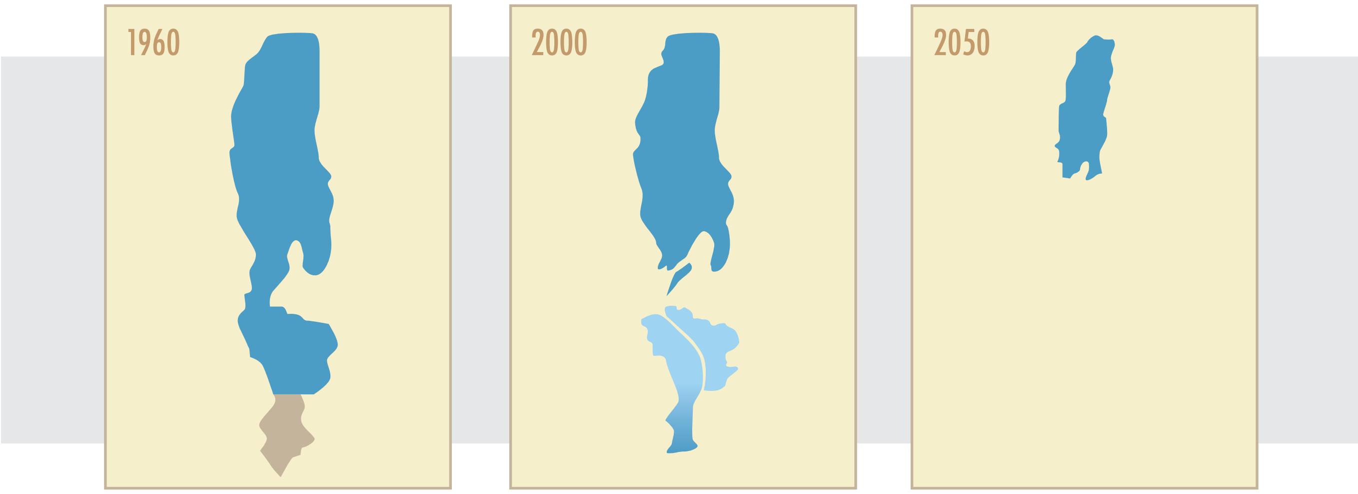
Jordan, Israel and Palestine have all expressed their interest in replenishing water levels in the Dead Sea through the RDC plan. However scientists have expressed concerns that the transfer of water from the Red Sea to the Dead Sea will cause a difference in composition, exposing the Dead Sea to algal blooms. Ecologists have also expressed their concerns about the effect such a project can have on marine life in the Red Sea. Alternately they have suggested that another option for saving the Dead Sea would be to

Fig 1-d: Reduction in Water Level in Dead Sea




*Source: Eng. Zafer Alem*

Fig 1-e: Dead Sea Status with Time, if No Action is Taken



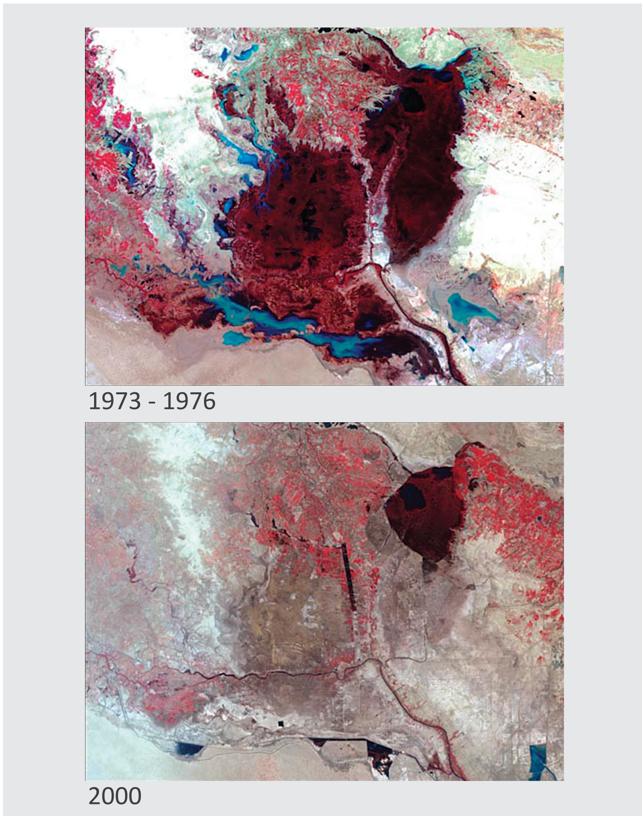

*Source: Eng. Zafer Alem*

target the source of its problem – thus save, preserve and enhance the Jordan River flow.

The Iraqi Marshlands once constituted the largest wetland ecosystem in the Middle East, with tremendous environmental and socio-cultural significance. Since the 1970s however, these marshlands have been damaged significantly due to dam construction and drainage operations by the former Iraqi regime. In 2001, the United Nations Environmental Programme (UNEP) alerted the international community to the destruction of the marshlands when it released satellite images, (shown in Figure 1-f) intimating that 90 per cent of the marshlands had already been lost. As a result, a large percentage of the indigenous population has been displaced and the rich biodiversity once unique to this region is disappearing. The area also faces water quality degradation, contamination by sewage, high levels of salinity and pollution from pesticides and untreated industrial discharge.

Many of these problems are due to the limited flow of water running through the marshlands. Several projects instituted in the 1990s affected the regular flow of the rivers and resulted in extensive desiccation

Fig 1-f: Reduction of Iraqi Marshlands from 1973 – 2000 (as seen from space)




*Source: http://haysvillelibrary.files.wordpress.com/2009/04/iraqi-marshes-1976-landsat.jpg* of the marshlands. Five major projects in particular led to drainage in this area, namely – the 500 km long Third River Canal from Mahmudiyya to Qurna which diverts most of the Euphrates, two other lengthy canals, the Fourth River Canal and the Qadisiyya Canal on the Euphrates, a moat that runs parallel to the Tigris and blocks water to the Qurna marsh and the Dujaila Canal which was built mainly for agricultural purposes. As the former regime collapsed, people began to open floodgates and break down embankments that had been built to drain the Iraqi marshlands. In August 2004, UNEP initiated a project that aimed to respond to the problems in this area in an environmentally sound manner. Re-flooding has since occurred in some, but not in all areas.

The impact of environmental degradation on surface and groundwater is implied in the discussion on sustenance of these resources. If the countries in the region declare the Dead Sea and Iraqi Marshlands as Regional Commons and cooperate to save them, they will have to introduce policies that will have a bearing on environmental factors affecting surface and groundwater in the region. Efforts must be made to strike a careful balance between human demands and environmentally sustainable alternatives.

## 7. Meeting the Challenges of Climate Change

The Middle East is one of the driest regions in the world, and is especially vulnerable to climate change. With a rise in temperatures and fall in levels of precipitation, the region will become drier and more arid. Experts have predicted that changes in climactic patterns will result in the shrinking of rivers, desertification, receding groundwater levels, and shifting rainfall patterns – all of which will result in a decrease in freshwater availability for the growing population in the region. Several national climate change reports and international experts predict that the summer temperatures will rise by 2.5-3.7˚ Celsius and the winter temperatures will rise by 2.0-3.1˚ Celsius, over the next 50-70 years, resulting in faster evaporation of surface water.

The Middle East region has a high dependency on climate sensitive agriculture and a large share of its population is located around flood prone zones. The 2007 Intergovernmental Panel on Climate Change (IPCC)[6] report states that the region is likely to become hotter and drier over the next few decades, with sea levels rising by approximately 0.6 m by 2100. Precipitation over certain areas, especially in parts of Israel, Turkey and Iraq is expected to decrease on average by almost 5 per cent by 2100. Other estimates state that while there will be a drop in precipitation in the latter half of the century in some parts of the region, and there is also a chance that this dry period will be followed by a period of heavy rainfall.

While experts are predicting that these climatic changes will affect the region over the next 50-100 years, some countries are already experiencing these effects – such as drought in Israel, the Palestinian Territories and Jordan, and desertification and decreasing groundwater levels in Syria and Iraq. These climatic changes, resulting in the loss of freshwater could heighten tensions between nations such as Israel and the Palestine Territories and could exacerbate the problems of internal water resource management in most of these countries.

Israel's national report on climate change states that its freshwater availability will fall to 60 per cent of the 2000 level by 2100. There will also be sedimentation in reservoirs, seawater intrusion in the Coastal Aquifer, increased seasonal variability in temperatures leading to desertification in parts, and extreme climactic conditions. In a country that is already experiencing deficits of water, a 60 per cent reduction of availability will prove extremely dangerous and unsustainable.

Saltwater intrusion, due in part to rising sea levels, in Gaza's Coastal Aquifer will increase if not dealt with immediately. Only 10-15 per cent of the water in the Gazan Coastal Aquifer is considered suitable for drinking due to years of sea water intrusion and pollution from lack of proper waste water treatment facilities. A further rise in sea water levels, which are estimated to be about 18 cms by 2030 as a result of climate change, could possibly render all the water in this aquifer unsuitable for drinking by 2020-2030.

The projected rise in sea level will affect other coastal cities in the Mediterranean, and is one of the biggest challenges facing Beirut, the capital of Lebanon along the coast. A gradual rise in levels, 18 cm by 2030, will increase the salinity of the groundwater leaving it unfit to drink.

Desertification is another result of climate change that is likely to affect Syria, Turkey, Iraq and Jordan. The UN panel on Climate Change predicts that with the rise in temperature, lack of rainfall and unpredictable weather, approximately 60 per cent of the land in Syria faces the threat of desertification. The biggest impact of this will be seen in the agricultural sector, where a fall in productivity will directly impact food security. For a country that is predominantly dependant on its agricultural sector, less arable land and water will prove extremely disastrous for the economy, which could also have social consequences such as loss of employment, internal migration and unrest.

Iraq is another country that faces the threat of desertification at an average rate of 0.5 per cent annually, due to reduced rainfall and hotter drier summers. Unpredictable weather patterns, in the second half of this century, may cause seasons of heavy rainfall, which could slow down this process. Dust storms, a normal phenomenon in the region during the summer months, have worsened over the last few years due to the drought and decrease in vegetation. The unpredictable weather and rise in temperature in the future might increase the frequency and severity of these storms, adding to the risk of desertification. The Iraqi government formally ratified the Kyoto Protocol in January 2008, which is seen as an important step towards addressing the future issues of climate change.

While desertification is not a national concern in Turkey, the research commission set up in 2007 by the Turkish National Assembly found that the Konya Basin was facing the threat of desertification. There are currently 66,000 known illegal wells in the basin which are over-pumping water and depleting the reserves. About 80 per cent of the depletion has occurred over the last decade, and at the current rate, the basin faces complete desertification by 2030. Currently plans are being developed to divert water from the Goksu River in the south to the basin. Lake Tuz, located a 100 km north of the Konya Basin, produces 70 per cent of the salt consumed in the country. Due to higher summer temperatures, low rainfall, and an increase in extraction, the lake faces a similar threat of desertification.

Changes in climate leading to a drop in water availability and loss of land to desertification are all closely linked to food security. In the view of some experts, there could be a 40-50 per cent drop in wheat, 25-30 per cent drop in rice and about 15-18 per cent drop in maize in parts of the region. The actual figures could vary from season to season and from country to country depending on the intensity of drought, irrigation and land quality.

In order to address climate risks in the region, the most urgent need is for new regionally developed climate change models, that take into account the requirements, nature and nuances of the countries in the region, so that these countries are not dependant on global models. The countries in the region are interconnected by the water bodies they share and any climate changes in one will affect the rest. Any regional effort to downscale the global model to a regional and sub-regional scale will serve in getting more precise results to predict extreme events quicker. A common regional collaborative climate change effort will not only benefit all parties, but will also build trust in other fields.

## 8. Addressing Internal Disequilibrium

Most of the countries in the region face unequal distribution of water across their territories due to their topography and geography. In Jordan, Turkey and Syria, densely populated cities are located far from a fresh water source, and effective transportation becomes a concern. In Turkey, Lebanon and Syria, mountain ranges and similar terrain also makes it difficult and costly to construct large pipelines. In Iraq, consecutive years of drought, war and the lack of adequate governance has hindered overall development in the water sector, and the country is simply unable to provide the required water to its population.

Jordan is the fourth most water-deprived country in the world and deserts comprise 80 per cent of the territory. The Eastern (Badia) and Southern Deserts, which cover most of Jordan receive an average rainfall of below 100 mm/yr. Ironically, the region of Amman-Al Zarqa, in north central Jordan with the highest population density and consequently the highest demand for water, is located at the edge of the Badia Desert. Increase in population and demand for water in the long term, especially in the growing Amman region, will require long term investments.

Syria is looking to other areas to provide water to the greater Damascus region. Feasibility studies have been conducted to examine bringing water down from the Euphrates River in the east to Damascus via pipelines, but this is a long term solution that might prove to be extremely expensive. Syria is also considering diversion of water to some of the other cities in the western part of the country to address internal disparities – e.g. from the Euphrates to the towns of Homs and Hama.

Turkey is considered water rich, but it has regions which face water scarcity. The northern region receives some of the highest rainfall, over 2,500 mm a year, and the most fertile region is around the Euphrates-Tigris Basin in the east and the Seyhan-Ceyhan rivers in the south. The central parts of the country have few rivers and receive less than 250 mm of rainfall annually. Turkey's capital city, Ankara is located in the central part of the country and has no natural water body or groundwater source located close to it. The city has faced severe water shortages over the last couple of years due to poor transportation of water from the northern rivers. The Ankara Metropolitan Municipality has developed plans to improve the situation by building pipelines either from the Black Sea region in the north to the city, or from the Kizilirmak river basin, but till these plans are realized, the city will continue to face shortages during years of low rainfall.

Izmir, located on the west coast and Adana in the south Mediterranean region are also both densely populated and face similar problems. Analysis of consumption patterns of hydrological basins across the country show that less than 20 per cent of the total potential of most of these basins is being harnessed. It is extremely important that the water potential of basins near major cities is harnessed, and the supply is increased to ensure that there is no water shortage in the future. Till Turkey ensures that supply within the country is adequate and that no major cities are facing stress, the question of exporting water to other nations is likely to give rise to internal opposition.

Solving internal disparities on water availability and supply is extremely important for these countries to avoid future stress, as well as social unrest and internal conflict. Turkey, which is already supplying water to Northern Cyprus, and has plans to expand this further to Libya and other countries, needs to ensure that there are measures for sustained supply within the country to avoid any political problems.

## 9. Addressing Regional Disparities

Although the Middle East is considered one of the most water-scarce regions in the world, there are regional disparities in freshwater availability that need to be taken into account. On a comparative scale, Turkey and Iraq have abundant freshwater resources. Lebanon will have enough water to secure its own future if it improves its hydrological management. Syria is teetering along the water poverty line but has the potential to manage demand if not hit by chronic drought. Israel, the Palestinian Territories and Jordan have already reached a point of severe water-stress and they lack enough available freshwater resources to support their respective populations. Therefore, a closer look at the water situation in the Middle East reveals a pattern. The northern countries like Turkey and Iraq are relatively comfortable. The countries located directly below the northern states lie in the middle of the scale and can prevent water crisis but have a challenging endeavour ahead of them. The countries located further south are water deficit. This pattern should be taken into careful consideration while crafting solutions to the region's water problems. Also, the wet season varies from the north to the south. Therefore, there may be scope to transfer water for whatever consideration from relatively comfortable countries in the north to the countries in the south facing crisis. Most countries prefer domestic solutions to the challenge posed by water scarcity. However, the variation in geographical and seasonal distribution of water resources may provide opportunities to address water scarcity, foster regional cooperation and pave the way for peace in future.

## 10. Using Water as an Instrument of Peace

Several countries in the region have experienced severe drought over the last few years in addition to the growing demand. These circumstances have in turn placed a lot of stress on their water systems and resources. The growing deficit between demand and supply has led to a number of social consequences, such as internal migration, low agricultural productivity, food shortage and famine, and deteriorating health conditions. If people do not have adequate access to clean water, all of these issues have the potential to worsen in the future, leading to social unrest within a country. In Syria, over 100,000 farmers have migrated from the north east regions to Damascus, as a result of the recent drought. This influx of people is placing a greater strain on the already stretched resources in Damascus, and there have been reports of a number of skirmishes between people living in the outskirts of the city and the migrants who have settled there.

Water courses do not respect man made boundaries, and the two major river basins in the region, the Euphrates-Tigris Basin and the Jordan River flow through several countries. Several of these countries covered by this study also share underground aquifers. Thus if shared rivers, aquifers and basins, can be seen as a means of cooperation, it will prove extremely beneficial in a number of ways to all the countries in the region.

Over the years, due to a number of initiatives, countries have resolved contentious water issues peacefully, albeit with short term solutions. The 1991 Madrid conference saw a shift from hydro-conflict to hydro-cooperation and led to several efforts between countries. In 1993, the Executive Action Committee was formed by Israel, Palestine and Jordan to share information and keep dialogue open regarding their shared water resources. The water ministries of Turkey, Syria and Iraq have recently decided to set up joint measurement stations on the Tigris and Euphrates rivers, through a MoU signed on 3rd September 2009, to track the flow and condition of the river.

As was suggested by Johnston in 1955 and later by Turkish President Ozal in 1987, water can be used as an instrument to enable cooperation and peace. While they used different approaches, the underlying concept was the same – to explore the potential of shared water resources to bring about peace. What is important here, especially in a water scarce region such as the Middle East, is a long term comprehensive and regional solution, taking into account the future needs of each country. It is important to examine water as an instrument of peace and change its current perception as a cause of future conflict.

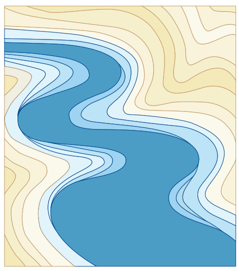
# Strategies – A Future of Possibilities 2

In order to address the ten objectives defined in this report, a complex approach is required. It would constitute of:

- Supply side solutions at the national level, mainly desalination, wastewater treatment and rainwater harvesting
- Supply side solutions at the cross-border level within the same circle of cooperation
- Supply side solutions at the regional level, mainly between basins or countries in two different circles
- Demand side solutions at the national level in all three sectors – agriculture, industry and domestic use.

These approaches are mutually complementary. If a country depends on only one approach, it would be useful but not sufficient. The region needs a judicious combination of all the strategies. The underlying approach should be national and regional at the same time, covering both demand and supply sides, effective in the immediate and distant future and essentially multi-dimensional and sustainable.





# Enhancing Supply

Conventionally, supply side strategies are confined to a basin. Experts discuss a strategy for the Euphrates-Tigris basin and a separate strategy for the Jordan River basin. This report examines options for augmenting supply through trans-boundary cooperation both within and between basins.

In order for a particular strategy to be acceptable, it must provide incentives to the parties concerned. States act in self-interest. They are not benevolent by nature. This report therefore analyses how each strategy can satisfy the dominant self-interest of each country.

In many cases, the motives may be more political than material. In the Cold War years when the geopolitical map of the world was static, countries in the Middle East might have found it difficult to be motivated by dominating geopolitical objectives. The second decade of the 21st century is bound to see the world in flux with a marginal decline in American power, rise in China's power and Europe's concentration on self-consolidation. In such a situation, countries such as Turkey and Iran may find opportunities to expand their space and countries such as Israel and Syria may find that it is in their interest to explore options which were unthinkable until 2010.

The strategies presented here may appear to be ambitious on the surface. However, in the context of geopolitical changes and the dire need for water for survival, compounded by climate crises, they are merely bold and potentially more acceptable than what is apparent.

## 1. Cooperation Council for Water Resources in the Middle East (Short Term):

There is no alternative to regional cooperation for sustainable water management for social and economic development in the Middle East. However, current political realities do not allow cooperation covering all countries in the region. HRH Prince Hassan bin Talal has therefore proposed the idea of Circles of Cooperation, where countries that have a broad understanding can collaborate in a mutually agreed manner. The idea of Circles of Cooperation would become operational if each circle has a political mechanism to define a common vision, identify priorities to translate the vision into a reality and an institutional architecture to follow up on and implement decisions taken at the political level.

One such Circle of Cooperation could comprise of Turkey, Syria, Iraq, Jordan and Lebanon. Such a grouping would focus on water as a resource in a holistic perspective, rather than treating it as a concern at the level of any particular basin. In future, if and when peace prevails on terms acceptable to all parties, it may expand horizontally in phases to cover other countries in the region. The European institutions, ASEAN, SAARC were all born with limited number of member countries and later on expanded in a gradual fashion.

### Concept

The proposed political mechanism to support a Circle of Cooperation should not be confused with a technical study centre or with a forum for organising conferences, training programmes and exchange of views and know-how. It is not perceived to be a bargaining or negotiating platform; a task performed by inter-ministerial meetings, but should be conceived as an instrument to develop a shared and cooperative vision and the tools for applying the shared vision. Such a political mechanism should therefore be in the nature of a Cooperation Council constituted by Heads of Governments, or their High Representatives or Ministers, supported by an institutional machinery to implement political decisions.

In brief, the idea of the Cooperation Council is perceived as follows:

| Not To Be | To Be |
|---|---|
| A negotiating platform | Instrument for developing shared visions |
| Study centre | Mechanism for policy coordination and standardisation |
| Forum for conferences and training events | Vehicle for the development of integrated basin management, joint projects, new technologies |
| Centre to undertake conventional tasks | Facilitator to address new challenges such as climate change and technological momentum in water and environment |
| Externally driven initiative | An initiative driven by countries in the region with external agencies involved in a supporting role |

In future, if there is political will, the Cooperation Council may extend its mandate vertically to cover a broader gamut of activities and spheres connected with water and environment. The Cooperation Council can therefore lay the ground for the evolution of a regional community of water and environment.

## Functions

It is envisaged that the Cooperation Council may undertake the following and similar functions:

- To evolve a consensus on principles of cooperation.
- To create regional protocols, guidelines and practical measures for standardising measurements of quality and quantity of water resources by upgrading gauging stations, developing common approach to interpret the data collected from equipment pertaining to water flows, climate and relevant environmental indicators.
- To set goals for restoration and long term sustenance of water bodies from an ecological perspective, similar to EU Framework Directives.
- To develop specific means of combating climate change and drought in a collaborative manner.
- To promote research, development and dissemination of new technologies for environmentally sensitive and energy efficient water related technologies.
- To facilitate negotiation and creation of joint projects at basin or regional level including common early warning and disaster management systems.
- To prepare ground for integrated water resource management at the basin level.

In order to implement some of the above mentioned functions, it would be necessary to understand the legal frameworks in all participating countries, attempt to streamline legal architecture within countries, and introduce commonalities between countries. This is not to propose a new international law but rather an agreement on certain principles, which can be used as standard parameters by all countries to render their own laws effective. It may be also necessary to undertake either joint or independent assessment of availability of resources, long terms supply and demand projections, and needs of consumers. The Cooperation Council may decide on the importance of such tasks and authorise appropriate bodies to implement them. The Cooperation Council may also decide if such tasks are viable in short term or it may establish a different order of priorities.

## Structure

The Cooperation Council for water resources is only possible if its structure reflects regional political ownership. It would require:

- Steering Committee of Heads of Government or their High Representatives to take political decisions.
- Technical Group of concerned ministries and water authorities to act as a bridge between political representatives and the secretariat to facilitate implementation.
- Independent secretariat to implement decisions taken at the political level.
- A network of parliamentarians, think-tanks and civil society groups to advance the decisions taken by the Council at the popular level.
- International Support Group of donor countries and international organisations.

## Funding

The Cooperation Council as envisaged here, should have funds from the member countries as well as international partners. The quantum and proportion of the contribution by the countries in the region may be determined through mutual agreement. International donors may contribute agreed proportions in the early phase to enable neutrality and independence of the endeavour but there should be an in-built mechanism to reduce their contribution in a gradual manner. A formula similar to the one proposed below may prove to be viable:

- The host country can provide the secretariat and administrative staff, perhaps under the auspices of an existing ministry or institution.
- The participating countries from the region can share on the basis of agreed proportions the cost of professional staff deputed by them and other core costs.
- External donors can contribute to the cost of projects, particularly the ones which require specialized expertise or equipment either from the region or outside.

## Lessons from Regional Study Centres and Organisations

The Cooperation Council in this concept paper is envisaged to be distinct in its nature from the existing and proposed regional centres of water studies in the Middle East.

Presently, there are two main regional centres of studies, both based in Syria: International Centre for Agricultural Research in Dry Areas (ICARDA) and Arab Centre for the Studies of Arid Zones and Dry Lands (ACSAD). Both undertake research, field visits and training which result in the production of scientific papers, training manuals, mathematical models. In addition ACSAD maps groundwater. They are not involved in policy coordination or harmonisation of laws and political dynamics.

There are currently two proposals under discussion for regional centres.

- A proposal by the United States to set up a regional centre for technical studies and training activities, with a likely base in Jordan.
- A proposal to create a regional centre for the Union of the Mediterranean (UFM) with a building in Beirut with a view to undertake technical studies and training.

The Cooperation Council would be totally different from and completely non-comparable to ICARDA and ACSAD, as well as the potential US and UFM centres. It is not intended to undertake technical studies, field visits, training, and conference management and instead focus on harmonisation of policies, laws and political dynamics. The Cooperation Council may in fact assign existing technical centres certain tasks, where their expertise would be relevant.

It may be also noted that EMWIS or Euro-Mediterranean Information System was created for an exchange of know-how in the region. Like the two existing and two proposed centres mentioned above, EMWIS prepares technical papers on specific subjects and training material.

The Middle East Desalination Research Centre (MEDRC) is an inter-governmental organization that supports the development and use of desalination. While MEDRC is supported at the Ministerial level in member states, it is primarily a research and training organization with limited engagement in the region.

The only effort which came close to the objectives of the Cooperation Council proposed in this paper was the Centre for Environment Studies and Resource Management (CESAR), a project of the Norwegian Ministry of Foreign Affairs. It had a focus on Israel, Palestine, Jordan, Lebanon and Syria. It did not include Turkey and Iraq in its scope of work, even while seeking engagement with Syria. It closed down within a decade of its existence.

The Cooperation Council should draw lessons from the working of international organisations in the Middle East. The UN Economic and Social Commission for West Asia (ESCWA) is relevant in this context. ESCWA comprises 14 countries in Western Asia: Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, the Sudan, the Syrian Arab Republic, the United Arab Emirates and Yemen. It is primarily involved in capacity-building activities such as:

- Providing expertise and technical tools
- Research and publications
- Financial assistance
- Developing case studies
- Climate Change impact assessment.

The work of ESCWA is in many ways similar to regional study centres such as ACSAD, ICARDA and other UN agencies and is undertaken in cooperation with them. In addition ESCWA has established an intergovernmental committee on water. Since its inception in 1995, it has had regular meetings once every two or three years. The 8th session took place in January 2009 and the 9th session is expected to be held in 2011. The meetings are attended by management or technical level professionals, with only the host country minister delivering the keynote speech. The membership does not include Turkey.

The committee sessions have highlighted important problems and solutions but there is no clarity about the implementation of ideas discussed. These have included the need for updating water legislation to protect ground water from pollution and over exploitation, cooperation in waste water treatment, coordination of information relating to the shared water resources, role of private sector, among others.

Another important inter-governmental organisation in the region is the Union for the Mediterranean (UFM). It comprises of 27 members states of the EU and 16 partners across the Southern Mediterranean and the Middle East. In 2010, UFM embarked on a Strategy for Water in the Mediterranean, with a draft declaration which was discussed at the 4th Ministerial Conference on Water.

The strategy aims at providing a common policy framework for achieving IWRM in the member countries, fostering cooperation and preserving resources amongst others. It outlines short, medium and long term operational objectives to achieving these aims.

The draft of the strategy paper was not accepted due to passages which led to a disagreement between Israel and Arab States with regards to reference to 'occupied territories'. The draft was also opposed by Turkey due to references made to 'international' rivers and the UN Convention on International Watercourses.

The key lessons from the regional study centres and water related activities of international organisations such as UN-ESCWA and UFM are as follows:

- Turkey has to be a member of any regional water cooperation and coordination mechanism. Several important water sources, relevant particularly to the Northern Circle, flow through Turkey. A mechanism that does not include Turkey is inadequate. This has been the case with UNESCWA, CESAR, and ACSAD.

- Any political mechanism must be conceived by leaders in the region and external supporters have to respond to the regional initiatives. Most of the political level initiatives such as CESAR and UFM have been driven from outside the region and countries in the region were expected to respond. A successful strategy needs a reversal of roles. This should also be reflected in financing and management of Cooperation Council.

- There is much happening in terms of studies, preparation of manuals, training programmes, conferences, field visits, and discussions. The proposed Cooperation Council must function as a political mechanism to develop common vision, approaches and strategies. It should leave capacity building and research activities to the technical centres and scientific institutions.



### Next Steps

The five countries – Iraq, Jordan, Lebanon, Syria and Turkey – have demonstrated political will for cooperation in trade, transit and telecommunications sectors. The atmosphere of trust is growing in the region. In this context, it should be possible for them to foster cooperation by creation of a mechanism to address the challenging issue of water sources. Since such a mechanism has to be owned and driven by decision-makers in the region, it would be essential for them to propose a mandate for a Cooperation Council which is viable from their respective national perspectives. Once national perspectives on the mandate of the Cooperation Council are crafted, it will be necessary to harmonise them into a regional mandate. International community can support the process by providing technical and financial support for implementing specific projects envisioned in the mandate by governments in the region.

## 2. Integrated Water Resource Management (IWRM) for Small Cross Border Rivers in the Northern Circle (Medium Term):

Once a Cooperation Council is established and it succeeds in agreement on standardised measurements, laws and goals, some of the countries may decide to upgrade cooperation at the basin level. Such an initiative must come from the countries concerned through a joint ministerial statement of the riparian governments. The parties may decide to approach international organisations and donors for technical and financial input. However, such an initiative has no potential to sustain itself if it is primarily driven by external institutions.

There are three possibilities for basin level cooperation in the next decade: Orontes, El Kabir and Yarmouk Basins. There is interest in Lebanon for cooperation over Orontes and El Kabir and in Jordan for basin level cooperation over Yarmouk. The Syrian policy on these issues is not known.

## The Orontes Basin

The Orontes River originates in Lebanon, flows through Syria into Turkey before it discharges into the Mediterranean Sea. It is joined by two main tributaries, the Afrin and the Karasu which originate in Turkey, and collectively the three rivers have an annual available potential of 2.8 BCM. The waters of the Orontes between Lebanon and Syria ranges between 400-420 MCM annually, though most experts have settled on the figure of 400 MCM for the purpose of calculations and future estimates. The rivers are used intensively by all riparian parties for irrigation purposes and domestic use. However the main strain on water sources in the future will be a result of increased development activity, and discharge of untreated wastewater into the river. There is no agreement or formal institutions in place for quality control in any part of the river.

Negotiations between Lebanon and Syria have been relatively smooth on this aspect. In July 1972, Syria and Lebanon signed an agreement concerning the use of the waters in the Orontes, which did not come into force. Another agreement was signed on 20th September 1994 building upon the previous agreement where both parties considered the waters as common, and agreed to divide the quantity of the waters available. The Lebanese share was to be 80 MCM and the remaining 320-340 MCM was for Syria, where during periods of high rainfall the excess would go to Syria. The agreement also stated that during period of drought and low rainfall, the amount of water harnessed by Lebanon would be reduced by 20 per cent, as measured at the Harmel Bridge. While Syria agreed to finance all maintenance activities for shared canals and water systems, and there is some form of monitoring along the basin, there is very little enforcement of the agreement.

An important issue is if and when Turkey could join Syria and Lebanon in basin level cooperation with regards to the Orontes. Syria considers the Hatay Province in Turkey as Syrian territory. However, since the Adana Accord of 1998 relations have been improving to a certain extent. The north western region in Syria is dependent on the surface and ground water resources in the Orontes Basin, especially the cities of Homs and Hama. Syria has built 40 small dams which have a total holding capacity of 736 MCM, though they are not all fully operational. Syria has enlarged the Orontes river bed to provide more water for irrigation and has drained the Al-Ghab marshes to open up land. Turkey has 12 different development projects for the area around the Orontes of which only four are currently in operation. With the tributaries in Turkey and Syria and the groundwater that forms the Orontes Basin, there is approximately 1.2 BCM annually for both countries (this does not include the waters harnessed by Lebanon and Syria at their border).

In 2004, Turkey proposed a joint dam to be built on the Orontes in Syria to produce hydropower and water for irrigation for both countries, though it wasn't till recently that a formal agreement was signed. In December of 2009 the two countries signed a MoU and agreed on the construction of a Joint Dam on the Orontes, under the name "Friendship Dam" or "Peace Dam". Both countries agreed to meet the cost of the dam which would be built at the border and produce energy for both sides, as well as irrigate 20,000 hectares in Turkey and 10,000 hectares in Syria. Work on the foundation of the dam was expected to begin at the end of 2010.

Syria and Lebanon also share the El Kebir which forms a natural border between the two countries and discharges into the Mediterranean Sea. The larger catchment area lies in Syria. After a series of meetings, it was decided in the 1990s that Syria would receive 60 per cent of the total discharge. The Akkar watershed around the river could pose a potential future problem. Recent studies have shown that there is enough water in the watershed, but increasing levels of pollution is affecting the water quality. Therefore, quality management rather than quantitative issues could be the main focus of basin level cooperation.

## Next Steps

There is tremendous scope for cooperation in a basin wide joint watershed development program on the Orontes River between Lebanon and Syria, possibly involving Turkey at some stage. The 1994 agreement between Lebanon and Syria is considered to be a major success story in the field of transboundary sharing, despite criticism from some experts, and the potential to carry this further into other areas must not be lost. In practical terms, cooperation on Orontes can evolve through three phases. In the first phase (2-3 years), an integrated data system on all aspects of the river basin needs to be created jointly by Syrian and Lebanese experts. In the second phase (3-5 years), practical cooperative measures on the ground such as cost-effective irrigation and quality control can be introduced. In the third phase (beyond 5 years), a joint basin management mechanism can be established.

The initiative for Orontes and El Kabir basin level cooperation has to come from the Governments of Syria and Lebanon. It should be reflected in a joint ministerial statement. Until there is political will for such an initiative in the two countries, there is no direct role for any external players. Once these two countries begin such a joint initiative, international financial and technical support is required. At that stage, they may approach donors and multilateral organisations. They could invite Turkey to join the Orontes basin management endeavour at some stage, acceptable to all three countries. Cooperation in basin management could lead to further cooperation and agreements in other sectors.

## Yarmouk Basin between Jordan and Syria

Jordan and Syria share the Yarmouk River, the River Jordan's largest tributary. Originating in the south-eastern slopes of Mount Hermon in Syria, the Yarmouk River forms the boundary between Syria and Jordan for nearly 40 km before becoming the border between the Kingdom of Jordan and Israel.

In 1955, an Arab League committee on water set Jordan's annual share of the Yarmouk River water at 377 MCM and 90 MCM for Syria, which currently gets 220 MCM per year.

In 1987, Syria and Jordan signed an agreement on the Yarmouk that stipulated the division of water between the two countries, specified the number of ditches that could be built along the river and even proposed a joint dam between Jordan and Syria. At that time the amount had decreased to a little less than 300 MCM, and Jordan was allowed to access 208 MCM, leaving the rest for Syria. In the present reality, Jordan receives only 50-100 MCM of water from the Yarmouk.

Since then, Jordan's main complaint has been that it only gets a fraction of the water stipulated in the 1987 agreement because Syria has set up more than 30-40 ditches and pumping facilities to store water along the Yarmouk, whose flow has subsequently fallen from 470 MCM to 270 MCM per year in the Adassiyeh border area. The agreement allows for only 25 ditches.

The proposal for a joint dam, known as the Wehde Dam, which would have a storage capacity of 225 MCM, has been shelved due to lack of funds and Israeli reservations over the dam and the effect that this could have on Israel's share of the Yarmouk.

Syria and Jordan conducted high level talks in 1997-1998 and recently in 2009-2010. At both times, committees discussed water sharing, concerns for water quality and the execution of the joint dam project but nothing has come to fruition as yet.

According to a media report, in 2009 Jordan and Syria commissioned a joint hydro-geological study, which aims to examine the quantity and quality of water sources in the Yarmouk River Basin and identify the causes of their depletion. However, enquiries with authorities and experts revealed that nobody is aware of any such study.

One of the main areas of contention between Jordan and Syria is the exploitation of the Yarmouk's freshwater resources for irrigation and agricultural purposes. The hydro-geological study will look at the amount of water being consumed upstream as well as downstream for cultivating summer crops and how this affects the overall flow. If no study has been undertaken, contrary to media reports, there is an urgent need to undertake one.

At present over 70 per cent of Jordan's water resources are utilized by the agricultural sector, while nearly 85 per cent of Syria's consumption goes to irrigation. Neither of the two will be able to sustain such a high dependence on freshwater to satisfy irrigation needs in the future. Hence efforts to ensure water cooperation between these two countries would have to include measures to curb the consumption of water in their respective agricultural sectors – through water quotas, pricing, virtual water imports, drip irrigation, cropping patterns, water-efficient infrastructure and of course the use of treated wastewater and brackish water in irrigation. Jordan has already started using treated wastewater in the agricultural sector and Syria can collaborate with Jordan in order to do the same.

### Next Steps

The joint study commissioned in 2009, or any such joint study to be commissioned at the earliest possible date in the future, is the first step in the right direction. The next step for cooperation between these two countries would depend on the outcome of the report. Once the data is ascertained, agreements on water sharing and joint cooperation in maintaining water quality and preventing pollution can be finalized. There is a regular consultative mechanism between Syria and Jordan at the inter-ministerial level. Meetings between Prime Ministers of the two countries are held at reasonable intervals and Ministers for Water join the meeting. Nevertheless, there has been no substantive discussion on the sustenance of the Yarmouk River beyond the two sides stating their known position. If the two sides agree to commission a study and jointly evaluate its report, conclusions can be discussed in the regular inter-ministerial meeting. The two governments may then decide to examine modalities of basin level cooperation.

## 3. Cooperation in the Euphrates-Tigris Basin (Medium Term):

Turkey, Syria and Iraq are connected via the Euphrates-Tigris Rivers that originate in eastern Turkey and flow southwards into the Persian Gulf. The rivers form one single transboundary course and are connected not only by their natural course when they merge at the Shatt al-Arab, but also at the man-made Thartar Canal in Iraq. The three riparians to the rivers - Turkey, Syria and Iraq - have been coexisting with varying degrees of hydro-political tension over the use of these waters.

A number of problems persist on this subject, with a significant factor being a difference in policy towards what is considered an international river. According to Turkey, the Euphrates becomes an international river only after it joins the Tigris in lower Iraq to form the Shatt al-Arab. Turkey considers these rivers as transboundary, which constitute a single shared basin. This viewpoint is not shared by the two lower riparians and has been the cause of decades of disagreement. While several bilateral and fewer trilateral meetings have been held, no formal

Fig 1-g: Map of the Euphrates Tigris Basin


*Source: http://maps.unomaha.edu/peterson/funda/MapLinks/SWAsia/gallery.html*

agreements have been reached. There is also the added problem of contradicting data coming out of each country on the extent of irrigated land, water requirements and industrial activity. As Aysegul Kibaroglu states in a paper especially written for Strategic Foresight Group, the lack of mutual trust and confidence inhibits the riparians of the basin from releasing the necessary data and information relevant to determining discharge values. Due to the range of figures available, analysts have arrived at a mean average annual flow of 32 BCM for the Euphrates, and 52 BCM for the Tigris. Some estimates for total flow of both the rivers, affected by variations of rainfall, climate change and development activity, vary between 68 and 84 BCM annually.

With population and economic pressures resulting in unilateral development projects, the situation remains tenuous. In total there are 32 major dams on the Euphrates and Tigris, with 8 under construction and 13 more planned. As a result the total storage of the dams on the Euphrates is 148.8 BCM or five times its average annual flow. The combined dam activity, hydro-electric plants, irrigation plans have given each riparian country control at varying levels. The projections by various authors indicate a deficit of

2-12 BCM in the Euphrates at full development if all plans are realized, and a surplus of 8-9.7 BCM in the Tigris in 2020, on which fewer plans are proposed.

Turkey's GAP project which began in the late 1960s and Syria's Tabqa Dam have both resulted in less water flowing down the rivers. The flow was also reduced due to smaller projects in Iraq, especially along the Tigris River. The first tripartite meeting was held in Baghdad in 1965 though no formal agreement was reached and the meeting ended in a deadlock. Iraq took the initiative and set up the Joint Technical Committee (JTC) between Turkey and Iraq in 1980, which Syria joined in 1983. The JTC held sixteen meetings over a decade but did not fulfil any of its objectives. However the role of the JTC should not be underestimated as it was a useful channel for communication. A sustained avenue for cooperation which provides a platform for discussion and development of the basin is extremely important.

In response to Syrian and Iraqi demands for a formal agreement, Turkey proposed the 'Three Stages Plan for Optimum, Equitable and Reasonable Utilization of the Transboundary Watercourses of the Tigris-Euphrates Basin'. The Plan encompassed joint inventory studies of land and water resources of the region and the estimation of the water needs for the competing sectors and agriculture in particular. This, then, would provide the basis for an optimum allocation of the available water. During the negotiations there emerged the fact that the water potential was unable to meet the declared demands of the three riparians. The creators of the Plan asserted that by quantifying the needs, the water issue would become more manageable. With the Plan, Turkey called for the establishment of a joint body for collecting, handling and exchanging data regarding water and land resources so that annual and seasonal variations could be incorporated in the estimations made to determine the allocations. In this respect, data sharing would facilitate the negotiation process and foster the creation of many cooperative structures. The plan was not well received by Syria or Iraq, but it is another option that could be revised and developed according to prevailing conditions to initiate transboundary cooperation.

In 1987, an agreement between Turkey and Syria guaranteed the latter a minimum flow of the Euphrates of 500 cubic metres per sec, which amounts to approximately 15.7 BCM per year. As per a previous agreement, Syria is obliged to allow 58 per cent or about 9.2 BCM to Iraq, leaving 6.7 BCM for its own use. With the construction of the Ataturk Dam and the beginning of the GAP project, Syria has accused Turkey of violating this agreement and allowing less water, which is also polluted, to flow downstream. On the other hand, Turkish experts argue that Turkey has been releasing more than the minimum guaranteed flow. The truth is that flow varies from one period to another within a year and from one year to another. Both countries can focus on data collected on a particular date to prove their argument and both can be right due to seasonal fluctuations.

The Ilisu Dam on the Tigris River, a part of Turkey's GAP project is one of the most controversial issues, not only amongst the riparians but also international credit agencies and NGOs. The dam is expected to hold over 10 BCM of water and will be Turkey's largest hydropower project, generating $400 million for the economy. NGOs claim that the project will have adverse impact on the surrounding ecological systems, and flood the ancient city of Hasankeyf[7]. Several funding agencies withdrew from the project in 2001 owing to international pressure, and after years of inactivity and uncertainty, work on the dam began again in 2006.

The Turkish and Syrian arguments for the individual development projects on the Euphrates and Tigris Rivers have been summarized by Dr. Faisal Rifai in a paper specially prepared for SFG. The Turkish position is as follows:

- The construction of dams is beneficial to all parties, because it controls the flow and may alleviate floods.

- Developing the Euphrates and Tigris waters which originate in Turkey, is a right by way of sovereignty.

- Syrian and Iraqi irrigation networks are inefficient because the water losses from them are over 50 per cent of the water used.

- Water needs in Syria and Iraq are over estimated.

The Syrian arguments may be summarized as follows:

- Water needs and use of the riparian states should be based on the principles of the International "equitable and reasonable uses" described in the UN Convention of Non-navigational Uses of International Watercourses" of 1997 (Iraq has also cited this argument on a number of occasions).

- The protocol signed with Turkey in 1987 to help Turkey filling the Ataturk Dam was on the assumption that it was provisional and would be reviewed to increase the allocations for Syria and Iraq.

- The Sajour River, which originates in Turkey and flows into Syria as a Euphrates tributary is at risk because Turkey is constructing a dam on it.

- Water from agricultural drains discharging into the Euphrates River, its tributaries or into Syrian soils from the Anatolian lands may be polluted by contaminants from insecticides and herbicides. This has caused the pollution of underground resources across the Turkish-Syrian border and increased the salinity in the water of the Euphrates River.

When examined in totality, the annual demand from these rivers from the three countries far exceeds their availability by almost double – more so in the case of the Euphrates than the Tigris. On account of severe drought in June 2009, President Gul of Turkey made a historic visit to Iraq and promised the release of 130 cubic metre per sec (4 BCM annually) from the Euphrates to flow to Iraq, which was to be on an ad hoc basis and stopped at the end of 2009.

On 22 March 2007, Turkish Energy and Natural Resources Minister Hilmi Güler came together with Syrian Minister of Irrigation Nader al-Bunni and Iraqi Water Resources Minister Abdul Latif Rashid in Turkey's Antalya province. The ministers decided that periodic meetings of the Joint Technical Committee (JTC), held between 1982 and 1992 before being severed completely, would be reinstated. Hence, a series of JTC meetings were held in Syria in 2007. At a subsequent meeting in February 2009 in Istanbul, officials decided that they would share past, present and future information regarding meteorological patterns and water quality in the Tigris and Euphrates basins.

The first ministerial meeting between Turkey and Iraq in September of 2009 sowed the seeds of multidimensional bilateral cooperation, which resulted in a strategic partnership agreement committing Turkey and Iraq to cooperate in the fields of politics, economy, energy, water, culture and security (48 Memorandums of Understanding were signed). The meeting was jointly led by Turkish Foreign Minister Ahmet Davutoglu and his Iraqi counterpart, Hoshyar Zebari in Istanbul. On water issues the two sides agreed to exchange data, information and knowledge of experts. Both sides also agreed to use regional water resources in an efficient manner and that the Joint Technical Committee (JTC) should be further strengthened.

Turkey undertook a similar initiative with Syria, during President Bashar Assad's September 2009 visit to Turkey. In the same month the three riparian countries also held a meeting in which they decided to begin water education programs and to monitor and exchange information regarding climate change and drought conditions. Given the potential effects of climate change and the threat of pollution to the river, this is an extremely important and necessary step.

In December 2009, at the first meeting of the High Level Strategic Cooperation Council in Damascus, Turkey and Syria signed 50 agreements and MoUs on cooperation including four MoUs related to water:

- The Memorandum of Understanding Between the Government of the Republic of Turkey and the Government of the Syrian Arab Republic for the Construction of a Joint Dam on the Orontes River Under the Name "Friendship Dam."

- The Memorandum of Understanding on Establishment of a Pumping Station in the Territories of Syrian Arab Republic for Water Withdrawal from the Tigris River. With this protocol, the quantity of water drawn annually from the Tigris River by Syria, when the flow of water is within the average, will be 1.25 BCM. The water withdrawals are decided according to monthly flows, and it is indicated that pumping will be done when time and place allows.

- The Memorandum of Understanding in the Field of Efficient Utilization of Water Resources and Combating of Drought.

- The Memorandum of Understanding in the Field of Remediation of Water Quality.

### Next Steps

The initiatives taken in 2009-2010 at the highest political level have created the promise of cooperation in the Euphrates-Tigris basin. Instead of focussing on areas where disagreements create obstacles in relationship, it would be useful to find areas of agreement and build on them. The first steps could be to agree on principles, norms, standards of measurements and goals, which are common to all three countries and which protect the interests of future generations and environment of the region. This can be done under the auspices of Cooperation Council proposed in this paper. Once such commonality has been established, it would be easier to discuss practical measures of basin level cooperation. Any initiative that the riparian countries decide to take can be supported by international and external donors with technical and financial input.

## 4. De-centralized Water Management in the Palestine Territories (Short Term):

The growing scarcity of water in Israel and the Palestinian Territories has led to over exploitation of ground water resources from aquifers in Gaza and the West Bank. This has endangered health security of the next generation of the Israelis and Palestinians, while the present generation is somehow managing with dwindling resources and increasing pollution.

There is a complete communication deadlock between the dominant political forces in Gaza and the Government of Israel, though an Ad Hoc Committee of the Palestinian Authority and Israel works together on certain logistical issues, including movement of goods into Gaza. However, this does not stop water pollution from spreading across territories beneath the ground controlled by the respective parties. The untreated sewage in Gaza city not only pollute the beach and create lagoons of filth that are an obvious health hazards for the Palestinians but also travels to the port city of Ashkelon. In the West Bank with groundwater flows travelling from the Palestinian side to the Israeli side, the chances of groundwater pollution affecting Israeli sources are much higher. It is in Israeli interests to help build infrastructure in the Palestinian Territories (Gaza and West Bank) and ease restrictions imposed on goods and fuel. Development in the territories will ensure greater water security for Israel in the future. Recognizing this, Ashkelon Mayor Benny Vaknin has initiated a $50 million project to modernize and upgrade Gaza city's sewage and sanitation systems and re-use treated wastewater in Gaza for irrigation.

Building wastewater treatment plants in the Palestinian Territories is necessary, but requires large investments. Funds for wastewater treatment and water infrastructure projects have been put on hold because of administrative hurdles, as well as the political and economic climate of occupation. Gaza has a master plan which includes the expansion and improvement of wastewater treatment – including three new plants but merely 2 per cent of the investment programme has been implemented due to hostilities between Israel and Hamas and sanctions placed on the Hamas government in Gaza after their hostile take-over of the strip in 2007.

The West Bank currently has one functional wastewater treatment plant in Al-Bireh (out of five plants in total) but it produces poor quality effluent that is not even re-usable in agriculture. Sewage has become a serious problem in the West Bank and if not treated it will contaminate the only indigenous source of freshwater that the territory possesses. Pollution of the Mountain Aquifer will affect both Palestinians and Israelis and similarly joint projects to improve the quality of wastewater will benefit them both. Israel has the technical expertise to assist the Palestinians. Today Israel is one of the leading countries in wastewater technology and utilizing wastewater in agriculture; they currently treat an estimated 96 per cent of their total wastewater. According to some experts, building a WWTP in Obeidiya should be the top priority since the wastewater from the Palestinian communities in East Jerusalem and the surrounding area contribute the largest proportion of untreated wastewater being released in the West Bank. Other large scale plants pending are Salfit, Jenin Regional, Tulkarem Regional and Ramallah. In the long term all of these will provide additional quantities of water for re-use in agriculture.

One option for the future, which could be implemented in the short term, is the construction of small household level waste water treatment plants for the poorest of the poor. In a paper specially written for SFG, Dr. Monther Hind and Dr. Clive Lipchin discuss a pilot project in the Bedouin communities of An Najadah and Az Zuweidin (located in the Hebron Governate), which provides an example of the potential of decentralized wastewater treatment plants in the West Bank. In 2009, the Italian Association for Solidarity among People (AISPO), Palestinian Wastewater Engineers Group (PWEG), and Union of Agricultural Work (UWAC) implemented a project to set up grey wastewater treatment plants to benefit 20 Bedouin households. In this system, black water is directed to the cesspit, while first anaerobic, then aerobic processes treat the water. GWWTs (grey wastewater treatment), with a capacity of 0.5 cubic metres per day, were installed to irrigate 500 square metre home gardens. About 80 per cent of household water use is in the form of grey water; out of this about 60 per cent can be recovered, treated, and reused. This system of grey wastewater treatment can yield drinking water savings of 150,000 L/household/year. Each home garden can produce roughly 300 kg of vegetables per season, with two or potentially three seasons each year. This pilot decentralized wastewater treatment programme reduces water consumption, as well as the costs associated with cesspit discharge. This project of 20 households annually provides 3,600 cubic metre of unconventional water, which can subsequently be used in home gardens, with an annual production of 12,000 kg of vegetables. Figure 1-h provides a cost benefit analysis of this pilot project.

Fig 1-h: Cost Benefit Analysis of Grey Wastewater Treatment System (180 cubic metre/yr)

| Cost (Euro) | | Annual Benefits (Euro) | |
|---|---|---|---|
| Construction and installation cost | 2,000 | Savings in emptying the cesspit (per year) | 200 |
| Depreciation (life time – 25 years) | 80 | Savings in freshwater purchase (per year) | 180 |
| | | Savings in medicines, and insecticides (per year) | 250 |
| | | Saving in fertilizers (per year) | 60 |
| | | Gender and Social Benefits: | |
| | | Strengthen socio-economic ties within the family | |
| | | Better relationships with neighbours | |
| | | Reducing management time of women on water and wastewater, giving more attention to family | |
| | | Savings on environment and public health | |
| Total | 2,080 | Total | 690 |

*Source: Dr. Monther Hind and Dr. Clive Lipchin*

Thus going by the estimated costs for the construction and installation of one plant, a two or three million Euro investment could establish a few hundred such plants in the West Bank. Of course a detailed study needs to be done to determine the running, energy and other related costs of such a plant; as well as the total number of people these plants would serve.

Besides the specific plant mentioned in the example given above, several other small size waste water treatment plants are available in the regional and global market. Some of them are designed to use solar energy. Some are slightly larger than the one mentioned above and can serve a small community, not merely a household or a cluster of households. It would be necessary to undertake a market study to identify options for small size waste water treatment plants, particularly the ones which are energy efficient or depend on solar or other alternative sources of energy. Some foreign aid can be allocated for this purpose as it will also provide exposure for companies in donor countries. The total cost would be a few million dollars or euros.

There is also a downside to the decentralised plants. It is difficult to control the discharge and treatment of sewage. Unlike a centralised plant where sewage can be managed by a single authority, thousands of decentralised plants would mean dependence on information, awareness, conscience and willingness of a large number of people to observe self-discipline. Therefore, introduction of decentralised plants in large numbers must be linked to a reliable monitoring and maintenance mechanism.

## Next Steps

Since decentralised plants carry significant benefits for poor communities but risks of health hazards, it would be necessary to have a group of experts to examine all aspects of the viability, merit and costs of introducing such plants on a large scale. The group can prepare a plan of action including technical details, budget, monitoring mechanism and submit its report to the Palestine Water Authority (PWA). If approved by the PWA, the plans should then be discussed at Joint Water Committee to ensure that Israel would allow the movement of components to the Palestinian Territories until Final Status negotiations are successfully completed.

## 5. Confidence Building Initiatives between Israel and Palestinian Authority (PA) (Short Term):

On account of a history of conflict and occupation, there is a breakdown of trust between water managers of Israel and the Palestine Authority. As a result, Israeli and Palestinian experts make conflicting claims about the amount of water, withdrawal, functioning of the Joint Water Committee and wastewater treatment. For instance,

- There is a lack of clarity about the amount of water available from the aquifers in 2010 and for future use. The data available from public sources, and used by major international organisations, does not appear credible. Much of it is based on estimates made in the early 1990s at the time of the Oslo Accords and does not reflect the depletion that has taken place in over 15 years. Informal indications point in the direction of 14 per cent depletion in Western Galilee aquifers and 7 per cent depletion in Mountain and Carmel aquifers. However, it is not clear which side has lost how much as a result of depletion.

- The Israeli experts are of the view that the Palestinians are unduly using water from aquifers over and above their share. On the other hand, Palestinian experts are of the view that the Israeli population is withdrawing more water than what may be considered fair and legitimate as per the proportions determined in the Oslo Accords.

- The Palestinians are of the view that the Joint Water Committee (JWC) does not function fairly and the principle of consensus is often used by the Israeli interlocutors to block developmental projects proposed by the Palestinian representatives in the committee. The Israeli officials are of the view that the committee is functioning fairly and they have only opposed projects of an ostensibly political nature. There are different views about authority and responsibilities in Area B. The Israeli experts argue that the Palestinian officials have not implemented Waste Water Treatment plants for which JWC has granted permission. The Palestinian experts argue that PWA has difficulties in importing or exporting any processed or raw material required for construction and the PWA is prohibited from managing storm water drainage and surface run-off. The sides hold opposite view about the permission granted by JWC to dig wells.

However, both sides understand the increasing gravity of the situation and would like to find a way out, which is fair and reasonable. Therefore, the way out would be to convene a meeting of Israeli and Palestinian interlocutors, along with international observes, on the following terms:

- The objective of the meeting should be to build confidence between two parties, create a possibility for a frank and transparent discussion on issues on which there is disagreement and opposite perception, and to seek clarity and agreement on the facts and real situation.

- The role of the first meeting should not be to discuss solutions and agreements, which may interfere in the peace process. The two sides may decide to continue the process of dialogue and upgrade it to a discussion on solutions either in support of the peace process or in lieu of it, if it is clear that the peace process is deadlocked.

- The main agenda for interaction could be: discussion on current figures about the level of water in all natural water bodies – particularly the aquifers as of 2011, functioning of the Joint Water Committee, defining key challenges in ensuring long term sustenance of the aquifers and all sources of renewable fresh water for future generations.

- The interaction should have the heads of water authorities of Israel and the Palestinian Authority and a maximum of three to four other persons from each side.

- The interaction should also have international observes from the Quartet or other members of the international community.

- The interaction - and the participation of the heads of water authorities - should be approved by government leaders in the two countries.

- The interaction should be completely confidential with no presence of the media, NGOs or others.

While the international community should take the initiative to urge both parties to have at least one detailed and confidential meeting, led by heads of water authorities and sanctioned by Prime Ministers from both sides, the future of the process and subsequent interactions should be shaped by the parties themselves.

## Next Steps

The Geneva Initiative Annexure Report, released in September 2009, has a section dedicated to water issues. It suggests that both parties must avoid causing significant harm to existing freshwater resources, with reference to over-pumping and pollution of aquifers. It proposes that appropriate measures should be taken to make sure that utilization and development procedures by one party do not in any way hinder water availability for the other. The report also recommends the resolution of disputes through peaceful means and the establishment of a Joint Water Commission that would resolve common issues such as monitoring, collection of data and water pollution.

The Geneva Initiative Annexure Report states that a re-division of access to water should take ecological factors, population, financial capabilities and availability of alternative resources into consideration. The report also mentions increasing the total amount of water resources through investments in marginal water and import of water from neighbouring countries. In order to reach an agreement on the share of water by Israel and the Palestine Territories, a reassessment of the current quantity in each of the three sub-aquifers is desperately needed. Measurements of actual freshwater availability in the Mountain Aquifers will have to be re-assessed.

It is now necessary to move from the broad understanding reflected in the Geneva Initiative Annexure, to the meeting of water commissioners authorised by the respective Prime Ministers as proposed above. Such a meeting should not be confused with technical level process taking place under the auspices of the United States since 1995 which was decided to be strengthened with quarterly meetings in 2010. It is important that any new process does not duplicate or complicate ongoing processes. The main value of the confidence building initiative would be its functioning at high political level with approval of the respective leaders and key international players.

However, for such an initiative to be successful an interim step is required. The international community or even any one country can take the initiative to convene an independent group of politicians and policy makers from Israel and the Palestinian Authority to meet in a neutral location, to prepare the ground for the authorised meeting between water commissioners proposed here. Such a group should have members of the Knesset and Palestinian Legislative Council, former ministers, and those associated with the water and environment sectors. For such a group to be effective it should be constituted by persons from the policy related sphere and not from civil society groups or technical experts. The group should interact with political leaders and water commissioners before and after their meetings.

It is envisaged that one or two meetings of such a group could pave the way for the confidence building initiative proposed above.

## 6. Red-Dead Sea Canal (Long Term):

The Red-Dead Sea Canal (RDC) is a joint Israeli-Palestinian-Jordanian venture that aims to build a 112 mile pipeline from the Red Sea to the Dead Sea. Taking advantage of the 400 metre drop from the Red Sea to the lowest point on earth, the pipeline will transfer an estimated 1.8-2 BCM of seawater annually to the Dead Sea. Half of this water is intended to replenish the fast depleting Dead Sea. The other half will be used in a desalination plant, constructed at the Dead Sea and will function as an additional supply of water for all three of the partner countries - a supply that more or less satisfies their combined excess water requirements till 2030. It is estimated that the water will take 3-4 days to flow 105 miles, relying entirely on gravity, and that the force or pressure created by the drop will be harnessed to produce hydro-electricity for the desalination plant.

The project may cost anywhere between $5 billion to $20 billion. It will be partially funded by the international community, as well as by Israel and Jordan. The Palestinian Authority is meant to use funds donated to it for this purpose as well. Governments are expecting that the private sector will contribute to financing the project, if they provide an enabling environment. For instance, the private sector may invest in the desalination plants and earn revenue by selling water. It can set up the infrastructure, tourism, housing and thereby earn returns. In the beginning governments will have to depend on multi-lateral funding to create the conveyance. Three possible conveyance systems are being examined: a buried pipeline, a low-level tunnel all the way and a higher-level tunnel and canal system.

Another option proposed by Israel, involves the same concept of transferring water via the future pipeline, between the Mediterranean Sea and the Dead Sea. The project is estimated to take around five years to build but perhaps 20 years before it is fully operational.

Yet before the Red-Dead Sea Canal project is launched it requires several feasibility studies. After a decade of discussions and planning, the project was proposed in 2007 at a Jerusalem meeting called by the World Bank. At that time the proposal was rejected because it was considered economically flawed.

### Components of the Canal

Firstly, the seawater from the Red Sea would have to be pumped approximately 200 metres uphill from the Gulf of Aqaba, before it continues its steep descent to the Dead Sea (which lies 400 metres below sea level). Therefore, in order to bring 1.8 BCM of seawater annually into the canal, the plan calls for the construction of the world's largest pumping station - situated at the northern tip of the Red Sea between Aqaba in Jordan and Eilat in Israel - that would require 550 MW of electricity just to pump the seawater uphill in the initial stage of the project.

Secondly, the transportation of desalinated water is very expensive. The 400 metre drop below sea level would no doubt generate hydro-electricity for the desalination plants situated at the Dead Sea and this would reduce the cost of desalinated water considerably. But pumping the water from the desalination station to cities in Israel, Jordan and the Palestinian Territories would be a financial and labour intensive effort. Jerusalem, for example, would require water to be pumped to more than 1,000 metres elevation, where the topography is fairly steep in places. This would raise the cost of water to $1 or $1.50 per cubic metre – almost a dollar more than the cost of a cubic metre of desalinated water currently in Israel. It will translate into a consumer price of

$2-2.50, which would be unaffordable.

The project is expected to be implemented in three phases:

- Phase I: transfer water from the Red Sea to the Dead Sea
- Phase II: produce energy and desalinate water
- Phase III: transport desalinated water and energy to the beneficiary parties.

Fig 1-m: Route of the Red-Dead Canal


*Source: Eng. Zafer Alem*

Several feasibility studies for the RDC project are still underway and should be completed by end of 2011.

The World Bank has taken on an official role as co-sponsor and coordinator of these feasibility studies, estimated at $15.5 million dollars (donor countries include France, Sweden, Japan, Italy, Netherlands, USA, Greece and South Korea). The focus of these studies is to assess not just the economic viability of the project, but also its environmental and social consequences. One study headed by Dr. Itai Gavrielli of the Israel Geological Survey, in the middle of 2010, called for further research to determine the long term effects of mixing water from the Red Sea to the Dead Sea. Mixing Red Sea water introduces sulfides which are not naturally found in the Dead Sea and it has yet to be determined how this will affect the unique mineral composition of the Dead Sea. There have been concerns expressed that the feasibility studies are being rushed without reaching desired results.

In June 2009, after meeting with the World Bank President Robert Zoellick, the Israeli Regional Cooperation Minister, Silvan Shalom, announced a pilot project to build a 180 km long pipeline from the Red Sea to the Dead Sea. It will pump 200 MCM of seawater annually. Half of this would be pumped into the Dead Sea and half will be funnelled into desalination projects. This pilot project is meant to judge not just the business viability of the RDC, but also the social and environmental effects that it may have in the future.

Some of the concerns include environmental issues such as the effect that the Red Sea water can have on the mineral composition of the Dead Sea[8], possible seawater contamination of surrounding aquifers in the occasion of a pipe burst or leakages and the effect that seawater pumping can have on the marine life in the Gulf of Aqaba. Social consequences include the rise of monstrous tourism projects that have been announced in anticipation of the RDC[9] and the impact that the RDC can have on surrounding farming settlements and people who live in the region[10]. Lastly, there is a huge financial concern that looms over the project. According to some sources $20 billion is required. The investment is supposed to come from international donors as well as the three parties involved, including private sector in those countries. However, both Israel and Jordan have already spent a reasonable amount of money on alternative water resources and securing more finances will prove difficult.

In September 2009, Jordan announced that it would embark on a unilateral large-scale desalination project without Israel and the Palestinian Territories as its water problems were worsening. Jordan's National Red Sea Project (JRSP) will bring 70 MCM of water annually to Jordan. The cost for the first stage of the project alone is estimated at $2 billion and Jordan is still in the process of acquiring funding for this. Under the circumstances it is difficult to foresee Jordan being able to secure further funding for the Red-Dead Sea Canal after its large scale National Red Sea project.

### Next Steps

As feasibility studies are under preparation, under the supervision of the World Bank, it would be essential to wait until the beginning of 2012 for their presentation to the three parties and international investors and donors.

## 7. Joint Desalination Plants (Long Term):

Most of the countries covered in this study are exploring the option of additional water that will supplement their freshwater supply; either because they are currently using over 100 per cent of their freshwater resources, as in the case of Israel, the Palestinian Territories and Jordan or because of limitations in supply and concerns for future water deficit, as in the case of Syria and Lebanon. However, almost all such plants are being set up or proposed as national projects. Such national plants carry security risks, since they could be the target of air or missile attacks in case of an armed conflict. If a desalination plant is run with nuclear energy and if it is attacked during hostilities, it would cause incalculable damage for the environment and population. It would be therefore advantageous to establish jointly owned desalination plants.

Advantages of Joint Desalination Plants:

- Joint plants are more secure as there is no incentive to attack them in the event of hostilities.
- Joint projects are easier to secure funding for, from the international community. The donors can also encourage joint ownership and management if they put in a lot of resources.
- The establishment of joint desalination research centres would also help to create and share desalination technology in the region. The centres can utilize expertise from all over the region to find more efficient, environmentally responsible and cost effective measures for desalination.

The present level of trust deficit in the region may not render joint desalination plants feasible. But political dynamic of the region is changing. Israel, PA and Jordan have already agreed to have a joint desalination project in the form of RDC complex. The relations between Turkey, Syria and Iraq are improving at a fast pace. While they may take a long time to agree on protracted disputes such as the one over the Euphrates, it would be easier to establish new joint ventures. It is not possible to envisage a joint desalination plant between Israel and Lebanon/Syria. However, joint desalination plants within each Circle of Cooperation should be feasible, and indeed easier than resolving long outstanding issues.

While desalination plants are expensive at present, technology is changing at a fast pace. New technology may enable small plants run by solar energy or plants powered by energy generated from urban garbage. Research in nano-technology indicates that it might be possible to produce a desalination plant at 50 per cent or less of the present costs.

### Next Steps

The experts in the region need to find out more about new technologies that can reduce financial costs substantially, as in the case of nano-technology or mitigate the use of fossil fuels as in the case of solar energy or garbage converted into energy especially to run desalination plants. It is also necessary to undertake comparative cost-benefit analysis of different sizes of desalination plants. This process is expected to take place in the commercial sector. The policy makers only need to provide an appropriate policy environment to encourage private sector cooperation between countries within each Circle.

To the extent that governments in the region are involved in projects and seek international funding, donor governments should urge the World Bank to convene a meeting to discuss the manner in which international funding can encourage joint ownership, research, development and management of desalination plants in the region.

## 8. Export of Water of Turkish National Rivers to the Jordan Valley (Long Term):

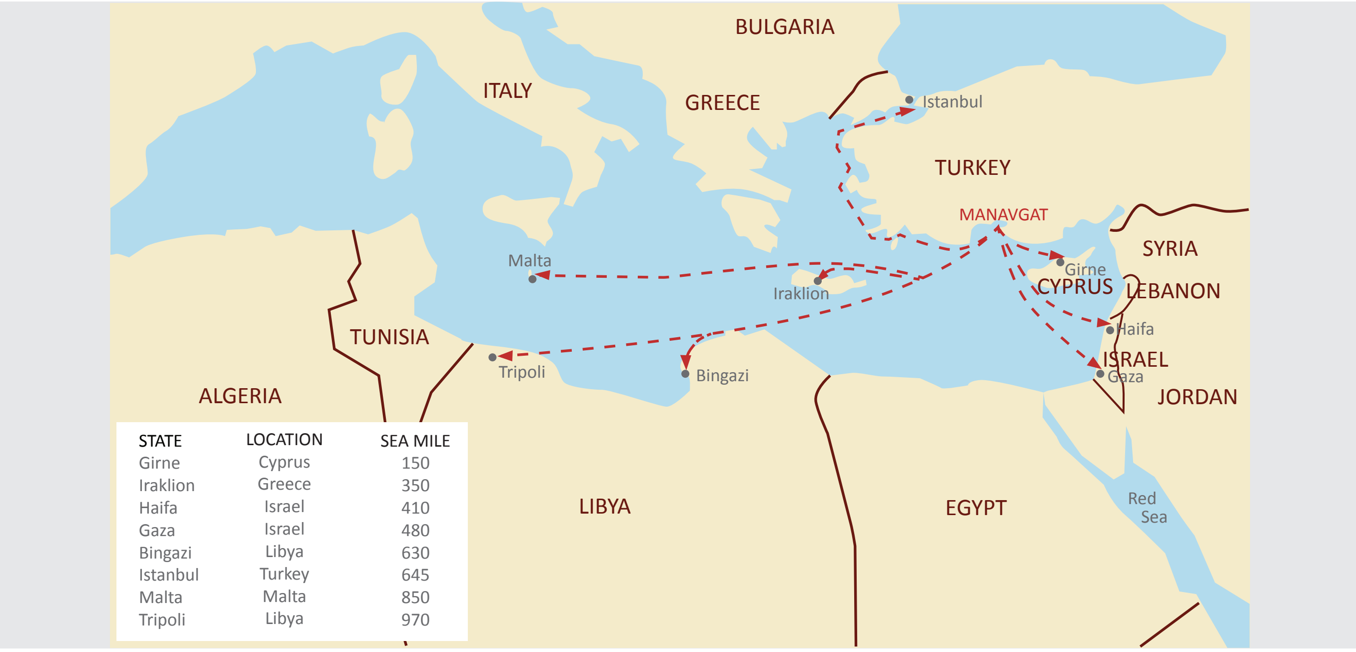
There has been discussion in Turkey on the possibility of developing fast moving national rivers for export. In the past, there was a proposal to export water from Seyhan and Ceyhan Rivers via pipelines to the Arabian Gulf. In the recent years, a proposal to export water from Manavgat River to Israel has been discussed.

The Manavgat River, located in southern Turkey originates in the Western Taurus Mountains and empties into the Gulf of Antalya. The river has a mean annual discharge of 140 cubic metres/sec or 4.7 BCM annually, of which 60 cubic metres/sec or 1.8 BCM are judged to be available for export. The existing plants are equipped to deal with only about 180 MCM of this water. The river is one of several situated in the southern province of Antalya and it has been estimated that even if the entire amount of 1.8 BCM were exported, it will not drastically affect the supply to the population in the future.

The Manavgat River Water Supply Project began in 1992 and was completed in 1997 with a total cost of $150 million. The project is equipped to provide up to 250,000 cubic metres of purified water and another 250,000 cubic metres of un-purified water daily. Separate pipelines and receiving stations have also been built from the river to the coast, where the water can then be loaded onto tankers, ready for export. Export of the Manavgat water to Northern Cyprus began in 1999, and in 2000 talks were held with Jordan, as well as Israel for the water.

In January 2004, an agreement, in principle, was signed after more than two years of negotiations for Israel to purchase 50 MCM of water annually for 20 years from the Manavgat River. Special tankers were commissioned to be built to transport the drinking water from Manavgat to Ashkelon on Israel's coast, a distance of 325 nautical miles, and from the port the water would be carried to the existing National Water Carrier. In March 2004, further steps were taken to implement the agreement and Ankara spent several millions for water treatment facilities, and more storage along the Manavgat. But in all the meetings the cost of water and cost of transportation were never finalized and proved to be one of the key impediments to the project. An alternative option to the tankers could also be to build an underwater pipeline across the Mediterranean Sea to Israel. With an average depth of 1500 metres, a low lying pipeline could be constructed near the bed of the sea. This has been done before in the Black Sea, where the current pipe carrying oil was laid at a depth of 2100 metres.

Fig 1-j: Water from Manavgat River Project to Countries in the Region




| STATE | LOCATION | SEA MILE |
|---|---|---|
| Girne | Cyprus | 150 |
| Iraklion | Greece | 350 |
| Haifa | Israel | 410 |
| Gaza | Israel | 480 |
| Bingazi | Libya | 630 |
| Istanbul | Turkey | 645 |
| Malta | Malta | 850 |
| Tripoli | Libya | 970 |

*Source: Presentation by Dr Omer Ozdemir at Sanliurfa, Turkey, September 2010 on file with SFG*

Experts vary in their estimates of the cost of water from Turkey, which ranges from $0.80 - $1 per cubic metre, which is more expensive than the water from desalination (approximately $0.50 - $0.55 per cubic metre, which could reduce further due to recent gas discoveries in the Mediterranean Sea, off the coast of Israel). It is important to note here that this will be the cost to Israel, and not to the consumer, which could be more depending on a number of factors. It has also been argued, mainly by Israeli proponents of the desalination option, that the 50 MCM will only serve 3 per cent of Israel's water consumption. But a March 2010 Knesset Special Committee Report[11] stated that the environmental damages of purchasing Turkish water would be less than the environmental damages involved with sea water desalination.



The idea of water sale from the Manavgat Project has raised some concerns in Turkey from time to time, particularly in the Parliament. Parliamentarians from the area have questioned the critical issue of pricing water, as well as raised concerns about the impact of the proposed sales to Israel vis-à-vis Turkey's relations with other Middle Eastern countries. Furthermore, the Members of Parliament were curious whether water ownership rights of the river would be transferred to Israel for a long duration such as 20 years. In each case, the technical and diplomatic bureaucracy concerned with the project reassured the Members of Parliament about the benefits of the project. In this respect, doubts raised were reassured by stating that the social water demand is limited (irrigable land within economic reach is limited and is mainly found at the estuaries) in the Manavgat river basin since the area is mountainous and forested. The Ministers have also stated that the Manavgat River's annual medium discharge rate is 4.7 BCM of which 180 MCM/year of water could be used by the project; and only 50 MCM/year is agreed to be exported to Israel for about 20 years.

The export capacity of the Manavgat facility is only 180 MCM annually, of which some water is already being sent to Northern Cyprus. Other countries such as Libya, Malta and Greek Cyprus have also expressed an interest in purchasing this water for a sustained period of time. The possibility that an agreement between Turkey and another interested party will be reached in the near future should not be discounted. Such an agreement would effectively mean that in the future if Israel or Jordan needs the water, it could no longer be available.

## The Seyhan-Ceyhan Basin

Besides Manavgat, other fast moving rivers could be also exploited by Turkey for exporting water. Some of the main rivers that discharge into the Mediterranean are Aksu, Esencay, Seyhan and Ceyhan. The combined capacity of national rivers is estimated at 35 BCM annually.

Seyhan and Ceyhan Rivers were considered for export of water as long as 20-25 years ago by President Ozal. At that time, President Ozal had proposed a land route. It does not appear to be feasible any longer due to seasonal variations in the river flow which may leave no exportable surplus for 3-4 months in the lean period. Located in southern Turkey in the province of Adana, Ceyhan and Seyhan Rivers have a combined exploitable potential that ranges from 12-16 BCM. The State Hydraulic Works (DSI) has developed plans for ultimate use of the waters, and Water Users Associations in the region represent the farmers who will have a stake in deciding the use the waters of the basin. The current demand and consumption for industry and agriculture stands at a little over 8 BCM annually, and with all the planned activities this will increase over the next few decades. Some scientific studies indicate that that the impact of climatic changes on the hydrology and water resources of the Seyhan river basin could be extremely large; a major fraction of the runoff in this river is dependent on snowmelt which is especially sensitive to changes in temperature, but this view is not yet widely accepted by the government and entire scientific community and is still under debate.

The surrounding delta is fertile and high value crops are produced for international markets – and the DSI has designed plans to ensure this flow is not disrupted. The DSI has also determined that the water available for use is of good quality. Allowing for industrial development, the basin has at the very least 4 BCM for export and other humanitarian use. At the current rate of growth in demand at 2 per cent, the consumption will be approximately 9.6 BCM by 2020, leaving 2.4 BCM as surplus in ten years. Allowing for future developments of Turkey, possible shrinking of the river due to climate change, and other occurrences, it can be assumed that there would be at least 1.5 BCM of water available in the basin. Even if a lower estimate of 1 BCM is realised from Seyhan-Ceyhan, an extra 300-500 MCM might be available from Manavgat and other national rivers. However, much of the export would be possible only over a period of 6-8 wet months. It will be impossible to export water from these rivers during the lean months.

The main reason is that with seasonal variations, monthly water budget can be as low as 100-200 MCM per month during lean months. This can occur for 3-4 months in the year. As local demand would need to be satisfied, there would be no exportable surplus. If pipelines are laid, they will be unused for a quarter of the period. As a result, the quality of pipelines will substantially deteriorate due to corrosion and other problems. Thus, the original Ozal plan for exporting national waters by pipelines will not work by 2020 and beyond. However, a project on the lines of Manavgat deal of exporting water via the Mediterranean by tankers is possible. The question of under sea pipelines, much shorter than the pipelines via land, will need to be examined.

The flow of the Jordan River has reduced by almost 1.2 BCM of water due to over pumping and use by the riparian countries. Assuming that Turkey annually replenishes the Jordan River to its original flow, it would mean 1.2 BCM of water flowing into the Jordan River and to the Dead Sea. This water could be used not only for consumption by Israel, Palestine

Territories and Jordan, but also restore the river and the Dead Sea.

Jordan, Palestine and Israel could incur an annual deficit of about 700-800 MCM by 2020, and about 800-1000 MCM by 2030, if their plans to expand desalination capacity do not succeed. If this total deficit amount were added to the water required to replenish the Jordan River, it amounts to about 2.2 BCM in 2020 and 2.4 BCM by 2030. With a potential availability of at least 1.5 BCM annually from the Seyhan/Ceyhan Basin and other Turkish national rivers half the water could be allowed to flow naturally into the Dead Sea and the other half would be shared equally or in proportion by the other parties.

It is also important to keep in mind that Turkish national rivers need not fulfil all the future water requirements of the Jordan River and the riparian countries. If it is found that for the period of 2020-2050, approximately 1.5 BCM of water per annum is available from the Turkish national rivers, it will be sufficient to offset some amount of stress that the Jordan Valley countries will face in the future. Clearly there will be a need for proper management within the countries, as well as a need to examine developing marginal water capabilities in addition to receiving fresh water from Turkey.

## Benefits

Turkey plays an important role in the region and in this context considers water as an instrument for regional cooperation. Such a plan not only aids Turkey in this endeavour but will also garner revenue from the sale of water. A supply system of storage, tankers, and perhaps the under sea pipeline in the region would provide jobs, investment and a boost to the local economy. Ultimately the real benefit to Turkey would be political, as they will hold an important asset that no one else will be able to deliver. With this Turkey holds the ability to persuade Israel and the Palestine Authority (or a future state) to engage in a relationship of peace and cooperation. Without a cooperative relationship between Israel, Palestine and Jordan, Turkey's plan of exporting water will not be politically feasible.

The water from Turkish national rivers would cost Israel approximately $0.80 per cubic metre (though this could decrease in the future), a little higher than local desalination projects at $0.50-$0.60 per cubic metres. Thus, while cost would be higher, the difference is not enormous. The essential problem for the Jordan Valley countries is not of cost – they have a much more basic problem of the availability of water itself.

It is unclear if Israeli politicians would potentially consider a water swap; this would essentially mean that for a part of Turkish water, Israel releases a certain amount into Gaza, or the Jordan River. This would be beneficial to the Jordan River and the Dead Sea in the long run. This water swap could deflect some criticism from the Arab states and any pressure they would apply on Turkey, as well as be a step towards promoting regional cooperation.

Perhaps the most important benefit that Israel would enjoy by diversifying its water resources is internal security. The import of Turkish national waters would not only satisfy a portion of Israel's demand for water but would reduce drastic measures like exploitation of shared water resources, and any possible conflict that could arise from such a situation.

## Current Status

2006 saw a change in the discussions, which moved beyond the water issue and included a possible future deal for gas. Under this project the existing Baku-Tbilisi-Ceyhan Gas pipeline will extend to Israel, and a network of four lines would be built to transport oil, gas, and water, as well as either fibre optics or electricity. Turkey has also held preliminary discussions with India on further transporting the oil to India, and other countries who want to bypass Iran. Existing dialogue between Turkey and Israel have centred on bringing these four lines from the Ceyhan Basin down the Mediterranean. If this were to materialize in the future, it could potentially result in water being transported from the Ceyhan/Seyhan basin, and not from the Manavgat.

Following the crisis in Gaza in January 2009 and the high seas confrontation near Gaza in June 2010, ties between Turkey and Israel were strained, and no further discussions have been conducted.

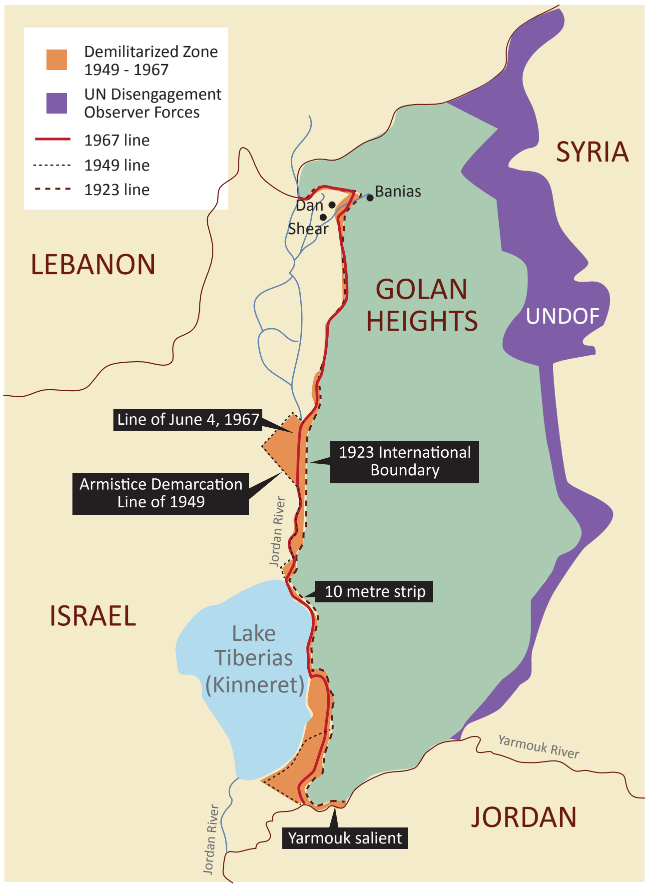
### Next Steps

Turkey has already begun exporting water to Turkish Cyprus and is in negotiation with other Mediterranean countries on the Manavgat water. At this point it is important to determine how much of the national rivers water would be available to the Jordan Valley countries, and if it will be available all through the year or there will be disruption in supply in the lean months. It is also equally important to conduct studies to examine the cost of transporting the water via an underwater pipeline vs. sending the water via tankers. Such studies must particularly assess the long term impact of climate change on national river flows, since there is considerable uncertainty at this stage. The estimates of supply on a monthly basis after taking into account climate change effect and seasonal variations will need to be compared to projected demand to assess exportable surplus over the next few decades. The political climate prevailing at the beginning of 2011 may not appear conducive for cooperation between Turkey, Israel, Jordan and the Palestine Authority. However, as Turkey's relations with Israel has gone through ups and downs between 2008 and 2010, it proves that political dynamics can change any moment in either direction with certain triggers. It is important to have reliable scientific and economic information readily available so that political leaders can make a well considered and technically sound choice when they are prepared for it.

## 9. Lake Kinneret (Tiberias) as Regional Commons (Long Term):

Syria lost control of the Golan Heights to Israel during the 1967 war. As a result Israel gained control of the Banias River and consequently secured control of 50 per cent of the Jordan River's upstream flow. Before this, the Dan River was the only source of the River Jordan that was located wholly within Israeli territory.

Fig 1-k: Different Borders between Syria and Israel at the Golan Heights




*Source: "Water Scarcity in Syria: Current and Future", 2010, Dr. Faisal Rifai*

In a 1999-2000 peace deal, brokered by the US and held in West Virginia-USA, Syria agreed to normalize relations with Israel and recognize its statehood in return for an Israeli withdrawal from the Golan Heights. While Syria insisted on the 1967 pre-war borders, Israel insisted on the 1948 borders. The main issue of contention was access to Lake Kinneret (Tiberias). In May 2008, Israel and Syria announced that they were conducting indirect talks or 'proximity talks' with Turkey as mediator and this included potential options over the Golan Heights. But talks broke down after the Gaza War broke out in 2008-2009 and have not been able to resume since.

From time to time there is speculation about resumption of talks between Syria and Israel, though often such rumours are denied by either or both parties. When finally talks do take place, they are likely to take off from where they left off, right before the Gaza War in 2008. Given current relations between Israel and Syria these talks will most probably be indirect, involving Turkey and some European countries as intermediaries, or perhaps even the United States. The agreement will involve a withdrawal by Israel to borders that are agreed on by both parties.

Once an agreement on the definition of the border (1948, 1967 or something else) and withdrawal of the Israeli forces within a time line is reached, the actual execution will require a process supervised by the international community. Israel should physically withdraw from 50 per cent of the area agreed to during the talks. At that time Syria can initiate the normalization process and call an end to enmity. From this point onwards Israel and Syria can conduct direct talks on land, borders, security, communities settled in the Golan and further withdrawal. The talks will include several issues, of which one will be about water security and sustainability for both parties. For the purpose of this report, potential for talks on water between Israel and Syria is our main focus.

With regard to water, Israel's main concern will be the Lake Kinneret (Tiberias); mainly maintaining the quality and quantity of one of Israel's most precious freshwater resources. Since some of the main sources of water, such as the Banias and the springs, are located in the Golan Heights, Israel will want assurances that these sources are kept clean and are not blocked or over-pumped in years of low rainfall. Syria on the other hand will want a level of independence once it gains control of the Golan Heights. In fact, Syria's insistence on complete Israeli withdrawal is to be seen in the context of its desire to pump water from the Lake Kinneret (Tiberias).

Therefore, 50 per cent withdrawal by Israel in return for an end to hostilities is a politically feasible proposition as the basis for conducting substantive negotiations. The main problem would be with Syria demanding Israel's full withdrawal and wanting to have access to the lake, while Israel demanding assurance for free flow of water to Lake Kinneret (Tiberias) and therefore maintenance of military control in a strip near the lake. Thus, both sides want to control the lake. The only possible option therefore is for Israeli withdrawal from Syria to the maximum extent as negotiated by the two parties and declaration of Lake Kinneret (Tiberias), Upper Jordan River with its tributaries, and all sources feeding the lake as a Regional Commons to be governed jointly by Israel and Syria with some role for international community in the management of such Regional Commons.

## Next Steps

1. At the outset there needs to be a revival of indirect "Land for Water" peace talks between Syria and Israel under the auspices of Turkey, EU or the United States.

2. A proper agreement should be reached about the border line, and a time table for Israeli withdrawal from the Syrian land, and Syrian assurance of Israeli access to Lake Kinneret (Tiberias) under joint management.

3. Transformation of peace processes from talks and

agreements to implementation under the auspices of the United States, Turkey and the European Union.

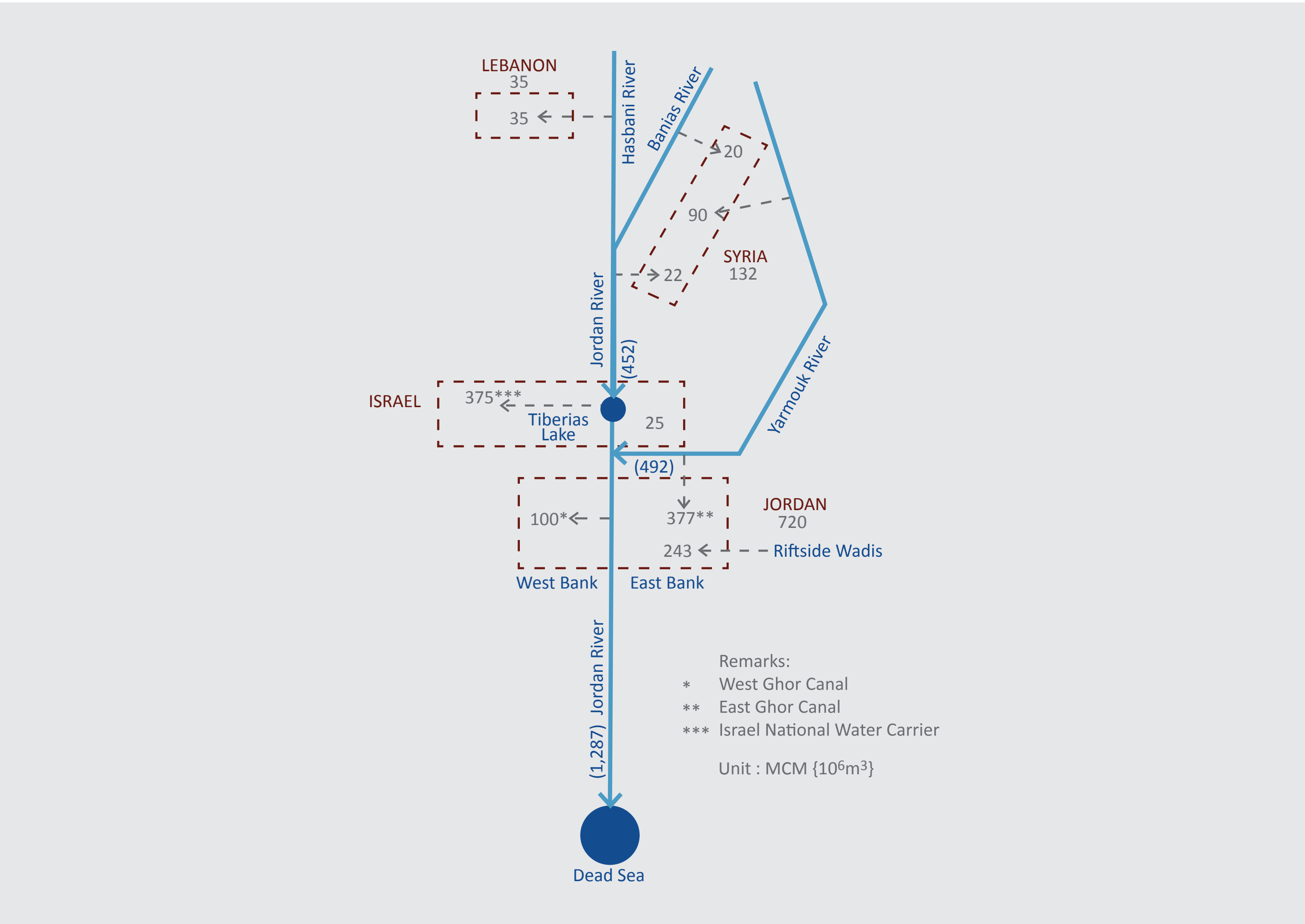
4. Physical withdrawal by Israel of 50 per cent of the land as per the border agreed upon in the first phase of talks, and declaration by Syria of the end of hostilities along with measures to ensure Israeli's physical and water security.

5. Opening of talks between Syria and Israel on water cooperation to include declaration of Lake Kinneret (Tiberias); terms of joint management of Lake Kinneret and its water sources.

Figure 1-l is included here for its historical reference to the water situation in the region, and its importance in developing any future strategies.

In Figure 1-m, Dr. Marwan Haddad outlines the cost of water under a variety of options to different cities. Some of these plans have been discussed in the previous section of this report. It would be useful to update the calculations at a later stage, as these dollar estimates are from the late 1990s and early 2000, taking into account changes in technology, the cost of the tankers and other transportation costs, as well as the amount of water available.

Fig 1-l: Schematic Representation of the 1955 Johnston Plan




*Source: Eng. Zafer Alem*

Fig 1-m: Regional Sub-Options for Mobilization of New and Additional Water

| Regional Option | Sub-Option | Module Size (MCM/a) | Delivery Point | Production Unit Water Cost (US$/cubic metre) | Total Unit Water Cost to Demand Centres (US$/cubic metre) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | TLV | GAZ | RAM | AMM |
| **Sea Water Desalination** | Single Reverse Osmosis Desalination Plant | 50 | Med Coast | 0.68 | 0.70 | 0.70 | 0.84 | 0.97 |
| | Med-Dead Inter-sea Scheme | 800 | Dead Sea | 0.42 | n.a. | n.a. | 0.72 | 0.72 |
| | Red-Dead Inter-sea Scheme | 850 | Dead Sea | n.a. | n.a. | n.a. | 0.98 | 1.01 |
| **Water Import by Sea** | Used Tankers | 200 | Med Coast | 0.83 | 0.85 | 0.85 | 0.99 | 1.12 |
| | New Water Tankers | 200 | Med Coast | 1.12 | 1.14 | 1.14 | 1.28 | 1.41 |
| **Manavgat River** | Large Vinyl Bags | 200 | Med Coast | 0.55 | 0.57 | 0.57 | 0.71 | 0.84 |
| **Water Import by Land** | Pipeline from Turkey | 150 | Lower Jordan R. | 1.44 | 1.95 | 2.16 | n.a. | |
| | Seyhan-Ceyhan Rivers | | Amman | 1.65 | | | | 1.65 |
| | | 200 | Lower Jordan R. | 1.36 | 1.85 | 2.13 | n.a. | |
| | | | Amman | 1.54 | | | | 1.54 |
| | Pipeline from Iraq | 150 | Lower Jordan R. | 0.94 | 1.50 | 1.59 | n.a. | |
| | Euphrates River | | Amman | 1.13 | | | | 1.13 |
| | Pipeline from Lebanon | 150 | Lower Jordan R. | 0.15 | 0.83 | 1.18 | n.a. | |
| | Litani River | | Amman | 0.68 | | | | 0.68 |

*TLV = Tel Aviv, AMM = Amman, RAM = Ramallah, and GAZ = Gaza City*
*MCM/a = million cubic metre per year, n.a. = Not available*
*Source: Paper specially prepared for SFG by Dr. Marwan Haddad*

# Managing Demand – The Other Side of the Coin

Most countries in the Middle East have some of the highest population growth rates in the world; this combined with an increased standard of living will lead to growing demand for water, especially in the domestic sector. Hence there is a need to put measures in place that will mitigate or control some of this demand.

Demand management is defined by some experts as 'the development and implementation of strategies aimed at influencing demand, so as to achieve efficient and sustainable use of a scarce resources'. There are two different approaches to targeting demand management. The first deals with structural measures. This includes leak detection and control systems in water distribution units, drip irrigation technology in agriculture and low-flush toilets in the domestic sector. The second approach involves non-structural measures. This involves economic and legal incentives that change the behaviour of the user, as well as institutional changes at the policy level.

There is a lack of a comprehensive water law which is a major challenge in the water sector in some countries. A clear need is identified for a framework law which assembles the guiding principles, norms, rules, procedures in water resources management and allocation. It has already been recognized that enacting a comprehensive national law will enable states to determine the roles and functions of existing actors/institutions; prioritise issues such as drought and flood management; cope with the impacts of climate change as well as water supply (conventional and unconventional-desalination, wastewater treatment); demand management with modernized and harmonized water information systems.[12]

Although water demand management has been addressed to some extent by all these countries and is not absent as a policy goal, it remains secondary to supply management and government expenditure. There is, therefore, great scope for further analytical work on demand management and even greater scope on ways to promote its adoption.

# Israel

Demand management, both structural and non-structural, are an integral part of Israel's solution to its water problems. The country pioneered efforts to try and increase its water transport efficiency in the 1960s through the National Water Carrier system (NWC). The NWC transports water from Israel's relatively water-abundant north to its water-scarce Negev desert in the south. It carries roughly 40 per cent of Israel's freshwater and has greatly increased water transportation efficiency.

Water loss has also been reduced to around 12 per cent in 2002, and may have come further down by 2010. (However, it is difficult to reduce water loss below 10 per cent.) This is partly because of Israel's advanced leak detection systems. A recent report revealed that Israel now has a 'fly-by system' where drone aircrafts read water metres in order to identify leaking pipes and this has helped save billions of dollars in lost water.

Non-structural measures have also been used to try and reduce water usage. Israel has launched a series of water saving campaigns, such as the 'Israel is Drying up' Campaign which reduced private water consumption by 12 per cent during the 2005-2008 drought, water saving campaigns instituted in 2000 and a recent campaign to save the Sea of Galilee.

In 1959, a Water Law was passed by the parliament declaring all water resources to be public. This helped to regulate water resource exploitation, allocation and water pollution. A Water Commission was also set up to regulate, monitor and manage the country's water resources.

Some of the plans to implement Water Demand Management (WDM) over the years include:

## Domestic and Municipal Use

- Double-volume toilet flushing basins were manufactured and enforced by law.
- Implementation of a tariff structure whereby the price of water per unit increases as the total amount of water used increases.
- Flow and pressure regulators on taps and showers were encouraged in the market. The 'Blue Label' project aimed to indicate the effectiveness of a product with regard to its water-saving capabilities. Products that were 'water friendly' were marked with a sticker with a blue drop.
- Water conservation campaigns have been launched in Israel over the past few years. Several websites including the Ministry of Environmental Protection have information on water saving measures.
- Water sensitive urban planning has been introduced in order to reduce water loss through surface run-off (estimated at 70 MCM before 2005) and in order to increase the quantity of rainwater penetrating into the ground.
- Use of water-saving technology such as drip irrigation, leak detection systems, mulching and water-efficient plants are being used in urban parks and gardens.
- The replacement and maintenance of pipes in order to reduce leakages amounting to roughly 50 MCM a year in 2005.
- Installing carwashes that use a recycling system for rinsing water. While a regular carwash uses 180-250 litres of clean water per vehicle, the recycling

system uses only 15-40 litres of clean water per vehicle.

## Industrial Use

- Using treated wastewater in industry.
- Installing cooling systems, metres and pressure reduction systems to reduce the loss of water through evaporation or leakages.
- Adopting technical means to reduce the water usage per unit of a product.
- Reducing water pollution by the industrial sector.

## Agricultural Use

- In recent years Israel has drastically cut down water allocated to the agricultural sector, especially during times of drought.
- Research, development and implementation of water-efficient agronomic techniques, particularly drip irrigation techniques and automated irrigation.
- Replacing old pipe systems and gravity irrigation with sprinklers and modern technology.
- Low water volume irrigation systems have increased the average efficiency to 90 per cent as compared to 64 per cent with the old fashioned furrow-irrigation techniques. As a result the average requirement of water/unit of land area has decreased from 8,700 cubic metres/hectare in 1975 to 5,500 cubic metres/hectare in 2005.
- Changing of cropping patterns based on the product value per unit of water.
- Replacing freshwater with treated waste-water in farming methods. In addition, increasing the level of sewage effluent quality in order to maximize its re-use potential in irrigation.
- Total water metering systems have been completed that help to monitor water-use by sector.
- Water abstraction fees deter the over-use of groundwater for irrigation.
- Minimizing subsidies helps provide farmers with incentives.
- Virtual water has been one of Israel's biggest policies. Israel imports the great majority of its grains as they are extremely water-demanding crops. According to Saul Arlosoroff, Israel virtually imports 3,000 MCM of water annually through their crop imports (twice the total availability of freshwater).

## Overall Assessment

Israel imposes allocations, norms and progressive block rates for each sector. According to the Ministry of Environmental Protection in Israel, the four main factors that have contributed to Israel's water crises have been increased water demand (mainly due to population increase), decrease in water availability (mainly due to drought), adverse impact on groundwater replenishment (mainly due to construction and urbanization) and pollution of groundwater (possibly through intensive agriculture). As a result, demand management measures or rather efficient use of water should include all of the factors that have contributed to the water crises, mainly, raising awareness of water scarcity at the domestic level, utilizing water harnessing techniques and greenwater in irrigation during years of adequate rainfall, preventing pollution and cleaning pollution in groundwater aquifers, instituting water pricing and other conservation measures.

Most of the water used in the Israeli agricultural sector today is treated wastewater and brackish water. Technology has also helped to reduce the amount of water used in this sector. The agricultural sector in Israel has made several sacrifices and it is not possible to compromise on water supply to this sector much in the future. Focus has shifted and should be maintained mainly in the domestic and industrial sectors in the future. Studies reveal that retro-fitting, pricing and other measures can reduce domestic demand by 40-50 per cent and this in turn can save a considerable amount of Israel's dwindling freshwater availability. Efforts to implement retro-fitting have been made in the past, but it needs to be more thorough in order to see substantial results.

## The Palestinian Territories

In the West Bank as well as in the Gaza Strip water demand has surpassed water supply and the population growth rate threatens to increase this gap even further in the future.

The Palestinian Water Authority (PWA) has developed an integrated water resource management plan. Here are some of the goals and policy objectives stipulated in the plan:

- Establishing water tariffs that cover the real cost of water. This is however dependent upon the political, economic and security situation.
- Taking measures that ensure the quality of groundwater. Specifically, aquifer sustainable yields must be properly understood and aquifer management plans defining well abstraction scenarios must be developed.
- Reducing the amount of water lost through leakages in the infrastructure. A target reduction of physical losses to 20 per cent (current losses are around 40-50 per cent of overall water supply). This involves the installation of water metres, leak detection units and projects in network rehabilitation.
- Using treated wastewater, brackish water and water harvesting for irrigation and industrial purposes.
- Conducting feasibility studies on water sector projects with a targeted full cost recovery.
- Capacity building actions in the water sector and development of service utilities.
- Implementing public awareness programs.
- Updating the current water legislation.
- Enforcing penalties for groundwater pollution and measures to encourage sustainable practices.

In addition, authorities dealing with agriculture have developed the following strategies:

- Rehabilitation of water infrastructure.
- Increasing the efficiency of water delivery and irrigation systems.
- Using brackish water and treated wastewater in irrigation.
- Enhancing water availability by encouraging water harvesting and water gathering.
- Strengthening research activities in agro-technology and encouraging the transfer of technology.
- Encouraging investments in water projects.
- Providing appropriate legal and institutional frameworks.

The PWA has developed a National Water Plan (which includes demand management) in 2004. An Emergency Plan was drafted in 2005. They have also drafted and ratified a comprehensive National Water Law and organized a National Water Council to provide ongoing guidance to water sector development. Unfortunately, these plans have not been approved as the National Water Council is not functioning and many of the objectives mentioned in the water policy have not been implemented.

## Overall Assessment

Water Demand Management (WDM) in the Palestinian Territories is a different case from most of the other countries under study in this report. Due to the occupation, internal conflict and lack of coordination amongst the different authorities, the Palestinians are not able to implement their plans. Their actual consumption patterns are extremely low. First, until larger issues of occupation and final status are resolved, the Palestinian and Israeli leaders will have to decide if they want to place the water issue on the fast track. The Palestinians blame Israeli authorities for restrictions on movement of goods and people, as well on their ability to implement several plans for demand management. The Israeli authorities blame the Palestinians of lacking interest in demand management and focussing on the politics of water rights. It is necessary to institute confidence building measures which can the pave way for implementation of demand management measures. Secondly, legislative and institutional solutions to demand management will require a larger role to be given to the Palestinian Water Authority (PWA) to ensure that laws and rules are implemented.  Lastly, demand management will also require coordination between the West Bank and Gaza authorities and the dominant political forces in the two territories.

# Jordan

Jordan's demand already exceeds its freshwater supply. Water lost through pipe leakages during transportation is estimated at around 35 per cent. Jordan has already established a Water Demand Management Unit (WDMU) at the Ministry of Water and Irrigation in 2002. The WDMU has various programs scheduled for Jordan's three main sectors.

## Domestic and Municipal Use

Several water saving initiatives were implemented under a five year program known as WEPIA -Water Efficiency and Public Information for Action Program. Most of these initiatives were non-structural in nature and dealt with consumers in the domestic sector, which includes residential, municipal and commercial users.

The initiatives included:

- Implementing a tariff structure whereby the price of water per unit increases as the total amount of water used increases.
- Launching of water media campaigns on T.V., radio and newspapers. For example, the 'Save Water' campaign run by the private water company Miyahuna aims to distribute and install water saving devices free of charge.
- Encouraging Private Sector Participation (PSP) in water utilities management.
- Introducing water demand management concepts in school curriculum; establishing a Master's degree program in Water Demand Management at Jordan University for Science and Technology and upgrading plumber education programs in vocational schools.
- Instituting laws to regulate and ensure efficient water use in construction and new building projects. For example – 'National Jordanian Construction code' and 'Beautification Codes'.
- Promoting the use of water saving technologies. Ministries have been instructed to use water saving devices in all government buildings as findings have shown that they can save up to 30 per cent of water.
- 'Retrofitting' amongst 60 per cent of consumers using more than 500 cubic metres of water per quarter (3 months).
- Creating four public parks to demonstrate the principles of water conserving landscapes.
- Researching the possibilities of re-using greywater (output from bathtubs, showers, sinks and washing machines) in toilet-flushing and garden irrigation.
- Encouraging studies that give accurate measurements of the total amount of water used in different appliances available in the market.
- Awarding small grants to poorer communities throughout the country that would help implement projects that either conserved water or increased water efficiency.
- Setting up pilot projects in rural communities that illustrated indoor and outdoor water conservation.

A second programme has started recently with the title 'Instituting Water Demand Management in Jordan' (IDARA). This program will focus more on instituting institutional and regulatory frameworks that support water demand management. The three objectives under this program are:

- Demonstrating selected water demand management initiatives.
- Developing and enforcing laws and regulations that encourage efficient water use.
- Creating an institutional capacity for work on water demand management.

## Industrial Use

As Jordan's industrial sector is set to rise in the next 10-20 years, measures need to be put in place that would allow for a more sustainable and water-friendly industry. Some of the measures already implemented include:

- Using treated wastewater instead of freshwater for industrial units such as the fertilizer plant in Aqaba.
- Using irrigation drainage water and brackish water in major industries such as the potash industry.
- Installing water saving technologies.
- Initiating preventive maintenance to stop leakages through pipes and other water installations.

## Agricultural Use

Since agriculture is the main consumer of freshwater in Jordan and roughly 80 per cent of the country is arid, measures to reduce water use in this sector is key. Some of the measures already taken in this sector include:

- Using of treated wastewater in agriculture, particularly in Jordan Valley irrigation projects where treated water from the Samra plant is used. In 2004, 14 per cent of water used for irrigation was treated wastewater.
- Reducing water use in the highlands where precious groundwater resources are over-pumped for more efficient and productive irrigation in the Jordan Valley.
- Using water efficient farming methods and modern irrigation technologies.
- Changing agricultural patterns in order to use crops that require less amounts of water and have higher economic returns (avocado, mango etc.)
- Issuing a financial tariff on well water use for agricultural purposes. This tariff, installed in the summer of 2002, is an economic instrument used to control pumping of groundwater.

According to Jordan's National Water Master Plan, water use in the agriculture sector will decline considerably between 2010 and 2020. According to the Third National Master Water Plan, this reduction is based on efficiency gains (implied in the measures mentioned above) and stopping irrigated agriculture in the Disi area. If these measures succeed, the reduction of water in irrigation will result in a substantial decrease in overall demand.

## Overall Assessment

In order to reduce water demand in Jordan, two measures in particular need to be put in place. The first will involve a substantial decrease in water utilization in the agricultural sector. The second way in which Jordan can attain efficient and sustainable use of their limited water resources is by reducing their UFW – Unaccounted for Water, or water losses through pipe leakages and illegal connections. The Ministry of Water intends to reduce this level to 15-20 per cent loss in 2020 through systematic network rehabilitation. This would free up 100 MCM of water a year. The authorities in Jordan clearly have a desire, goals and strategies for effective demand management. If they translate their intentions into actions in an efficient and effective way, Jordan will be able to manage demand and reduce wastage in the coming decade.

# Lebanon

Lebanon is losing over 40 per cent of the available water to leakage and poor transportation networks. The demand from the population is also rising at a high rate of 60 MCM annually, which has already surpassed the supply.

The main policy of the government, over the last two decades, has been to concentrate on building dams to expand the availability of water resources, to offset any future crisis. Little is known about the government's efforts for water conservation, modernising irrigation techniques or pricing policies. The objectives to address these issues are mentioned in government documents but an objective assessment of implementation of demand management plans is not available.

Some potential demand management methods to be introduced in the agricultural sector would not be any different from those used in other countries in the region and include:

- Use of drip irrigation, and subsidies for water efficient technologies to farmers.
- Encourage the growth of drought resistant crops, and minimize the cultivation of water intensive orchards, such as citrus.
- Promote and support locally adapted water saving irrigation techniques.
- Creation of Water Users Association.

## Overall Assessment

Lebanon has a complicated water governance structure which makes demand management difficult. The ministry, as well as the parliamentary committee, dealing with water is combined with the responsibilities for energy and public works. On the other hand, there are river authorities with considerable degree of autonomy, thus decentralising water management. As a result of several different structures, the line of responsibility is not clear. It might help to streamline a water demand strategy with clear institutional structure to execute it.

In terms of specific proposals, Dr. Hussein Amery, a leading expert on water politics in Lebanon, in an email interview to SFG suggested the following:

- Engage civil society for better management of available resources. Organizations such as Green Peace are extremely effectively in dissemination of information in Lebanon, especially at the local level.
- Effective laws to minimize pollution and allocate proper budgets to maintain water infrastructure to reduce waste and loss during transportation.
- Raise water tariffs to closely reflect the cost of extracting and delivering water, which would also offer a disincentive to wastage.
- Educate the common people on water conservation in the schools and the community through the media.
- Along with other structural and non structural methods that can be implemented in each sector, there is an urgent need to improve all existing water networks and transportation systems.

# Syria

Syria has made plans to reduce water loss and implement water saving practices in irrigation systems and domestic water supply networks. These plans are ongoing and JICA, the Japanese International Cooperation Agency, is the partner organization to repair old pipes around Damascus, and lay out new systems in other parts of the country. It is estimated that the improvement in the infrastructure and networks will reduce the loss of water from 60 per cent to 20 per cent.

## Domestic, Municipal and Industrial Use

The domestic demand has been met by water from springs and wells. The main policy of the government has been to provide safe and clean drinking water. Urban and rural sanitation facilities are upgraded regularly, and 95 per cent of the urban population and 80 per cent of the rural population is aimed to have access to safe water. This has resulted in a deficit in most basins, especially around the big cities of Damascus and Aleppo. There is a need for better pricing policies, regulated access in the cities, monitoring of facilities and networks, and raising the awareness of the population on the importance of applying water saving practices. It is necessary to set up small scale, local rain water harvesting units, especially in zones that receive high rainfall during the year.

## Agriculture Use

In Syria, about 87 per cent of the available water is used for irrigation, but the predominant method of irrigation used is age old and has an efficiency of less than 50 per cent. About 60 per cent of the land is irrigated with groundwater, and government policies have done little to regulate this practice. These methods of irrigation are not cost effective and are a drain on the water resources. Moreover, as Dr. Rifai in a paper written for SFG states, irrigated water tariffs are not calculated based on the real costs of water production and distribution, nor have opportunity costs been considered in terms of the value of water in economic sectors. Almost invariably, the low charges on irrigation water have led to a tendency of excessive application of water on the fields which resulted in over-pumping from groundwater and inappropriate irrigation that led to soil salinity which is compounded by a lack of proper drainage. The economic efficiency of the agricultural production requires calculating the charges on irrigation water based on its real value.

## Overall Assessment

The Syrian government, in an internal document, has recognized in 2009-2010 the need to achieve water security along with strategic management of water resources, as part of their overall objective for the future. These objectives also state the need to reduce consumption. Not much is known about implementation of the stated objectives.

- In 2000, the Ministry of Irrigation initiated an action plan for modernizing the irrigation systems with a total investment of 600 million dollars for ten years. The overall objective was to save water by increasing the conveyance and water use efficiency. In all new projects the design criteria was to avoid open channels for conveying water and use closed conduits to cut evaporation and reduce seepage. Methods of applying water have started to move on a limited scale from furrow and basin irrigation to sprinkler and drip irrigation whenever the crop allows. All these measures need a follow up for good implementation. The irrigation projects which were constructed starting from 1980 need rehabilitation and modernization because their conveyance and distribution efficiencies are very low.[13]

- All treated sewage in each basin may be used for irrigation especially from the treatment plants of large cities like Damascus, Aleppo and Homs. Research is needed to identify how, and where, to use treated sewage for irrigation and on what crops.

- Proper training modules need to be developed and used by local officials on methods of demand management, and aspects of resources management.

- Development of the human resource capabilities across the country in the water sector.

- Introduce awareness campaigns through local non-governmental organization and community networks on the importance of saving water, as well as the future effects of climate change.

- Enhance participatory approach with the private sector initiatives for water for industrial, domestic and agricultural use.

- Establish proper sanitation treatment units.

- Undertake steps to reduce the disproportionate supply of water between the urban and the rural areas, as well as between rich and poor sections of society.

# Iraq

The Ministry of Water and Irrigation is looking to develop a Master Water Plan for the next 30 years and is engaging the international community for financial and technical support. Several organizations have submitted options for such a plan, but nothing concrete has been developed.

In a conference in April 2009 conducted in Sulimaniya Governorate, the Ministry of Water Resources outlined a number of plans for the future, recognizing the need for a proper consolidated national strategy for adequate water management. These are important initiatives, and some of them related to demand management include:

- Build the technical capabilities of institutions to study, research, and operate water projects.
- Prepare a detailed annual water balance according to the water inflow.
- Prepare adequate measures to manage demand of water.
- Encourage farmers to switch from the old systems of irrigation and introduce alternative methods of modern irrigation that save water.
- Establish consumer associations and encourage planting the land with alternative crops that consume less water.
- Establish a national project to deal with climate change and its impact on future water availability in Iraq.
- Complete proposed dam construction projects, as well as develop new projects to store water in appropriate areas, to deal with future stress.

## Overall Assessment

Iraq has been suffering from a dysfunctional political system characterised by years of dictatorial rule subjected to sanctions by external powers, war, and a fractured political process constantly interrupted by intense violence. Under the circumstances, it is difficult to manage any sector – and particularly water which covers a vast and complicated geography with rivers and underground waters spread across different regions of the country and shared by neighbouring countries. While Iraqi leadership has sincere intentions to improve demand management, their ability to deliver concrete results will depend on broader political dynamic which is outside the control of water sector managers.

## Turkey

The current national plans by the DSI clearly state that while they are looking at efficient water resource management policies, their overall policies are directed towards satisfying demand for domestic water supply, generation of energy and achieving food security. All water management policies are centrally planned and implemented basin wise. The centre has developed and is implementing an integrated water resources management approach, which will be sustainable for the future. These policies are also in line with the Millennium Development Goals, to ensure proper access of safe clean water to all. The focus is on efficient water use and sustainable management.

### Domestic and Municipal Use

The DSI is implementing five year plans to minimize water loss during transportation within existing water systems. The country has introduced widespread metering of water at the household level, which has helped conserve water use; however the government and local municipalities are still combating the problem of unpaid bills.

### Industrial Use

Some measures which have been introduced in other countries that can be adapted to this context are:

- Use of treated wastewater instead of freshwater for industrial purposes.
- Use of irrigation drainage water and brackish water in major industries.
- Installation of water saving technologies.

### Agricultural Use

The land is partly irrigated by surface irrigation methods, and partly by groundwater and springs. The management of groundwater is by the State, which greatly reduces the risk of contamination and over pumping. The loss of water to the land by this system is also minimal in most areas. Additionally all irrigation schemes are contracted and financed by the government, and the groundwater is allocated to individual farmers free of charge. The maintenance is in the hands of local village authorities and cooperatives, which ensures that public participation leads to effective management.

While Turkey is projected to increase the number of hectares under cultivation, with the increased utilization projections, the share of irrigation of the total water used will decrease from 75 per cent to 64 per cent by 2023.

A major reform has been the establishment of Water Users Organizations (WUOs), which now are responsible for local maintenance and proper implementation of allocated resources. While there has been some measure of success, there is an urgent need for a well-defined institutional and legal framework for the WUOs to enable the sustainability of such a participatory approach.

# The Blue Peace

The world is changing at a fast pace. A quarter century ago, oil was the main driver of industrial progress in the world. A quarter century from now, it is plausible that oil may prove to be one of the several sources of energy. A quarter century ago, it was not possible to eliminate bacteria completely from dirty water and desalinate sea water on a large scale. A quarter century from now, nanotechnology may make desalination and wastewater treatment an inexpensive and daily part of our lives. A quarter century ago, pipes leaked without anyone noticing them. A quarter century from now, computer software will alert control towers about pipeline leakages. A quarter century ago, environmental concerns were on the fringe of politics. A quarter century from now, environmental politics will be at the core of politics. A quarter century ago, rivalries between large powers shaped the architecture of global security. A quarter century from now, large and successful countries may embrace cooperation over competition.

The Middle East cannot escape change, nor indeed can any other part of the world. Since change is inevitable, the decision makers in the Middle East do not have a choice. They will have to adjust themselves to change. They may do it per force and reluctantly. Alternatively, they may decide to take a lead in shaping the future. The recommendations contained in this report provide them an opportunity to make a new beginning with several different building blocks, which can be built at different times, at varying pace and in different locations. Such an approach offers a manageable opportunity to construct the future rather than suddenly facing a new paradigm imposed by nature, climate change, technological breakthroughs, global politics, and new philosophical concepts.

On the surface, the recommendations made in this report are aimed at securing and sustaining the availability of water for a growing population and changing economy. However, the way sustainability is proposed to be achieved provides scope to create a virtuous circle of sound management, dialogue, cooperation, growth, peace, leading to better management of water resources. Thus, water can be both cause and effect of peace, provided the water itself is not polluted. Polluted politics produces polluted and overexploited water and fragmented and interrupted water courses. Polluted water creates social and economic stress and gives rise to destructive and polluted politics. Visionary and courageous politics can produce clean water and reliable watercourses. Similarly, blue water can create a new form of peace based on mutual stakes in survival and prosperity between different people and also between people and nature – the Blue Peace.

Blue Peace will be a key determinant of the global security architecture in the 21st century. No two countries with abundant supply of blue water will go to a war. Also, countries that actively seek peace and cooperation will be assured of clean water for their people. Much of North America and Western Europe will be free from warfare in this century, despite a chequered history of several centuries, because of blue peace. If countries in Asia, Africa, Latin America and the Middle East pursue blue peace, they can count on a future full of hope for their people.

## Interdependent Strategies

The Blue Peace essentially requires a comprehensive approach. It is necessary to act on several fronts at the same time, and yet it is possible to choose different entry points of intervention as per social and political dynamics.

Sustainable management of demand and conveyance of water systems can reduce need for external resources, creating a more viable context for cooperation. Standardisation of quantitative and qualitative measurements with installation of similar gauging equipment can make sustainable management possible in an atmosphere of mutual trust and confidence.

If each party trusts in the responsible behaviour of other parties, it is easy to collaborate to assess the needs of a region or a basin and introduce integrated water management practices across borders. If an agreement for data-sharing and regional cooperation is reached, habits of responsible behaviour are formed automatically.

If new technologies are developed and disseminated, efficiency in water and energy use can reduce deficit and enhance scope for cooperation between neighbours. If countries create common markets and joint funds, it is easier for entrepreneurs and consumers to avail of new technologies.

If statesmanship leads to some form of understanding about managing regional commons, it is easy to resolve political differences. If political disputes are resolved, it is possible to discuss ideas such as regional commons.

If water from challenging sources is to be availed, cooperation between neighbouring countries is essential. If countries are involved in intensive regional cooperation, it is easy for them to acquire water from non-conventional sources.

Interdependence between water security and human security makes blue peace special. White peace is peace on the battleground, achieved through a treaty between armies or governments. Green peace is a desired state of equilibrium between nature and people. Blue peace is derived from and reinforced by a positive equation between water and society and also between one society and another. Once set in motion, blue peace has a positive flow. It creates a virtuous cycle. White peace is easy to achieve, but difficult to preserve. Green peace is difficult to achieve since a positive equation between nature and people, cannot ignore positive equation between countries and communities. Blue peace is characterised by its forward movement and expanding impact. The recommendations in this report essentially offer an opportunity to the Middle East to introduce blue peace to its people.

## Roadmap

In order to prepare for the blue peace, it will be necessary to take a number of steps.

The primary responsibility of all countries is within their own borders. Irrespective of what a country may say about the behaviour of another riparian, certain steps can be taken in any case in its own interest. These would include:

- Demand management through efficient irrigation, innovative cropping patterns, conservation in domestic, urban and industrial sectors.
- Mitigation of conveyance losses.
- Introduction of waste management and desalination technologies.
- Addressing internal disequilibrium to satisfy the development needs of the whole population.
- Awareness building through citizen action and water users' associations.

While such domestic and unilateral measures are necessary and easier to implement, no country can afford to limit its strategy to unilateral actions only.

When watercourses run across borders, it is essential to have a dialogue and systemic cooperation with other riparian countries. Such interaction already exists between some of the countries covered by the scope of this study on a limited, ad hoc or nominal basis. It is necessary to upgrade it to a structured and institutional level. In the case of the Northern Circle of five countries, the first step could be a Cooperation Council for Water Resources in the Middle East. In the case of Israel and the Palestinian Territories, the initial steps could involve structured confidence building meetings, in the presence of third party observers, to clarify data and reach common understanding on technical, operational and management issues.

Institutional architecture is essential but never adequate on its own. It has to be infused with the spirit of blue peace through concrete programmes and goals. Such an initiative would primarily depend on the enthusiasm and commitment of political leaders at the highest level. It can not be left to Water Ministers alone, though those in charge of specific domains can play a critical role to advance the flow of blue peace.

Some countries in the Middle East have demonstrated that it is possible to cooperate when political leaders rise above narrow definition of national interest. Turkey, Syria, Jordan, Lebanon and Iraq have already initiated cooperation in trade and transit. They also have well functioning cross-border telecommunication links and in some cases electricity grids. It is not fair to compare one sector to another. It may be argued that water is a very special resource at the core of national interest. Nevertheless, once some countries indicate willingness to cooperate in some respects, they accept the principle of cooperation.

If countries in the region have the commitment to initiate, own and promote cooperation for the sustainable management of water resources, it would be helpful for the international community to provide a generous response with technical and financial support. Standardising measurements, data exchange, developing regional climate change models, integrated basin management, infusion of new technologies, and such other activities require certain kinds of equipment and skills. In the global village, it is possible that the required resources might be available in abundance in some other parts of the world. It will be in the interest of the international community to make them available to the region on affordable terms since blue peace in the Middle East can contribute to larger peace in the world.

While governments in the region and the international community are essential catalysts, the future of the common citizen is at stake. Therefore, the urge for transformation from brown stretches of land to the enhancing flow of blue peace needs to come from the people of the Middle East. In such a transformation, opinion leaders including legislators, the media and civil society have a crucial role to play. They cannot wait and watch until governments and external parties act. Simultaneous action by opinion leaders, governments and the international community can turn a turbulent region into an example of peace and cooperation in a decade or two. However, the region is a losing a race against time. The time to begin change is yesterday.

# PART II

## Country Reports

# Introduction

The country reports in Part II of this report use average annual flows for calculating the water budget. While this is a useful indicative tool, it has its limitations. It is important to note that two factors produce very different realities of water availability than the annual averages used in the country reports. River flows experience seasonal variations ranging anywhere from 1:10 to 1:25. Further, a drought year can substantially reduce water flow while an exceptionally wet year can generate 130-150 percent more of the long term annual average flow. Wherever possible, an effort has been made to provide seasonally adjusted data. Where annual averages are used in the absence of reliable seasonal data, it is important to bear in mind that the deviation could be as large 40-50% in certain periods.

There are also differences in regional endowments, rendering national averages irrelevant. Nevertheless, we need to consider national averages for broad indication and future calculations. Secondly, pipe leakages, illegal tapping and other forms of inefficiency result in loss of water in transit. In some countries it is estimated that 30-50 per cent water supplied to the domestic and industrial sectors is lost.

However, estimates of transit losses to agriculture, which consumes 60-80 per cent water, are not available. Overall, supply statistics provided in the country reports should be adjusted to the reality of inefficiency on the ground.

Finally, it is impossible to predict drought on a long term basis. There are models to forecast climate change and infer precipitation from expected changes in temperature. Most such models are not perfect. Any projections made for future can be significantly affected by chronic drought and extreme weather events.

Despite these limitations and drawbacks, it is necessary to have some idea of broad trends in countries under study. The following country studies are therefore useful to understand the current situation and envisage general patterns of future change. They are useful for their indicative value for policy formulation, as well as for their reference value for scientists and water experts.

# Israel 1

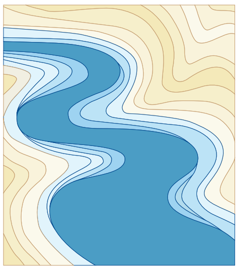
## Country Overview

Israel has an annual renewable freshwater availability of approximately 1300-1400 MCM annually as per indications available for 2010. About 60 per cent of this comes from groundwater, 35 per cent is derived from Israel's only freshwater lake – Kinneret (Tiberias) and an additional 1.5 per cent is obtained from the Yarmouk River. Water from the occupied territories - Golan Heights and the West Bank - makes up a sizeable share of Israel's freshwater supply.

Current consumption in Israel far outstrips its renewable freshwater availability - demand for water in 2010 was 2,100 MCM. As a result, the country is highly dependent on marginal water to satisfy the excess requirement. At present, Israel has the capacity to produce around 800 MCM of marginal water. Thus, demand and supply roughly match in an average year. However, in the case of chronic drought, there is deficit which can be filled by enforced reduction of demand or excessive pumping from aquifers. Israeli authorities deny incidence of over pumping, but this view is contested by the Palestinians who share aquifers with Israel.

Water loss through leakages in pipes has been substantially reduced. In 2002 Unaccounted for Water (UFW) in Israel was 11-12 per cent as compared to 50 per cent in most other Middle Eastern countries. Estimates for 2010 are not available, but informal inquires indicate no major change in the situation. Israeli experts indicate that it is practically impossible to bring down conveyance losses below 10 per cent. Therefore, Israel is already functioning at the highest possible level of efficiency.





Two severe periods of drought in the last decade led to serious water shortages in Israel's agricultural sector, which experienced large cut-backs in the water supply. Freshwater allotted to the agricultural sector in Israel has reduced from roughly 1,300 MCM in the 1980s to 350 MCM in 2009-2010. There is also a maximum limit of 500 MCM placed on this quota regardless of the freshwater availability. Most of the water used in the Israeli agricultural sector today is treated wastewater and brackish water. Technology has also helped to reduce the amount of water used in this sector. It is not possible to reduce supply to the agricultural sector any more and so the focus has shifted mainly to the domestic and industrial sectors.[14]

## Geography, Climate and Rainfall

There is a distinct difference in precipitation levels between the north and south of Israel. The north is generally characterized by heavy rainfall – up to 950 mm of mean annual precipitation in some parts of the Lake Kinneret (Tiberias). The south, on the other hand, is dominated by Israel's vast Negev desert region where rainfall at the southern tip can be as low as 25 mm annually. Israel's National Water Carrier (NWC), a highly efficient water network that distributes water throughout the country, is primarily used to supply irrigation water from the north to the parched southern regions. The NWC is also used to supply drinking water to dense population centres and to recharge groundwater aquifers.



More than half of Israel's population lives on the western coastal strip overlooking the Mediterranean where the country's main cities – Tel Aviv, Haifa and Ashkelon - are located. The Coastal Aquifer, which Israel shares with Gaza, supplying a safe yield of 250 MCM for Israel, extends under this coastal strip.

The Jordan River flows to the east of Israel, supplying the Kinneret (Tiberias) with water and later forming Israel's border with Syria and Jordan, while the inland region of Israel is dominated by the Judaen Hills of the West Bank. The Mountain Aquifer extends under these Judaen Hills.

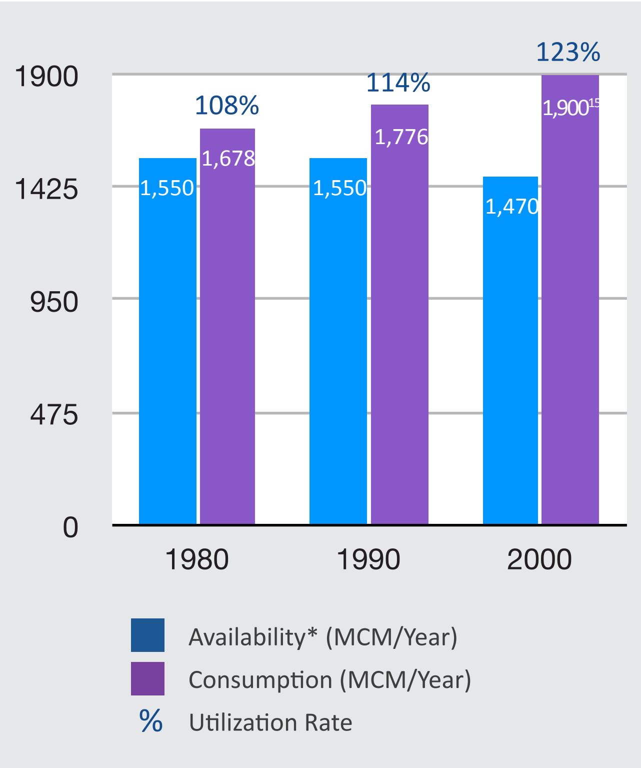
About 75 per cent of Israel's annual rainfall is concentrated into four winter months from November to February. Variations in rainfall occur from year to year with periods of drought interspersed with periods of heavy rainfall. In the past 20 years, Israel has experienced two devastating periods of drought, each lasting a period of four years. The first period of drought was from 1998-2001, with an average deficit of 500 MCM/year. This was followed by a period of adequate rainfall in 2002 and 2003. The second drought period occurred from 2005-2008, with an average deficit of 250 MCM/year and was broken by rainfall in March of 2009.

## Utilization Rate

The utilization rate of higher than 100% as compared to fresh water resources indicates growing dependence on treated waste water and desalination, which has been an important part of the Israeli policy for the last two decades.

Israel has also taken steps to mitigate its excessive utilization rate and supplement freshwater availability. It has expanded the National Water Carrier (NWC) system and the increased capacity to produce alternative sources of water. Measures have also been put in place to control demand, especially in the agricultural sector, through the utilization of water-efficient technology such as drip irrigation. Yet despite all these measures, Israel cannot be assured of its water security during years of drought.

Fig 2-a: Utilization of Total Available Freshwater Resources




*Sources: Saul Arlosoroff, and Israeli Ministry of Environment and Protection*

** Availability is taken as the mid-point between 1,500 and 1,600 MCM. This is correct for the period until 1990, since calculations were made in the early 1990s. The availability in 2000 would be somewhere between 1450-1500 MCM and therefore utilization rate much higher. The availability in 2010 would be somewhere between 1300-1400 MCM.*

## Summary of Water Sources

### Rivers and River Basins

Israel's main surface water resource is Lake Kinneret (Tiberias). It divides the upper and lower portions of the Jordan River System. The lake is fed by several underground springs but its main source of water is from the Upper Jordan River[16]. The total average annual inflow into the catchment basin is 900 MCM, of which about 200 MCM serves consumers in that region, about 400 MCM is withdrawn to serve consumers throughout the rest of the country by means of the NWC and about 300 MCM is lost to evaporation.

In dry years, with drop in precipitation, the water level in the Kinneret (Tiberias) had reached a critical mark - known as the 'Red Line'. After a four year drought period that lasted till 2008, this critical mark has been lowered still further - to the newly formed 'Black Line'. When the Black Line is reached the pumps can not be able to operate, thereby stopping all water supply from the Kinneret (Tiberias).

### Groundwater and Groundwater Basins

Israel is divided into seven major groundwater basins. Its two main groundwater aquifers - the Coastal Aquifer and the Mountain Aquifer - are shared with the Palestine Territories. To borrow a phrase from environmental resource expert Hillel Shuval, 'It's actually as if two people are drinking from the same glass of water with two straws'.

**The Coastal Aquifer:** It is made of calcareous sandstone (kurkar) and the flow of water, in contrast to the Mountain Aquifer, is north-south, in other words the water travels from the Israeli part of the aquifer to the Gaza Coastal Aquifer. This aquifer was one of the main sources of drinking water to Israel's major cities but due to over-pumping and pollution, caused by industrial waste and excessive urban development, around 15 per cent of the groundwater no longer complies with drinking water standards. As a result, Israel has had to shift its dependence for drinking water to the Mountain Aquifer.

**The Mountain Aquifer:** It is currently Israel's most important groundwater resource, supplying roughly one third of Israel's total freshwater supply. The aquifer is divided into three sub-parts - namely the Western, North-Eastern and Eastern Aquifers. It is composed of limestone, chalk and marl and the main source of water comes from the Yarkon and Nahal Taninim springs. The general direction of flow follows an east-west direction, which is from the Palestinian Territory to Israel. The Western sub-aquifer has its recharge area almost completely in the West Bank and its storage area in Israel. The Mountain Aquifer is one of the main issues of contention in the Israel-Palestine conflict.

In addition, smaller groundwater resources in the Western Galilee, the Carmel Mountains and the Negev and Arava desert contribute to Israel's overall water availability.

Fig 2-b: Median Availability with Total Recharge from Rainfall

| Source | Quantity (MCM/Yr) | Pre-1967 Allocations |
|---|---|---|
| Coastal Aquifer | 221 | Israel |
| Western + Lower Galilee (aquifer) | 155 | Israel |
| Carmel Aquifer | 40 | Israel |
| Negev | 32 | Israel |
| Kinneret/Tiberias/ Galilee WS | 468 | Israel & Golan Heights (Banias-125MCM) |
| Mountain Aquifers[17] | 476 | |
| Yarkon-Taninim (Western Aquifer) | 317 | Israel & Palestine (317) + (20) (94%) + (6%) |
| Nablus-Gilboa (North-Eastern Aquifer) | 92 | Israel & Palestine (92)+ (38) (71%) + (29%) |
| Eastern Aquifer | 67 | Israel & Palestine (67) + (100) (23%) + (77%) |
| **TOTAL** | **1,392** | |

*Source: Basic data collected from interaction with Israel Water Authority in 2010 and adjusted by SFG to reflect Palestinian share of Mountain Aquifers under Article 40 of the Oslo Agreement*

The Mountain Aquifer is divided into three main aquifers and Figure 2-c shows the new availability in each sub aquifer, as compared to the Oslo II allocations and availability around 1993 taking into account depletion of 7 per cent from 1993 to 2010.

Fig 2-c: Comparison with Oslo II (MCM per median year)

| | 1993 Availability (Oslo II) | New Median Availability | |
|---|---|---|---|
| | | Israel | Palestine |
| Yarkon-Taninim (Western Aquifer) | 362 (340+22) | 317 | 20 |
| Nablus-Gilboa (North-Eastern Aquifer) | 145 (103+42) | 92 | 38 |
| Eastern Aquifer | 172 (40+54+78) | 67 | 100 |
| **Total** | **679** | **476** | **158** |

*Source: SFG discussions with Israel Water Authority*

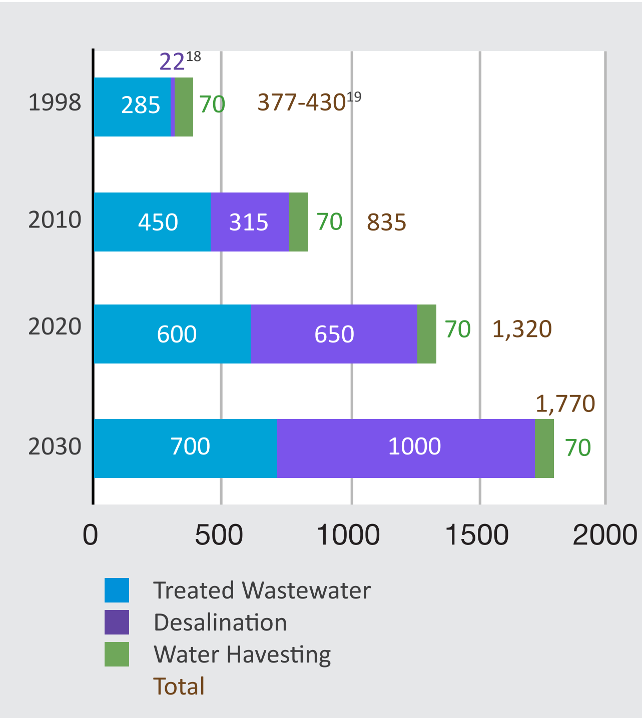
## Marginal Water

Today Israel is one of the leading producers of alternative/marginal water and by 2020 marginal water (desalination and wastewater treatment) will make up almost 50 per cent of the country's total water supply. Israel is also considered to be a leading country in technologies for treated wastewater use in agriculture. In 2007, 92 per cent of the wastewater in Israel was treated and around 75 per cent was used for irrigation. Currently Israel is working on improving the transportation and the quality of this treated wastewater.

Israel has three large desalination plants, one at Ashkelon, with a capacity of 120 MCM/year and Hadera with the capacity of 130 MCM, both of which are functional; and one at Sorek which is still under construction with an aim to produce 130 MCM of water annually. In 2005, Israel produced approximately 80 MCM of desalinated water, which reached 315 MCM/year by 2010 – that is a 294 per cent capacity increase in 5 years. By 2020 roughly 23 per cent of total potable water in Israel will be desalinated water.

The Water Authority in Israel states that they will increase this capacity to 1000 MCM annually by 2030. Consultations with officials in the Water Authority in 2010 show that the cost of each plant which can produce up to 150 MCM of desalinated water annually is approximately $400 million. Therefore to produce 1000 MCM by 2030 will require about eight plants, at a total cost of $3.2 billion over a period of 10-20 years, which is easily affordable for Israel.

Fig 2-d: Marginal Water – 1998-2030 – MCM/Year




*Sources: Yosef Dreizin's papers on wastewater reuse[20] and integrating large-scale seawater desalination[21]. Information on water harvesting derived from the Israeli Ministry of Environmental Protection[22]*

## Future Changes in Supply and Demand

### Per Capita Availability

Israel currently has per capita availability of 190 cubic metre/capita/year water, down from around 260 cubic metres per capita per year in 1990. This will reduce even further by 2020. Calculations have been made using Israel's renewable freshwater availability without marginal water resources.

Israel is however supplementing its freshwater availability at a faster rate than other countries in the Middle East with desalinated water and treated wastewater, although both these alternative resources are costly ventures. In order to keep a standardized format - per capita availability will always be calculated by renewable freshwater available and not virtual, purchased, over-pumped, additional or marginal water.

Fig 2-e: Renewable Per Capita Freshwater Availability

| Year | Total Water Availability (MCM/Yr) | Population (in millions) | Per Capita Renewable Freshwater Availability (cubic metre/Yr) |
|---|---|---|---|
| 1990 | 1,550 | 6.0 | 258 |
| 2010 | 1,392 | 7.3 | 190 |
| 2020 | 1,300 | 8.3 | 156 |
| 2030 | 1,300 | 9.2 | 141 |

*Sources: UN Population Prospects report, 2008*

### Renewable Freshwater Availability Remains the Same, While the Demand Increases

The first scenario takes only Israel's 'freshwater' availability into account. The total recharge from adequate rainfall is around 1392 MCM annually, accounting for depletion in certain aquifers, and assuming (unrealistically) that there is good rain and future recharge is as per the median recharge of the last 17 years.

Consultations with Saul Arlosoroff, former Water Commissioner and Member of the Mekorot Board of Directors, in January 2010, revealed that pricing mechanisms, retro-fitting and other water conservation programs, if implemented, can reduce domestic/industrial demand by 20-40 per cent.

The demand however has increased over the years, due to a number of factors, among them population increase and high standard of living are the two most important. For many years the agricultural sector in Israel consumed a majority of the water supply but contributed to a very small percentage of the total annual GDP. As a result, there has been a significant reduction of water allocated to the agricultural sector, especially during periods of drought. There has also been a significant amount of work done by the Israeli government to try and control the increasing domestic and industrial demand for water.

The 2010 consumption, according to discussions with Dr Shimon Tal, former Water Commissioner, is a little over 2.1 BCM. Domestic demand has been brought down to 100 $m^3$ per capita per year, which is the lowest sustainable amount. In the event that there is a crisis or a severe drought this can be brought down to 90 $m^3$ per capita, though experts state that 100 $m^3$ per capita is an ideal amount. As mentioned before, the government has also decided on a ceiling of 500 MCM of water annually to be allocated to the agricultural sector, as was stated in a recent Knesset Investigative Report, and new methods of management are being introduced to ensure that this is not crossed in the future without affecting food security. The Israeli Water Authority has projected a demand of 3 BCM for 2030, taking into account these caps and measures of demand management.

Hence, Figure 2-f visualizes the water balance if demand were to increase at a controlled rate (with measures of demand management) while the freshwater availability, naturally, remained the same. Utilization rate is taken as more than 100 per cent as Israel utilizes all of its renewable freshwater resources and more.

Our hypothesis of constant fresh water availability is not realistic. If the trends of the last two decades continue, freshwater availability is likely to be between 1150-1200 MCM and therefore water deficit closer to 1800 MCM, rather than 1700 MCM calculated on the basis of assumption of the status quo remaining constant.

### Scenario 1 - Accounting for Marginal Water as a Supplement to Freshwater Supply

Since freshwater availability alone (surface water and groundwater) can no longer satisfy the demands of a growing population and economy, Israel has developed its marginal water sector and has plans to increase its marginal water supply substantially in the future. In 2010, marginal water (desalination, wastewater treatment and water harvesting) accounted for almost 45 per cent of agricultural consumption. It is expected that marginal water will satisfy approximately 60 per cent of agricultural demand and a minimum of 35 per cent of industrial demand in Israel.

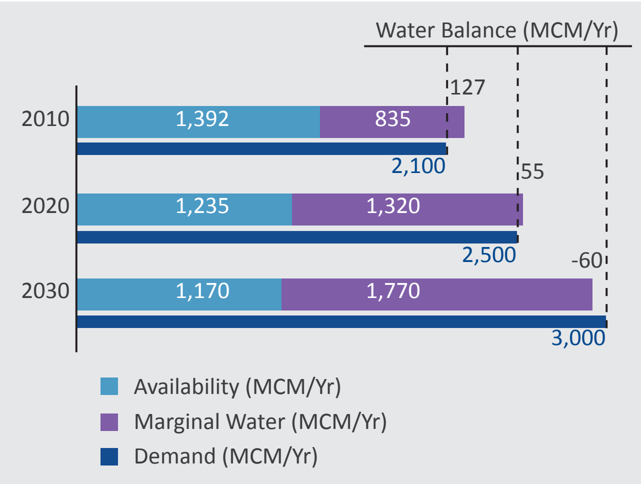
Figure 2-g accounts for the addition in water supply due to Israel's growing marginal water sector and

Fig 2-f: Water Balance with Increasing Demand

| Year | Population (in millions) | Availability (MCM/Yr) | Utilization Rate | Demand (MCM/Yr) | Water Balance (MCM/Yr) |
|---|---|---|---|---|---|
| 2010 | 7.3 | 1,392 | Over 100% | 2,100 | -700 |
| 2020 | 8.3 | 1,300 | Over 100% | 2,500 | -1,200 |
| 2030 | 9.2 | 1,300 | Over 100% | 3,000 | -1,700 |

*Source: Demand figures derived from consultations with Israel Water Authority* adjusts the overall water balance accordingly. It indicates that Israel is planning to match demand and supply with marginal surplus or deficit (less than 100 MCM per year).

Fig 2-g: Water Balance with Marginal Water




*Source: Yosef Dreizin's papers on wastewater reuse[23] and integrating large-scale seawater desalination[24]*

Israel's urgent need for water has been a driving factor in its pursuit of the latest and most cutting edge water technologies. Today, Israel is one of the leading countries specializing in wastewater treatment and reverse osmosis desalination. Apart from the field of marginal water, Israel is renowned for its groundbreaking efforts in another water saving technology, namely - drip irrigation technique, used in agriculture.

## Scenario 2 - In the Case of Drought

We know that Israel went through a period of severe drought from 1998-2001, with an average shortfall of 500 MCM to the water supply every year.[25] The 1998 drought was deemed the worst drought that Israel faced in over 100 years (worse than the recent 2005-2008 drought that resulted in a 250 MCM deficit every year).

Based on past statistics, we can infer that in the future another drought could reduce the water available by 100-200 MCM every year, which will naturally bring down the overall supply to the population, resulting in shortages. In the event of an extremely severe drought, the availability would decline further, though it is difficult to determine the exact degree, and is beyond the scope of this paper.

## Scenario 3 - Accounting for Water Pollution – Deterioration of the Coastal Aquifer

Water pollution in the Coastal Aquifer can lead to a shortage in supply. The Coastal Aquifer is in danger of becoming unusable because of contamination – from mainly high chloride and nitrate concentrations – through agricultural fertilizers and industrial pollutants.

As far back as 1994, 10 per cent of the wells exceeded salinity levels and 17 per cent of the groundwater exceeded nitrate levels of 70 mg/liter. In 2002, 15 per cent of the water in the Coastal Aquifer no longer complied with drinking water standards.

Fig 2-h: Nitrate and Chloride Concentrations in the Coastal Aquifer

**Nitrate Concentrations:**

Nitrate reading 1994: 40-50 mg/litre

Nitrate reading 2005: 63 mg/litre

Level of increase: 0.6 mg/litre/year

Level at which unsuitable: exceeding 70 mg/litre

**At this rate, nitrate levels in the Coastal Aquifer will reach unsuitable levels in another 10 years (around 2020).**

**Chloride Concentrations:**

Chloride reading 1994: 150 mg/litre

Chloride reading 2002/03: 195 mg/litre

Rate of increase: 2 mg/litre/year

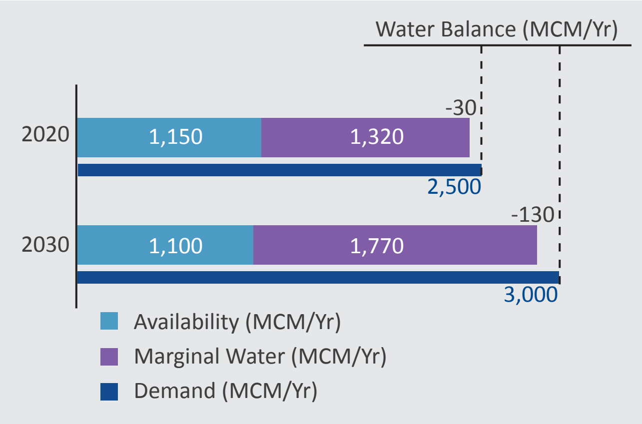
Level at which water becomes unsuitable: 250mg/litre

**At this rate, chloride levels in the Coastal Aquifer will reach unsuitable levels in the year 2030.**

*Source: Israeli Ministry of Environmental Protection.*

Figure 2-i assumes a gradual deterioration of the Coastal Aquifer over the years. In 1998, 10 per cent of 250 MCM safe yield of the coastal aquifer was considered unpotable. By linear calculations, 20 per cent of 250 MCM is projected as unsuitable for consumption in 2010, about 30 per cent of the 250 MCM in 2020 and 2030. It is assumed that government and technological intervention will arrest the rate of deterioration by 2030.

Fig 2-i: Water Balance Accounting for Water Pollution




*Source: Ministry of Environmental Protection*[26]

In addition, Israel's two other main sources of water, Lake Kinneret (Tiberias) and the Mountain Aquifer, are in danger of pollution due to over-exploitation as well.

Salinity of Lake Kinneret (Tiberias) is a major concern. The levels of salinity in the Kinneret fluctuate dramatically – chloride concentrations vary from anywhere between 230 mg/litre 300 mg/litre. It is therefore imperative to keep the salinity of the lake as low as possible. This includes maintaining a limit on over-pumping water from the lake.

Due to rapid deterioration of the Coastal Aquifer, the Mountain Aquifer is becoming one of the main suppliers of drinking water in the country. At present, chloride concentrations are only high, at about 226 mg/litre, in the southern parts of the aquifer, but if over-pumping in the Mountain Aquifer increases, then the chances of pollution and salt-water intrusion can be much more drastic, due to the aquifer's *karstic*[27] nature.



## Future Geopolitical Projections

### Scenario 4 - Subtraction of Freshwater Availability in the Case of a Two-state Solution

If Israel were to renounce all of its post 1967 territories and allow for a separate Palestinian State, freshwater supply in Israel would be reduced considerably. A sustained agreement and two-state solution will obviously result in Israel losing a certain amount of water, with the Palestinians assured of minimum access. But it is difficult to make any judgement on the exact amount of water allocated, and thus the exact reduction of water available to Israel. It is also possible that at this time, anywhere from 5 to 15 years in future, Israel may decide to release some financial resources to import food or water, which will reduce the demand. Thus the available balance of water to Israel could change in any number of ways and it is difficult to ascribe any realistic numbers, though it is safe to assume that the availability of freshwater from conventional sources will decline.

## Climate Change

According to Israel's national report on climate change, freshwater availability will fall to around 60 per cent of 2000 levels in 2100. There will be sedimentation in reservoirs, intrusion of seawater in the Coastal Aquifer and increased surface run-off will reduce the natural level of aquifer recharge.

Israel will experience a general warming trend in temperature and a decrease in precipitation in the next 90 years or so, especially in the north and centre.

### Warming

0.3-0.4 °C by 2020
0.7-0.8 °C by 2050
1.6-1.8 °C by 2100

### Decrease in precipitation

-2 to -1% by 2020
-4 to -2% by 2050
-8 to -4% by 2100

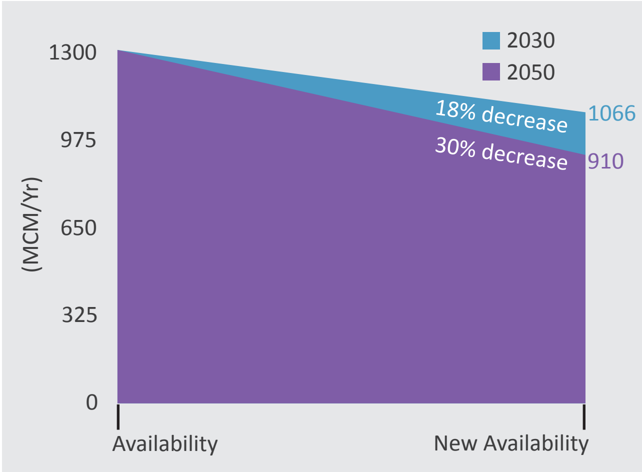
Apart from changes in mean climate conditions, another important factor of the changing climate in Israel will be the increased seasonal variability in temperature and the frequency and severity of extreme climatic conditions. Rains in the winter months could be delayed and at the same time, certain regions could experience high intensity rainstorms.

Desertification will occur, especially in the Negev region, which could experience high intensity rainfall, increased surface run-off, soil erosion and therefore low vegetation. Increased evapo-transpiration will also result in a higher level of salinity in the soil, thus removing all possibility of agriculture in this region.

On the other hand, greater rain intensities and flooding may damage crops in wetter areas such as the Coastal plain. A rise in sea levels – estimated to be 18 cms in 2030 and 50 cms in 2100 – in the Mediterranean region will lead to increased salt-water intrusion into the Coastal Aquifer, which already suffers from water pollution.

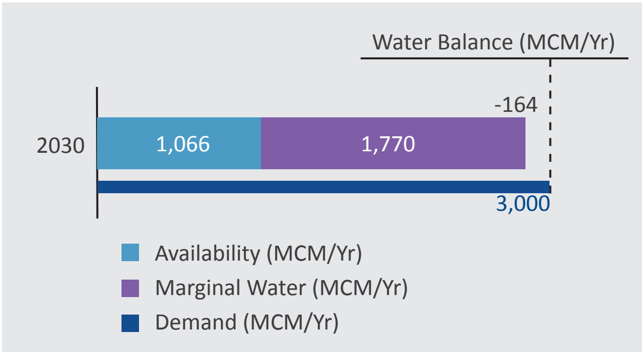
If climate change, as stipulated in Israel's national report on climate change, would result in a decrease of 60 per cent of total freshwater availability between 2000 and 2100, then in 2030 and 2050 the reduction in total available freshwater would be 18 per cent and 30 per cent respectively (taking a 0.6 per cent reduction every year since 2000).

Fig 2-j: Decrease in Availability Due to Climate Change




*Source: Israel's National Report on Climate Change*[28]

Fig 2-k: Accounting for Climate Change in 2030




*Source: Israel's National Report on Climate Change*

The impact of climate change will therefore have an effect on overall freshwater availability in Israel. If we factor in this change while calculating the overall water deficit in case of increasing demand and marginal water, the final balance will change.

## Future Water Surplus/Deficit

The estimates of Israel's total recharge from rainfall assume normal behaviour of nature. Severe drought periods in the future can render these estimates irrelevant. Similarly, the return of land in the case of a two-state solution could result in a water deficit to a degree difficult to calculate today. However, the increase of marginal water, especially with the desalination capabilities projections, could be sufficient to balance this water deficit.

In addition, gradual pollution of Israel's freshwater resources will exacerbate the problem of water scarcity, and will impact Israel by 2030 despite having a projected marginal water capacity as high as 1,700 MCM. In theory, Israel's deficit can be reduced to a minimum with efficient demand management and increase in wastewater and desalinated water. However, in practice, it would be too much to assume that both demand and supply management strategies will succeed at the highest level of potential and further, that there will be no drought. Even in such an extremely optimistic situation, Israel can hope to have a per capita water availability of only 200 cubic metres. In reality, climate change, drought, some degree of transmission leakage, and growth in demand with economic development are bound to put pressure on water supplies and generate a deficit in the years to come. Therefore, purely unilateral solutions may work for a decade or so, but Israel will have to look for external sources and regional cooperation beyond 2020 to ensure its water security.

# Palestinian Territories 2

## Country Overview

While the West Bank relies solely on the Mountain Aquifer for its freshwater supply, the Gaza Strip depends on the Coastal Aquifer as its sole freshwater resource.

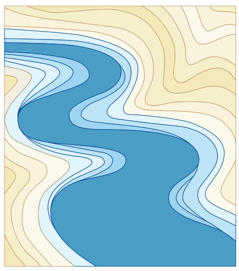
The Palestinians are estimated to have an access to 158 MCM water per year from Mountain Aquifer on the basis of median calculations for 1993-2010 using shares allocated under Article 40 of the Oslo Accords.

The Coastal Aquifer is a shared resource that flows from Israel to the Gaza strip. The Gazan portion of the Coastal Aquifer has an annual renewable freshwater yield of 57 MCM. Some sources indicate that it is around 35 MCM per year on the basis of median recharge from rainfall. In addition, Oslo II designated 5 MCM of potable water to meet immediate needs. This was to be supplied to the Gazans by Israel, through a Mekorot pipeline, but supply has been irregular.

Water demand currently exceeds the available supply in the Palestinian Territories which has led to low consumption rates. The gap between supply and demand in early 2011 would be in excess of 200 MCM according to anecdotal evidence. Reliable scientific data is not available.

The key problem that the Palestinian Territories face today is the reduction of fresh potable water in both the Mountain and the Coastal Aquifers. In addition, rapid urbanization threatens to reduce run-off and consequently decrease the aquifers' recharge capacity in coming years. A decline of freshwater from the aquifers will widen the gap between supply and demand further in the future.





About ten per cent of the population in the West Bank lacks network connections to a regular supply of water. Unconnected communities pay a high price for water, as high as $3 per cubic metres, while the price of water bought from Mekorot is around $0.7 per cubic metre as compared to the price Israelis pay (less than $0.5-0.6 per cubic metre). Moreover, there is disruption in water supply in time of crisis. The Israeli attack on Gaza in December 2008-January 2009 cut off more than 50 per cent of Gazan households from any access to water networks at all – some of them for more than ten days at a time.

## Impact of Occupation and Conflict

A big hindrance to improvement of the water situation in Palestinian Territories is the occupation and conflict in these territories. Several UN and donor supported projects have been put on hold, investments have been obstructed and independent access to freshwater has been denied.

Both the Palestinian Territories suffer from limited access to water supply. In the Gaza Strip, border closures during times of conflict place restrictions on chlorine for water treatment, fuel for water pumping stations and building materials for water infrastructure. In the West Bank, Israelis have placed heavy restrictions on Palestinian well drilling despite growing domestic, irrigation and industrial demands[29]. Israel offers to sell back water that they tap from the shared Mountain Aquifer (most of which originates in the West Bank itself). According to several Palestinian experts to water at reasonable prices[30] has become such a problem that several Palestinians have resorted to unlicensed well drilling in order to secure freshwater for themselves, which makes calculating correct withdrawal amounts very difficult. However, Israeli authorities disagree with reasons offered by the Palestinian experts for unlicensed well drilling.

Although West Bank's overall water supply (not per capita water availability) has increased since the Oslo agreement, so has their dependence on Mekorot - which now provides over 45 per cent of municipal and industrial water to the West Bank. In addition, the Palestinians argue that Israel has pumped more than its stipulated amount from the Mountain Aquifer during years of drought. This has led to a drop in water levels in Palestinian wells in the West Bank. Israeli settlers living in the West Bank receive around four times the amount of per capita water supply than their Palestinian neighbours, thus worsening disparities between the Israelis and Palestinians.

The separation wall constructed in and around the West Bank has also caused much damage to the Palestinian water supply. The sector most affected by the separation wall is agriculture. In addition, over 100,000 trees have been uprooted, and 36,000 metres of irrigation networks have been destroyed. Delays associated with travel through the limited gates of the wall have undermined the daily routines, productivity and efficiency of Palestinian farmers, delaying and altering their agricultural operations. The lands blocked by the wall contain 80 per cent of the West Bank's water wells in operation and provides 53 per cent of its water-sector employment. Currently, a minimum of 50 productive water wells and 15 villages are being trapped in the buffer zone and west of the wall[31].

Internal conflict between the Hamas and Fatah has also led to dysfunctional governance in the Palestinian Territories. The Palestinian Water Authority (PWA) for instance had developed a relatively strong presence in Gaza which has now significantly weakened. In the absence of PWA's regulatory authority and a severe lack of water, unlicensed wells in Gaza are proliferating.

## Geography, Climate and Rainfall

The West Bank is flanked by the Jordan River on its eastern side and the Judaen Hills on its western side. The Mountain Aquifer runs through the length and breadth of West Bank. Rainfall varies greatly in the West Bank - precipitation in the Jordan Valley ranges from anywhere between 90-375 mm/yr, the eastern slopes region has more of a desert climate with rainfall between 150-300 mm/yr, while the Central Highlands enjoy the highest amount of rainfall – between 300 mm/yr in the south to 600 mm/yr in the north.

The Coastal Aquifer runs under the Gaza Strip and along the Mediterranean Sea. The coastal plain receives rainfall between 200-400 mm/year and agriculture plays a substantial role in Gaza. The Gaza Strip is located alongside the Mediterranean Sea although access is restricted.

## Utilization Rate

Fig 3-a: Total Available Freshwater Resources in the Palestinian Territories

| Palestinian Territories | Year | Availability (MCM/Yr) |
|---|---|---|
| West Bank (WB) | 2008 | 158 + 20.5 |
| Gaza Strip (GS) | 2008 | 35 |
| Total | 2008 | 213 |

*Source: Tables 2-b, 2-c in Israel Country Report*

In 2000 the quantity of freshwater available to the West Bank was 138.5 MCM as per the Oslo Accords. However, a 2009 study conducted by the World Bank on the Palestinian water sector development, found that water availability in the West Bank had dropped, mostly due to over-pumping and drought, bringing the total amount of water withdrawn from wells from 118 MCM to 113 MCM[32]. The World Bank data does not seem to consider depletion of groundwater resources. The more realistic assessment of availability of water from the Mountain Aquifer would be under 158 MCM from the Mountain Aquifer in the West Bank including the undecided portion in the Oslo Accords.

Added to the amount over drawn from the wells, is 20.5 MCM that is received from additional wells under the immediate needs plan, and an additional 3.1 MCM supplied by Mekerot, though that is not counted as renewable freshwater.

There has been a continual decline in the static water level, water quality has been deteriorating and there is an increase of saltwater intrusion into the Gaza Coastal Aquifer that has rendered 95 per cent of the water unsuitable for drinking. Assuming total recharge from rainfall, water availability has declined from 57 MCM in 1990 to 35 MCM in 2010.

## Summary of Water Resources

### Rivers and River Basins

Although the Lower Jordan River flows through the West Bank, Palestinians do not receive any surface water supply from the river due to a number of reasons – a) Palestinians were not included in the original Jordan River water sharing agreement (outlined in the Johnston Plan), even though they are considered one of the five riparian states. b) Excessive damming by Israel, Syria and Jordan has blocked a majority of the Lower Jordan River's flow to the Dead Sea. c) Settlements in the Jordan Valley have made access to this water resource extremely difficult for Palestinians[33]. The Lower Jordan River does however supply the West Bank with its groundwater recharge. A few small rivers flow through the West Bank but they contribute a negligible amount to overall availability and they are not perennial in nature.

Wadi Gaza is a major wadi (surface water) in the Gaza Strip that originates in the Negev Desert in a catchment area of 3,500 $km^2$ with an estimated average annual flow of 20-30 MCM/year. At present however, water from Wadi Gaza is diverted towards reservoirs for artificial recharge and irrigation within Israel. This means that now only a little water out of the high winter flows may reach the Gaza Strip and therefore is not included as a multi-annual source of freshwater.

### Groundwater and Groundwater Basins

The resources available to the Palestinian Territories taking into account the Oslo Accords in the 1990s and depletion until 2010 have been assessed in the country paper on Israel, since the Palestinian Territories are currently under Israel's occupation. They would be approximately 195 MCM as per the Article 40 of the Oslo Accords.[34] In Figure 3-b, current availability to the Palestinian Territories is presented.

### Marginal Water

Currently Gaza has small public and private desalination plants that produce a combined total of roughly 3,000 cubic metres of water a day (1 MCM/Yr). In addition there are also 20,000 home desalination plants. Though there is potential for large-scale seawater desalination plants along the Gaza coastline, they have yet to be developed. It will prove beneficial, for the immediate future, to concentrate on developing and increasing the number of small scale community and home desalination plants. The quality of wastewater treatment in Gaza is poor. There are three existing wastewater treatment plants that function intermittently, little sewage is treated and most is returned raw to lagoons, wadis and the sea. The Gaza treatment plant has been overloaded beyond capacity and only 60 per cent of Gazan households are connected to the sewerage network. Gaza has a master plan which includes the expansion of wastewater treatment, including three new plants but only 2 per cent of the investment program has been implemented due to hostilities.

At present the West Bank does not produce any desalinated water. Only four towns in the West Bank have wastewater treatment facilities, producing poor quality effluent and there is no planned or regulated reuse of the effluent. According to a recent World Bank study, 250 MCM of effluent is being discharged at 350 locations of the West Bank every year. Only 31 per cent of Palestinians in West Bank are connected to a sewerage network.

## Future Changes in Supply and Demand

### Per Capita Availability

Per capita freshwater availability is calculated by dividing the 'renewable' freshwater resources by the population, at any given time, and not the virtual, purchased, over-pumped, additional or marginal water. In Figure 3-b, per capita water availability has been counted without taking into account water purchased from Mekerot. Taking the total amount of water allotted to the Palestinian Territories in the Oslo Agreement, the combined per capita availability in the Palestinian Territories was at an average of 60 cubic metres in 2000[35]. This amount is supplemented through purchase of water from Israel, small scale desalination projects and illegal pumping of the all the aquifers, but in spite of this the Palestinians in the occupied territories suffer from severe water shortage.

Fig 3-b: Renewable Per Capita Freshwater Availability in the Palestinian Territories

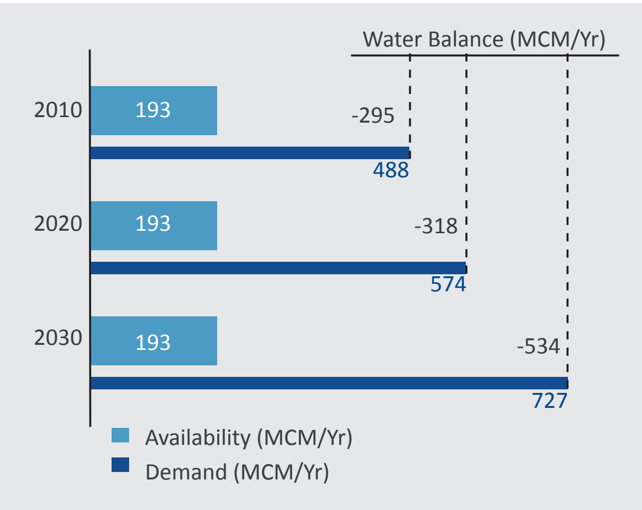
| Year | Total Water Availability (MCM/Yr) | Population (in millions) | Per Capita Renewable Freshwater Availability (cubic metre/Yr) |
|---|---|---|---|
| 2010 | 193 | 4 | 48.2 |
| 2020 | 193 | 4.6 | 42 |
| 2030 | 193 | 5.8 | 33.3 |

*Source: Population figures from UN population projections 2008, CIA Fact Book PASSIA 2008 report and Population Reference Bureau*[36]

### Renewable Freshwater Availability Remains the Same, While the Demand Increases

A study on supply and demand in the West Bank - titled 'Integrated Water Resource Management' and summarized by Eng. Abadi and officials from the PWA (Palestine Water Authority) uses constrained domestic consumption rates in West Bank (55 litres per day) as the basis and calculates demand of 217 MCM/yr in early 2000. Demand in 2010, 2020 and 2030 is calculated against this figure given by PWA and West Bank's growing population; displaying increase in water demand of roughly 19 per cent every 10 years. The water balance in Figure 3-c is measured against the total freshwater availability alone. Water supplied by Mekorot is not included here. Since the utilization rate is already above 100 per cent, the supply of freshwater availability will remain constant over the years.

Fig 3-c: Water Balance in the Palestinian Territories




*Source: Demand in the West Bank derived from PWA study by Eng. Abadi*[37]

Demand in 2000 for the Gaza Strip is derived by subtracting the total water demand figures for West Bank (217 MCM) from 2000 figures of total Palestinian demand (388 MCM) – calculated by sector - given in a study by the Palestinian Hydrology Group[38]. We therefore come to a demand of approximately 171 MCM for the Gaza Strip. Once again projections in demand for the future years are calculated off the 2000 population and demand figures.

Gaza had a supply coverage rate of 98 per cent before the December 2008 attack and we know that the supply in 2000, as a result of over-pumping, was approximately 157 MCM. However, since this is not sustainable by any measure the water balance is calculated against the renewable availability and not supply.

### Scenario 1 - Accounting for Additional Water Resources as a Supplement to Freshwater Availability

#### West Bank:

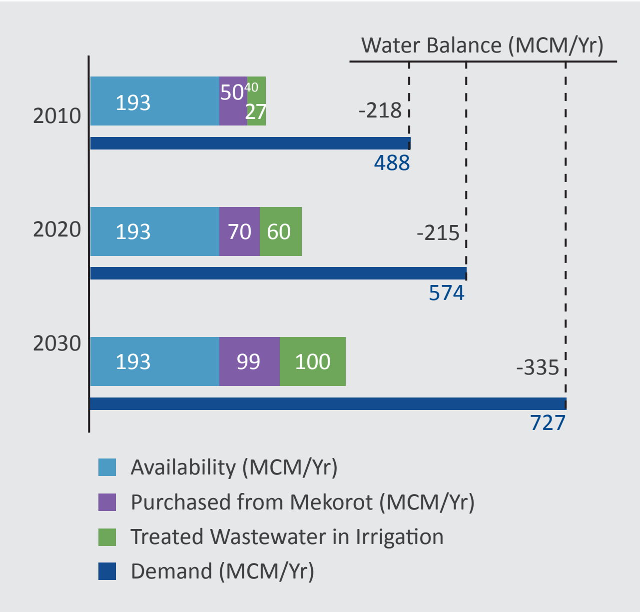
Desalination: In the case of West Bank, additional water would include Mekorot's supply to West Bank and a potential increase in treated wastewater. At present the West Bank does not produce any desalinated water. A future plan was proposed by Israel to export approximately 50 MCM/Yr of desalinated water from a plant in Hadera but the Palestinians were opposed to the plan and no agreement has been reached.[39]

Mekorot supply to West Bank: After the Oslo agreement, it was agreed that Mekorot would supply an additional 3.1 MCM to West Bank, over and above the 27.9 MCM that it was already supplying – resulting in a total of 31 MCM. According to the Palestinian Water Authority, the amount purchased by West Bank Palestinians from Mekorot had increased to 45 MCM/year in 2008.

Wastewater Treatment: In the West Bank there is currently one large-scale WWT plant in the Al-Bireh municipality that is functional. Four other existing plants are overloaded. Projections in Figure 3-d, assume that all 5 plants are functional (95 per cent) by 2020 and the effluent from these plants is used efficiently to satisfy irrigation demand. Since agricultural demand in the Palestinian Territories makes up a sizeable share of total demand and constitutes roughly 23 per cent of GDP, wastewater treatment is a necessary and advantageous investment to make in the future. Wastewater treatment is also important in both these territories because inadequate waste management in the future threatens to pollute limited groundwater resources.

Over-pumping is not a sustainable option and for this reason it has not been considered as a means to increasing the supply. It must also be noted that the calculations in Figure 3-d take into account the total withdrawal assuming zero conveyance losses. In reality, even with minimal conveyance losses, the actual deficit would be much worse than indicated.

Fig 3-d: Water Balance with Marginal Water




*Source: Zimmo, Imseh paper on treated wastewater for irrigation in Palestine*[41]

Although additional water resources such as wastewater treatment and increased supply from Mekorot will reduce the deficit in coming years, it will not be able to completely offset the increasing demand. Furthermore, Palestinian dependence on Israel will increase under this assumption; and Israel is itself running into a deficit and thus more water will only mean more over-pumping from the Mountain Aquifer.

## Gaza Strip:

Desalination: At present the Gaza Strip has four public desalination plants, producing roughly 1,000 cubic metres of water a day and private desalination plants that sell water at retail and wholesale prices, producing approximately 2,000 cubic metres of water per day. In 2009 Gaza was therefore producing a total of 3,000 cubic metres a day or 1 MCM of desalinated water a year. In addition there are also 20,000 home desalination facilities in the Gaza Strip. These facilities have been built out of necessity as a coping strategy, but in the future there is a need for large-scale desalination plants in Gaza.

Situated along the coast, Gaza has a huge potential to harness desalinated water from the Mediterranean. In early 2000, Gaza proposed a plan for a reverse osmosis desalination plant that was developed with USAID assistance. This plan has been used as a base to study the possibility of desalination development in the Gaza Strip. Assuming that this plan could be executed in the next few years by 2015, it would include the extra water that could result in 55 MCM/year increase in supply in 20 years and approximately 24 MCM/year increase at the initial phase[42].

Wastewater Treatment: It is also taken into account under additional water, assuming that all three of Gaza's existing WWT plants are functioning at 95 per cent efficiency, and this water will be re-used for agricultural purposes in the future.

Water sold by Mekorot: Lastly, the 5 MCM of drinking water purchased from Mekorot is also included after 2010 to give a realistic picture of total water supply in the Gaza Strip. The new water balance will include these additional water resources in total supply.

## Scenario 2 – In the Case of Drought and Water Pollution

Both drought, as well as water pollution could

Fig 3-e: Average Concentration of Chemical Parameters in Drinking Water in Gaza Strip

| Year | 2009 | | | | |
|---|---|---|---|---|---|
| **Governorate** | **No. of wells** | **Total Flow (cubic metre/h)** | **TDS (total dissolved solids) (mg/l)** | **Nitrates (mg/l)** | **Chlorides (mg/l)** |
| Rafah | 17 | 1,505 | 1,196.13 | 113.62 | 428.59 |
| Khan Younis | 32 | 2,470 | 1,602.7 | 205 | 637.43 |
| Middle | 39 | 2,308 | 14,94.61 | 80.17 | 634.26 |
| Gaza | 44 | 4,562 | 1,695.5 | 139.24 | 772.35 |
| North | 32 | 3,904 | 720.37 | 96.53 | 180.64 |
| WHO Standard | | | 1,000 | 50 | 250 |
| Total | 164 | 14,749 | | | |

*Source: Professors Youssef Abu Mayla, and Eilon Adar*

severely affect the water availability in coming years. According to the PWA (Palestine Water Authority) the 2008 drought exacerbated existing water shortage realities in the West Bank. Rainfall was 64 per cent of the average in the northern parts of West Bank and 55 per cent of the average in the southern sections. According to Prof. Marwan Haddad, spring discharge in the West Bank dropped from 51.7 MCM in 2003 to 25.2 MCM during the 2008 drought.

Water pollution and saltwater intrusion in Gaza's Coastal Aquifer has left only 5-10 per cent of the water as suitable for drinking. The rapidly growing population in the Gaza Strip is resulting in an increase in domestic water demand, leading to further pollution in the aquifer due to over-pumping and an increase in waste production, which flows into the aquifers untreated. This could lead to a severe shortage of clean water for the Gaza Strip, and could also result in dependence on freshwater imports from neighbours unless measures to reverse the pollution in the Gaza Coastal Aquifer are taken immediately.

The chloride contents in most of the wells in Gaza fluctuate from 300-700 mg/l which is double the recommended value by the World Health Organization (WHO) for water that is to be used for drinking purposes. The nitrate concentrations used to indicate groundwater contamination by wastewater, solid waste and agricultural fertilizer - are also well above the internationally accepted standards.

The West Bank is also in danger of pollution due to a lack of waste disposal and adequate sanitation. According to a study by Friends of the Earth Middle East (FoEME) on the impact of solid waste on the Mountain Aquifer[43], a serious risk is posed to the quality of the aquifer by 40 per cent of waste produced in Palestine, for which there is no planning for the future. This waste originates in the governorates of Tulkarem, Nablus, Qalqiliya, Salfit and Hebron.

## Future Geopolitical Scenario

### Scenario 2 - Addition of Freshwater Availability in the Case of a Two-state Solution

Assuming that Israel were to renounce all of its post 1967 territories and allow for a separate Palestinian State, freshwater supply in the newly formed state would increase considerably. The return of land and water resources to the Palestinian Authority would result in an addition of approximately 100-120 MCM of water from the North-Eastern Mountain Aquifer and the Eastern Mountain Aquifer.

This is also provided that the amount of water measured in these aquifers stands as before.

This figure does not include the Western sub-aquifer of the Mountain Aquifer, as its storage area is located almost completely in Israel's pre-1967 borders and Israel already utilizes 94 per cent of this of the water in this aquifer.

A sustained agreement and two-state solution will obviously result in Israel losing a certain extent of water, with the Palestinians assured of minimum access. But it is difficult to make any judgement on the exact amount of water allocated and available to the Palestine Territories. While there might be a certain amount of additional water, there will also be an influx of people returning to the newly formed state which will increase the demand, thus affecting the balance. In addition current dependence on Israeli company Mekorot might cripple future plans unless Palestinians strike a deal with Israel for continued purchase or develop an alternative supply plan to supplement this.

## Varying Demand

In a specially prepared paper for SFG, Prof. Marwan Haddad has calculated varying demand figures for Palestine based on three different scenarios - the existing scenario (in which annual per capita demand is assumed at 80 cubic metres in 2030), a compromised scenario (in which annual per capita demand is assumed at 100 cubic metres in 2030) and

Fig 3-f: Projected Water Demand and Population (2030-2050)

| Scenario | Year | West Bank | Gaza Strip | Palestine |
|---|---|---|---|---|
| Reference Population<br>Water Available | 2010 | 2.513<br>144.4 | 1.535<br>164.2 | 4.048<br>308.7 |
| Suppressed Population<br>Water Demand | 2030 | 4.539<br>363.1 | 3.236<br>258.9 | 7.775<br>622.0 |
| Suppressed Population<br>Water Demand | 2050 | 8.198<br>655.8 | 6.823<br>545.8 | 15.021<br>1201.6 |
| Compromise Population<br>Water Demand | 2030 | 4.615<br>461.5 | 2.980<br>298.0 | 7.595<br>759.5 |
| Compromise Population<br>Water Demand | 2050 | 6.858<br>685.8 | 4.428<br>442.8 | 11.286<br>1126.6 |
| Full Sovereign Population<br>Water Demand | 2030 | 6.395<br>767.4 | 4.449<br>533.9 | 10.844<br>1301.3 |
| Full Sovereign Population<br>Water Demand | 2050 | 11.550<br>1386.0 | 8.036<br>964.3 | 19.586<br>2350.3 |

*Source: Prof. Marwan Haddad*
*Water Demand = MCM/yr*
*Population = Millions*

finally a full sovereign state scenario (in which annual per capita demand is assumed at 140 cubic metres in 2030). The existing scenario offers the least water rights and hence the lowest demand, the compromise scenario assumes a partial agreement on water and land allocation and the full sovereign state scenario projects full water rights for Palestinians and hence the highest demand figures. The projections are made for 2030 and 2050 respectively.

## Climate Change

Climate change impacts could exacerbate problems between Israel and Palestine, particularly if final water agreements are not yet in place. Although Israel has definite projections for the impact of climate change on its total freshwater availability there are no specific quantities given on how this reduction will affect shared water resources in Gaza and the West Bank. We can however surmise the consequences of climate change in these territories, though it is difficult to determine the exact level of impact.

The Mountain Aquifer is extremely porous in nature and easily prone to contamination in the future; over-pumping and inadequate waste management have already increased this risk and if a trend of rapid exploitation continues it could lead to permanent damage thereby destroying the only natural source of drinking water in the West Bank.

If we take the effects of climate change into account, the chances of over exploitation of the Mountain Aquifer in the future are unpredictable. Increased temperatures, reduced precipitation and rapid surface water run-off in this region will result in a reduction of groundwater re-charge; the shortage of groundwater and a simultaneous increase in water demand will lead to further over-pumping and illegal connections. Consequently the water level in the Mountain Aquifer will keep decreasing and will be unable to replenish itself and which will result in long-term damage. However the rate at which this will occur, ultimately depends on behaviour and circumstance.

The situation in Gaza is critical due to salt-water intrusion and pollution from nitrates. A further rise in seawater levels - estimated at 18 cm in 2030 and 50 cm in 2100 as a result of climate change, could potentially render all the water in the Gazan Coastal aquifer as unsuitable for drinking by 2030.

## Future Water Surplus/Deficit

Both the West Bank and the Gaza Strip have scarce additional resources and an extremely limited amount of renewable freshwater availability. Demand, however, is increasing and the overall water requirements need to be met. Without any additional resources the Palestinian Territories will run into a deficit of over 300 MCM by 2020 and 500 MCM by 2030. Assuming that they will develop adequate desalination and wastewater treatment capacities, the overall water deficit can be reduced to some extent. However this is still dangerous, particularly considering that it is at low consumption rates. If water available after discounting losses due to pollution and conveyance leakages is considered, the deficit would be much worse.

If a peace agreement between Israel and the Palestinian Territories is reached within the next decade, the supply to the West Bank will increase. However a potential refugee influx as well as a growing demand in 2030 will push the Palestinian Territories back into a larger deficit, unless provisions are made for the development of alternate and marginal water capabilities.

# 3 Jordan

## Country Overview

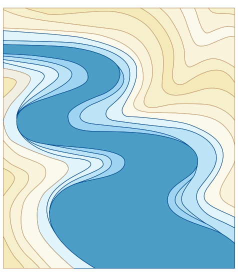
Jordan has an annual renewable freshwater availability of roughly 500-570 MCM. Of this amount around 250-270 MCM comes from surface water resources, while 250-300 MCM is derived from renewable groundwater resources. Jordan also has non-renewable groundwater or fossil water aquifers located in the southeast (Disi, Mudwara and Jafr) that can provide Jordan with around 100-150 MCM of water for another 50-100 years.

Demand in Jordan outstrips freshwater availability by a sizeable quantity. Current demand exceeds freshwater supply by more than 1,000 MCM. In order to make up for the excess demand, Jordan has embarked upon efforts in wastewater treatment, brackish water and seawater desalination and has plans to extract around 100 MCM from its fossil water aquifer - the Disi Aquifer.

Unaccounted for Water (UFW) or water losses through water supply system leaks and illegal connections are a huge problem in Jordan. The government has brought them down from 50 per cent a decade ago to 35 per cent in 2010, though most of the improvement has been around Amman.

Jordan is the fourth most water-deprived country in the world. Deserts comprise 80 per cent of the Hashemite Kingdom's territory and droughts are a natural part of its climate.





### Geography, Climate and Rainfall

Annual rainfall starts in October and ends in May. The average annual rainfall quantity over Jordan is 8.23 BCM. This quantity can reach 12 BCM in wet years and goes down to 5.2 BCM in dry years. Approximately 92.2 per cent of the rainfall evaporates, 5.4 per cent recharges the groundwater and the rest - 2.4 per cent - goes to surface water. More than 80 per cent of the area of Jordan receives less than 100 mm/yr.

There are roughly three main climatic zones in Jordan:

- **The Jordan Rift Valley** which is located along the western border of the country. Average rainfall ranges between 350 mm/yr in the north, 200 mm/yr around the Dead Sea and less than 50 mm/yr in the South towards the Red Sea.
- **The Northern and Southern Highlands** where Jordan's rivers and wadis arise. Rainfall here can be as high as 600 mm/yr.
- **The Eastern (Badia) and Southern Deserts** which cover most of Jordan. The average rainfall in these desert regions is below 100 mm/yr.

About 90 per cent of Jordan's population live in the Northern provinces due to the concentration of water resources there. The next most populated area is along the Jordan River Valley. Ironically, the region of Amman-Al Zarqa, located in north central Jordan with the highest population density and consequently the highest demand for water, is located at the edge of the desert (Badia).

## Summary of Water Sources

### Rivers and River Basins

The main rivers flowing through the Hashemite Kingdom of Jordan that contribute to its surface water supply are: the Jordan River, two of its main tributaries - the Yarmouk and the Zarqa and the side wadis that flow from the Jordanian highlands.

**Jordan River:** Characteristics of the Lower Jordan River, flowing through the Hashemite Kingdom, are very different than those of the Upper Jordan River. This is because only a small percentage of the inflow into Lake Kinneret (Tiberias), Israel is released into the Lower Jordan River; and much of the water from the Yarmouk is diverted for water supply before its confluence with the Jordan River. In fact due to excessive water diversion and dam building, the annual flow of the Jordan River into the Dead Sea has dropped over the last 50 years from 1,300 MCM/year to only 70-100 MCM/year today.

**Yarmouk River:** The Yarmouk is the main surface water resource in Jordan. It originates in Syria and Jordan, and later flows into the Jordan River 10 kms below Lake Kinneret (Tiberias). Jordan was entitled to 733 MCM of the Yarmouk as per the Johnston plan. It agreed to a reduced share of 208 MCM in the 1987 agreement with Syria. In reality the amount of water it receives at present is 50-100 MCM and in dry years even much less.

**Zarqa River:** The Zarqa, also a tributary of the Jordan River, is extensively used to meet demand and is located in one of the most densely populated areas in Jordan. The river is controlled by the King Talal Dam and feeds the KAC (King Abdullah Canal) along with the Yarmouk. Withdrawals from the Zarqa-Amman groundwater basin have reduced base flows in this river and most of its summer flow comprises of mainly treated wastewater.

**Side Wadis:** Jordan's surface water flow is supplemented by smaller rivers known as side wadis. Most of these side wadis originate in the Jordanian highlands and flow westward, toward the Jordan Valley. There are nine perennial side wadis that contribute to the eastern Lower Jordan River catchment. They include, Wadi Arab, Ziglab, Jurum, Rayyan, Kufranja, Rajib, Shueib, Kafrein and Hisban.

## Groundwater and Groundwater Basins

Jordan's groundwater resources are distributed among 12 major basins, ten of which are renewable and two, located in the southeast, are fossil or non-renewable aquifers. At present, most of these groundwater resources are exploited at maximum capacity. Out of the 12 groundwater basins, six are over exploited, four are balanced and two are under exploited. The Disi aquifer, Jordan's main fossil aquifer, is located on the border between Jordan and Saudi Arabia. It is both an important and a highly controversial water resource that can supply much needed drinking water to Amman. Other non-renewable resources include the Mudwara and Jafr aquifers.

Fig 4-a: Break-up of Jordan's Renewable Freshwater Resources (multi-annual average)

| Source | Quantity (MCM/Year) | Basins |
|---|---|---|
| Surface Water<br>Jordan<br>Yarmouk River<br>Side Wadis | 250-270<br>(0)<br>(50-70)<br>(200) | 15 basins |
| Renewable Groundwater | 250-300 | 12 basins |
| Total Renewable | 500-570 | |
| Non-Renewable | 100 | |
| Total | 600-670 | |

*Source: Discussions with former Ministers of Jordan and water experts*

According to former Jordanian Water and Irrigation Minister Engineer Zafer Alem, the Kingdom of Jordan receives no water from the Jordan River due to diversion of the upper Jordan River through the Israeli National Water Carrier at the Lake Kinneret (Tiberias). A more realistic assessment would be 10-15 MCM provided it is not an extreme drought year.

Drought and the effects of climate change have also led to a decreasing flow in Jordan's surface and groundwater resources over the years[44]. This report takes the multi-annual average of water resources as a constant figure for freshwater availability, but it is important to observe that river volumes decrease drastically as a result of seasonal and annual variations.

Total renewable freshwater resources in Jordan amount to roughly 500-570 MCM/year (availability will be taken as 550 MCM for further calculations). If we include the non-renewable or fossil water sources from Disi/Mudwara and Jafr, the total annual resources will have roughly 100 MCM more but only for the next 50 years or so. This extra amount will be accounted for under additional resources in future scenarios which also includes marginal water (namely wastewater treatment projections and desalination plans).

However, the annual flows do not accurately reflect seasonal variations. The Lower Jordan River has a lean period of seven months when water budget accounts for only 5 per cent of the annual flow. Thus, monthly flow during the lean period is less than 1 MCM per month. Yarmouk River has a lean period of nine months during which it has 23 per cent of annual discharge. Thus, it has a monthly flow of barely 3-5 MCM from April to December, which at times drops to 2 MCM. A similar situation prevails with regards to Zarqa, where seven lean months have 40 per cent of the annual flow.

The annual averages can be deceptive. The ratio of water discharge in the lowest and highest month can be anywhere from 1:20 to 1:60. Therefore, a river flow of 250 MCM per year can still mean barely 10-20 MCM water for a quarter of the year and little more for another quarter. The issue is not merely of water availability, but also of adequate water being available for a quarter to half of the year. The statistics used in this paper and papers by other institutions and experts are only broadly indicative for another reason. There are variations in river flow from one year to another. There are also geographical variations with the southern part being more affected by dwindling water resources. The problem of Jordan is most acute in the southern half of the country in the six month period from April to October in dry years. It is somewhat manageable in the northern part of the country in the wet months of the wet years.

Fig 4-b: Lower Jordan, 1978-1996, as measured at Nahariyam

| Period | No. of Months | MCM |
|---|---|---|
| Full Year | 12 | 252[45] |
| Lean Months (May - Nov) | 7 | 12 (median rdgs.) |
| Wet Months (Dec - April) | 5 | 240 (median rdgs.) |
| Lowest Month | 1 | 1 |
| Highest Month | 1 | 60 |
| Ratio (lean on wet) | | 5:95 |
| Ratio (lowest on highest) | | 1:60 |

*Source: Water Databanks Project, US Geological Survey for the Exact Action Team, 1998*
**Lower Jordan River experiences drastic changes between wet and dry years and wet and dry months.*

Fig 4-c: Yarmouk River, 1964-1996, as measured at Adasiyia Station (near the confluence with the Jordan River)

| Period | No. of Months | MCM |
|---|---|---|
| Full Year | 12 | 146 |
| Lean Months (April-Dec.) | 9 | 34 (median rdgs.) |
| Wet Months (Jan.-March) | 3 | 98 (median rdgs.) |
| Lowest Month | 1 | 2 |
| Highest Month | 1 | 38 |
| Ratio (lean on wet) | | 23:67 |
| Ratio (lowest on highest) | | 1:19 |

*Source: Water Databanks Project, US Geological Survey for the Exact Action Team, 1998*

Fig 4-d: Zarqa River, 1964-1997, as measured at New Jerash Bridge (above the King Talal Dam)

| Period | No. of Months | MCM |
|---|---|---|
| Full Year | 12 | 52[46] |
| Lean Months (April-Oct.) | 7 | 20 |
| Wet Months (Nov.-March) | 5 | 32 |
| Lowest Month | 1 | 2 |
| Highest Month | 1 | 9 |
| Ratio (lean on wet) | | 2:3 |
| Ratio (lowest on highest) | | 1:4.5 |

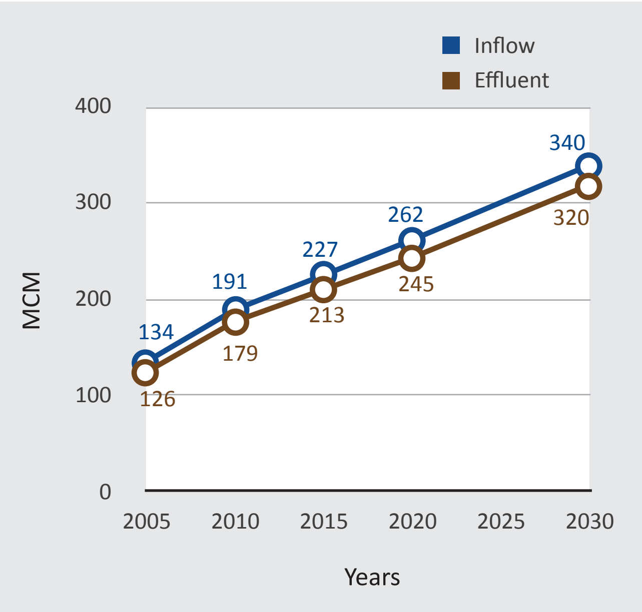
*Source: Water Databanks Project, US Geological Survey for the Exact Action Team, 1998*

Zarqa River has very dramatic fluctuations between wet and lean months, as well as wet and lean years which are not adequately represented in the median readings.

### Marginal Water

Jordan supplements its freshwater supply with marginal water resources, mainly treated wastewater and desalinated water. In 2002, Jordan treated 80 per cent of its total wastewater with 19 plants. Since then, measures were put in place to increase the number of wastewater treatment plants to 36 in a period of 10-12 years. Desalination plants, on the other hand, although required, are very costly. In 2005, Jordan produced only 10 MCM of desalinated water (mainly from brackish groundwater). But, a Jordan National Red Sea Project (JRSP), announced in 2009 will change the amount of desalinated seawater that Jordan produces each year.

Fig 4-e: Wastewater Treatment Capacity (MCM/Year)




*Source: Jordan National Water Master Plan*[47]

Projections for 2030 were made taking an average increase in inflow of 35.5 MCM every five years and a constant treatment rate for effluent of 94 per cent. Projected wastewater treatment figures for 2010, 2015 and 2020 were procured from the Jordan National Water Master Plan.

In terms of desalination, Jordan has embarked upon small scale groundwater desalination ventures resulting in roughly 40-70 MCM of desalinated water per year. In 2009 however, Jordan announced its intentions to move ahead with a National Red Sea Desalination Plan. This project aims to transport seawater from the Red Sea to a desalination plant at Aqaba and then pump this water to parched areas in Jordan, particularly Amman. This plan should not be confused with the international Red-Dead Sea Canal project (RDC) between Israel, Jordan and the PA.

## Future Changes in Supply and Demand

### Per Capita Availability

Jordan is facing a future of very limited water resources; among the lowest in the world on a per capita basis. In 2010 the per capita availability was 85 cubic metres per year and is projected to be 73 cubic metres by 2020. This figure does not even take the complete number of Iraqi and Palestinian refugees into account, when calculating the population.

Fig 4-f: Per Capita Availability

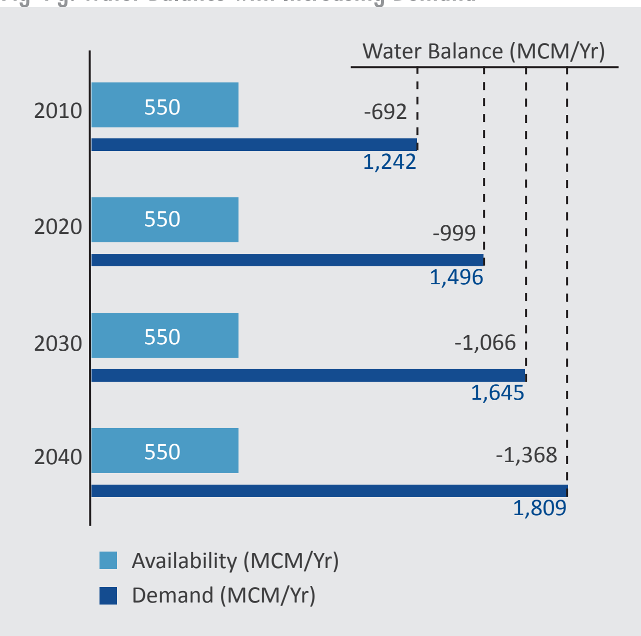
| Year | Total Water Availability (MCM/Yr) | Population (in millions) | Per Capita Renewable Freshwater Availability (cubic metre/Yr) |
|---|---|---|---|
| 2010 | 550 | 6.5 | 85 |
| 2020 | 550 | 7.5 | 73 |
| 2030 | 550 | 8.6 | 64 |

*Sources: United Nations World Population Prospects: the 2008 revision, population database*
*[Note: In order to keep a standardized format – per capita availability is calculated by renewable freshwater available and not virtual, purchased, over-pumped, additional or marginal water.]*

### Renewable Freshwater Availability Remains the Same, while the Demand Increases

Jordan has the 9th highest population growth rate in the world at 2.2 per cent. One of the main factors responsible for the high water demand in Jordan is the rapid population increase. Between 1960 and 1970, the population grew by 210,000 while in the period between 1980-1990 the population increased by over 1 million. The population increase is caused partially by the influx of Palestinian and later Iraqi refugees into Jordan. This refugee influx, paired with an increasing standard of living, will further increase the gap between the Kingdom's demand for water and the amount of renewable freshwater actually available.

Fig 4-g: Water Balance with Increasing Demand




*Source: Jordan's National Water Master Plan and consultations with Eng. Zafer Alem*[48]

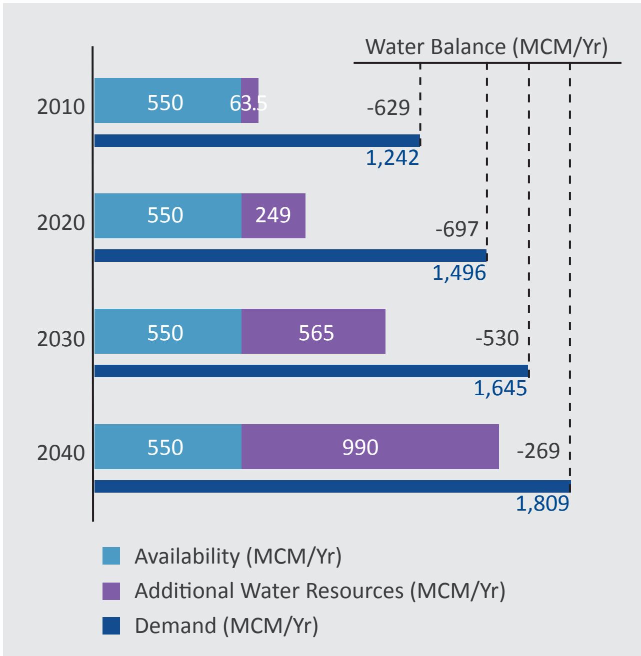
Figure 4-g projects the total deficit that will accrue between projected demand and freshwater available in the future. Demand figures (2000) are taken from the Jordan Ministry of Water and Irrigation (W&I), National Master Plan - 2004. The demand figures for 2010 and 2020 are derived from a specially commissioned paper by Eng. Alem. Demand projections for 2030 are taken using the 10 per cent increase in water demand between 2020 and 2030. Demand projections for the future have been curbed as the Jordanian government plans to curtail water allocations in the agricultural sector due to the water shortage and scarce resources. The Ministry of W&I plans to take strict measures to reduce the water consumption of Jordan's agricultural sector by close to half.

The Jordanian government has made efforts to decrease this water deficit by supplementing freshwater resources with additional water resources. The first scenario takes all current as well as future additional resources into account.

Note: Utilization rate is taken as more than 100 per cent as Jordan utilizes all of its renewable freshwater resources and more. Thus the supply is a 100 per cent of the availability and not a portion of it.

## Scenario 1 - Accounting for Additional Water Resources as a Supplement to Freshwater Availability

Figure 4-h: Water Balance with Additional Water



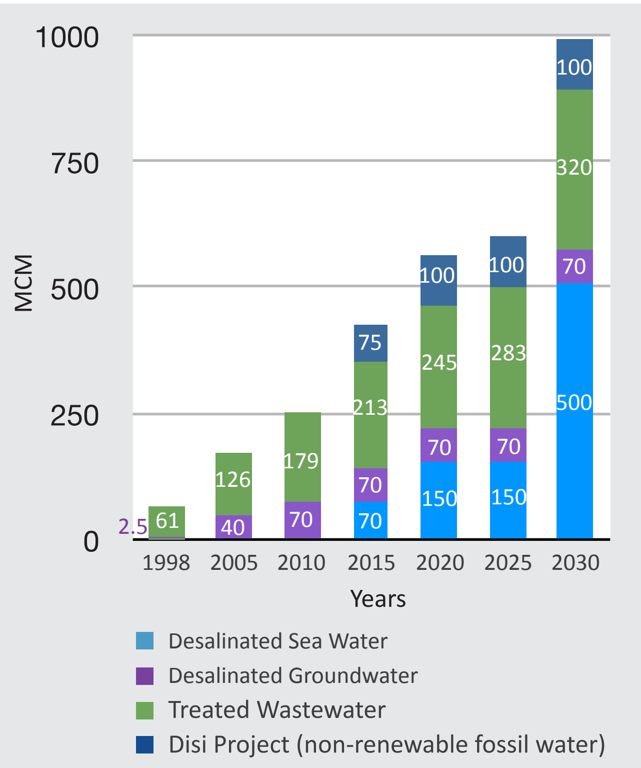

*Source: Eng Zafer Alem*

In order to fulfil the country's growing demand in the future as well as at present, Jordan has had to rely on supplementing its freshwater availability with additional or non-conventional water resources. These resources include desalinated brackish groundwater and sea water, treated wastewater and non-renewable water resources such as the Disi Aquifer. Pumping water from the Disi Aquifer is controversial because it is not sustainable in the long term, and the water from this aquifer is jointly shared by Saudi Arabia. Figure 4-h depicts Jordan's water balance, after taking the projections for the additional/non-conventional water resources into account.

Calculations show that although these additional resources will reduce the water balance significantly, they will not be able to offset the deficit accrued between demand and supply completely. Even with the Kingdom's plans for additional water, Jordan will run into a water deficit of 500-600 MCM in the future, however the additional water from the RDC project will contribute significantly to a reduction in this deficit as is shown in the calculations made for 2030.

Water deficits that occur after supplementation by non-conventional sources usually result in cutbacks or over-pumping of groundwater aquifers.

Fig 4-i: Additional Water Resources (MCM/Year)




*Source: Eng Zafer Alem and National Master Water Plan*

Recent statistics and projections on:

1. Desalinated Sea water - The Jordan National Red Sea Project was announced in 2009. Supported by Ministry of Water & Irrigation and Jordan Atomic Energy Commission, the project aims to provide 50 MCM of water annually to Amman and 20 MCM of water to Aqaba in its first phase, expected to be complete in 2015. An additional 80 MCM is expected in 2020 which will be desalinated for cooling purposes of the nuclear plant. There is lot of misinformation about the JRSP in the media[49] that confuses projections with the large-scale regional RDC plan. The projections given here have been confirmed with Jordan's former Water and Irrigation minister Eng. Zafer Alem (2005-2007). In 2030, RDC's (Red Dead Sea Canal) projected increase of around 350 MCM has been added to seawater desalination along with the total of 150 MCM from the National desalination project.

2. Desalinated Groundwater - has been kept constant in 2030 since it will not be economically feasible to expand this area along with the sea water desalination project. Desalinated brackish water takes into account the Abu Zighan wells, Zara and south Shuneh[50].

3. Treated Waste Water - Projections for treated wastewater were made in accordance with the trend of a 30 per cent increase in wastewater inflow from 2010-2020 and in keeping with rate of 94 per cent treated wastewater effluent since 2005. Amount of treated wastewater and desalinated water in 2000 has been taken from the ESCWA paper on sectoral water allocation. The rest of the projections have been derived from the Jordanian National Water Master Plan.

4. Fossil Groundwater - Total annual withdrawal from the Disi (fossil) Aquifer will be approximately 100 MCM. Around 75 MCM is expected to be transported in 2015 from this project according to Eng. Alem.

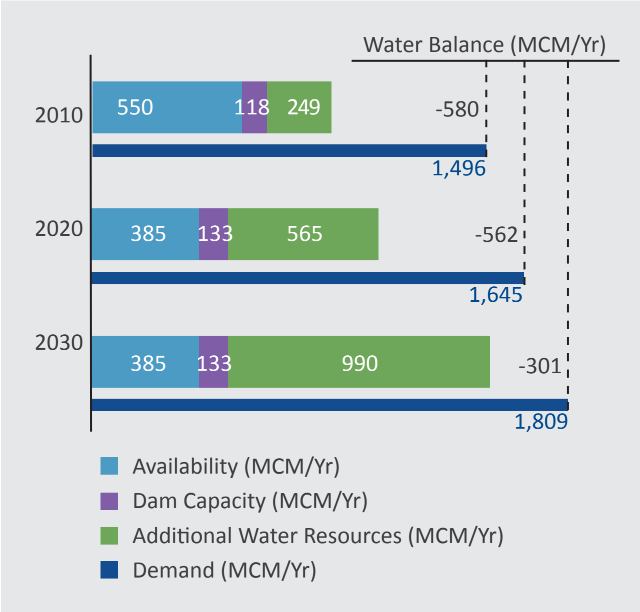
### Scenario 2 – Accounting for a Decline in Freshwater Availability

The effects of drought, climate change, dam activities and pollution can lead to a gradual decline in Jordan's freshwater availability in the future. Jordan already has an extremely dry climate where roughly 92 per cent of the rainfall is lost through evapo-transpiration and over 80 per cent of the land surface receives less than 100 mm of rainfall a year. Drought is a natural part of the climate in Jordan and the country was hit by severe drought periods around 1999, as well as around 2008[51]. Experts believe that the effects of climate change have already caused a reduction in Jordan's surface water resources. Damming, diversion and excessive utilization of resources such as the Yarmouk and Jordan Rivers by upper riparians Syria and Israel, have decreased Jordan's surface water flow considerably in the past. Pollution of both surface and groundwater sources from untreated wastewater flow and industrial effluent is also apparent in the kingdom.

Discussions with water experts and former ministers in Jordan show that there has been an overall decline of approximately 30 per cent in Jordan's freshwater availability due to a combination of all these factors. Figure 4-j continues along this trend of a 30 per cent overall reduction in freshwater availability over a 10-20 year period taking the current figure of 550 MCM as the base in 2010. Figure 4-j also takes Jordan's additional water and its estimated dam capacity into account.

Jordan currently has 10 major dams with a total capacity of 337 MCM, although the actual quantity of water in the dams that can be used on average is 118 MCM. Projected dam capacity for 2020 includes the addition of five new dams with a combined capacity of 15 MCM – a recent plan announced by the Ministry of Water and Irrigation in 2009[52].

Fig 4-j: Water Balance with Declining Freshwater Availability




*Source: Information for 30 per cent decrease in overall availability is an approximation surmised after discussions with water experts in Jordan*

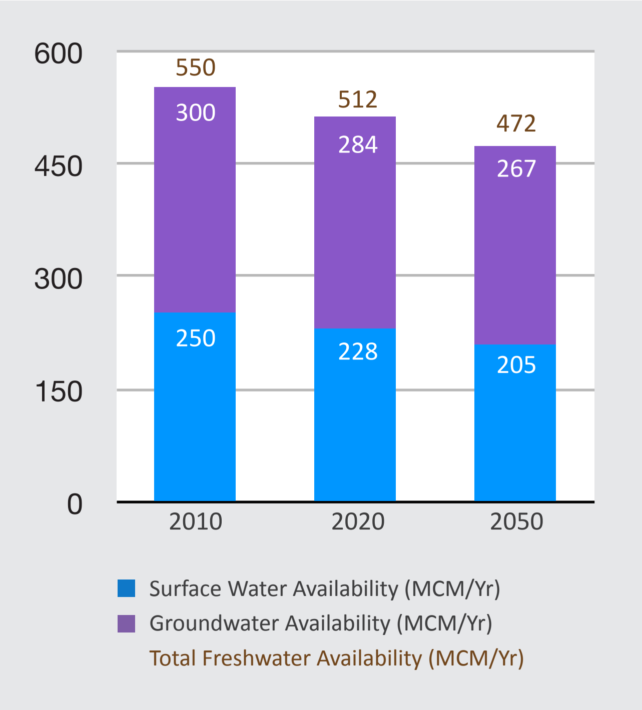
Hence with its current dam capacity, an additional five new dams and additional water resources Jordan will still not be able to cope with a decline in water availability in the future. Without the dam capacity of 133 MCM Jordan's water deficit could be as high as 700 MCM in 2020. In 2030 the water deficit could be as high as 450 MCM with declining availability, increasing demand and no stored water; despite water from the RDC project and other additional resources.

## Climate Change

Experts believe that climate change has already caused a reduction in Jordan's surface water resources. According to some reports over 30 per cent of the Kingdom's surface water resources have been lost to drought and desertification. The amount of water utilized by the agricultural sector, which constitutes roughly 65 per cent of total demand - is already unsustainable. With arid land constituting 91 per cent of Jordan, the country is susceptible to further desertification. Soil salinity and erratic rainfall patterns will reduce agricultural productivity even further.

Increase in temperature and reduction in rainfall will reduce aquifer recharge by a minimum of 30 per cent and a maximum of 70 per cent. A study conducted by Abdulla and Al-Omari in 2008[53] stated that a rise in temperature by 2-4 °C in Jordan will reduce the flow of the Zarqa river between 12 and 40 per cent. A recent World Bank study on global natural disaster hotspots found that Jordan is one of the six Arab countries which is at high risk of natural disasters that are strongly linked to climate change.

Fig 4-k: Decrease in Availability due to Climate Change




*Source: IISD Report and Study by Abdullah and Omari on Climate Change in Jordan*[54]

In June 2009, Jordan announced the launch of its first systematic climate change adaptation project. The details of this project have not yet been disclosed. According to a recent report on the impact of climate change by International Institute of Sustainable Development (IISD)[55], water availability from the Jordan River could shrink by up to 80 per cent at the end of the century. Jordan's surface water resources are comprised of the Jordan River and its tributaries; thus assuming that a reduction in the Jordan River would mean a reduction of freshwater availability in its tributaries, surface water flow (250 MCM) would reduce by around 9 per cent in 2020 and around 18 per cent in 2030 (taking a 0.88 per cent decrease every year from 2010). Furthermore groundwater recharge (300 MCM), as mentioned above is projected to decrease at an average of 50 per cent in 2100. That would be a 5.5 per cent reduction in 2020 and an 11 per cent reduction in 2030 (taking a 0.55 per cent decrease every year since 2010). This means the effects of climate change alone can cause an estimated 15 per cent decline in freshwater availability in 2020.

## Future Water Surplus/Deficit

Jordan's ambitious plans to institute additional water resources and demand management has the potential to alleviate the Kingdom's water scarcity in 2030, provided these projects are completed to their full capacity by then. Calculations show however that Jordan will not be able to satisfy overall demand in 2020 or 2030 in spite of all these measures and will incur a deficit of roughly 500 MCM in 2020. Additional water resources can reduce this deficit to 300 MCM in 2030, despite increasing demand, mainly because of the potential 350 MCM from the International Red Dead Sea Canal project.

If we account for a potential decline in freshwater availability however, which is a very real and apparent possibility; Jordan can run into a deficit of 500-700 MCM in 2020, even with additional water resources (including storage capacity). Further, this water deficit will not be evenly distributed. It will be more acute in the six months from May to October, with the lean period at times being extended to December.

It must also be noted that the over-exploitation of groundwater and shared fossil water resources will lead to a drop in water quality, which could have serious implications for health of the population.

4

# Lebanon

## Country Overview

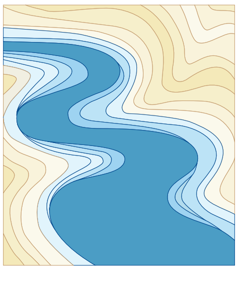
Lebanon faces extreme variations in water availability from one year to another and from one part of the country to another. The potential availability of surface water ranges from 4,100 MCM in an average wet year to about 2,200 MCM in a dry year. On account of weak coordination amongst its numerous water authorities, Lebanon experiences shortage of water at certain times, even though the country is generally viewed as having abundant water resources.

Lebanon is a mountainous country with two parallel ranges running through almost the entire length of the country with the Bekaa Valley between them. This creates heavy precipitation along the coast, much less in the Bekaa Valley and almost irregular quantities on the eastern border.

In the last 15 years, several studies on Lebanon's water situation have been undertaken. One of the latest studies was authored by Dr Selim Catafago, President of Litani Water Authority, in 2005 comparing demand and supply. The study was published in 12 volumes. It is used as the basic reference for data in this report.

The largest reservoir, at the Karaoun Dam, can hold 220 MCM of water and is currently used to produce electricity. It is planned to use 140 MCM for irrigation in future. During the early part of the last decade, plans were discussed to build two reservoirs in the northern parts of the country and about 20 dams along 15 rivers, but Lebanon has several geographical challenges which hamper development. Several plans have been postponed and in 2007 a new dam, the Shabrouh was inaugurated with a capacity of 8 MCM.





According to the UN and other experts, currently about 70 per cent of Lebanon's population is connected to the main water supply and pipeline network, though almost 40 per cent of available water is lost to leakage.

Lebanon currently generates a little over 300 MCM of wastewater every year and organizations such as the European Union, in coordination with the relevant national authorities have recently begun feasibility studies on harnessing and re-using this wastewater. No clear projections have been made for the future in terms of how much of this can be added to the supply.

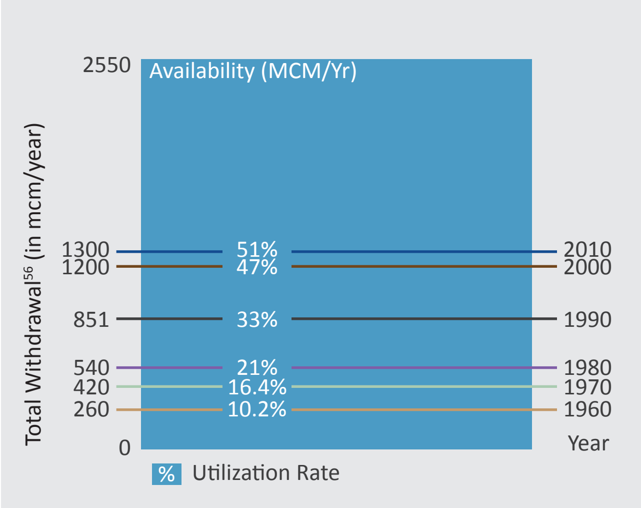
### Consequences of the 2006 War

The Israeli attacks in the course of war between Hezbollah and Israel in 2006 caused severe damage to infrastructure, water and sanitation systems in the southern parts of the country. Water was transported from the north to southern villages and communities by relief agencies, the UN and NGOs. Though efforts have been put into place to rectify the extensive damage, there is still more to be done. Several workshops on effective management principles and training of farmers have been conducted by the WHO, UNICEF and the EU in collaboration with local authorities. There is very little data available as to how much of the damaged facilities and systems have been re-built, and little assessment on what the requirements are for the future.

## Utilization Rate

About 65 per cent of the current available water is consumed by the agricultural sector with the rest shared by the industrial and domestic sector. The amount of land used for irrigation is constantly increasing and it is expected that by 2015-2020 the water needed for irrigation will significantly increase, creating a deficit in areas like the southern part of the Bekaa Valley if modern irrigation methods that save water are not implemented.

### Fig 5-a: Utilization of Total Available Freshwater Resources



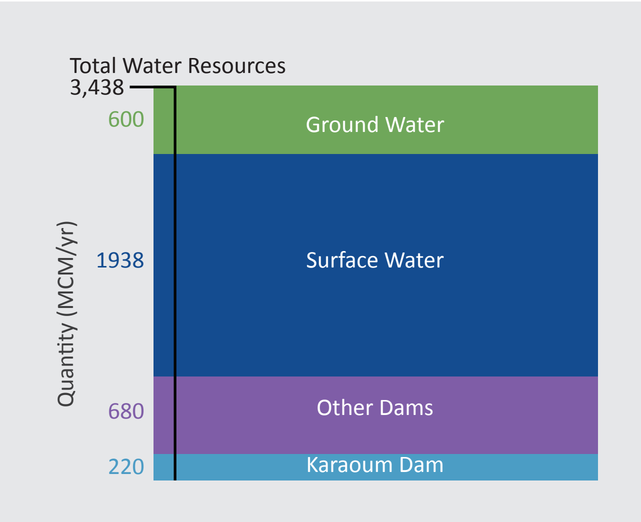

*Source: Dr. Catafago's 2005 Study on Lebanon's Water Resources, Bureau ARCS*

The utilization rate is calculated against the available exploitable fresh water resources of about 2,550 MCM, as a median figure between the range provided by Dr. Catafago of 2,300-2,800 MCM annually. In 2009-2010 Lebanon put into place some methods of water management and had made some efforts to reduce its overall water loss. In 2009-2010 all sectors used a total of 1,310 MCM, bringing the current utilization rate to approximately half of the available exploitable water resources. However, if we calculate the utilization rate against potential renewable fresh water of 3438 MCM (Figure 5-b), including water available in dams and underground, the current utilization rate would be around 37 per cent.

The rate of utilization is likely to increase by 10 per cent per decade until 2020 and 16 per cent per decade from 2020. It is not expected to increase further due to saturation in scope for irrigation. It is extremely important that over the next two decades actions are undertaken to improve the demand management, to reduce loss from conveyance systems and to store water during years of high rainfall.

## Summary of Water Resources

Fig 5-b: Lebanon's Renewable Freshwater Resources in Wet Years




*Source: Dr. Selim Catafago's 2005 Study for Bureau ARCS*

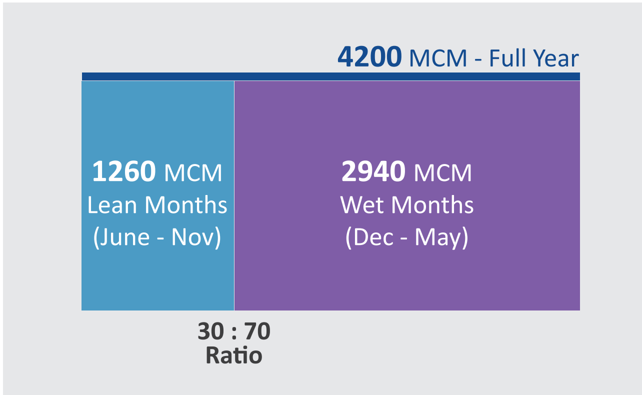
### Rivers and River Basins

The Litani is the longest river in Lebanon and flows entirely within the country. The Litani basin is in the south and east and its total catchment area covers about 20 per cent of the total country. The waters of the Litani have a low salinity of only 20 parts per million. The river provides Lebanon with less than 800 MCM of water in an average wet year.

The Orontes is a transboundary river which originates in Lebanon and flows north into Syria. The river has an estimated annual discharge of about 400 MCM at the Hermel Bridge. Following an agreement with Syria in 1994, Lebanon's share is 80 MCM, though in some years this has dropped to 67 MCM. The water available to Lebanon gets adjusted relative to the reduction in the flow. In the case of a dry year, Lebanon receives about 20 per cent of the flow at the Hermel Bridge. The river drains the northern aquifers of the Bekaa Valley. In the event of severe drought this region will be badly affected. The El Kebir is another river Lebanon shares with Syria, which forms part of the border between the two countries before flowing into the Mediterranean Sea.

The Hasbani, a northern tributary of the Jordan River, receives most of its discharge from the Wazzani springs and flows south into Israel to join the Jordan River. The river currently supplies Lebanon with 20 MCM of water which is minimal in comparison with the estimated groundwater below the springs of around 350 MCM.

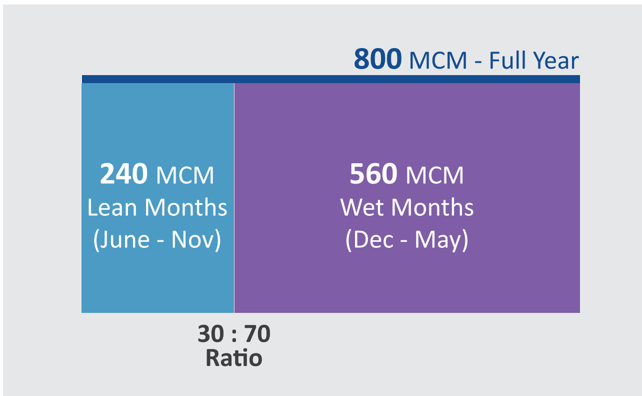
Fig 5-c: Lebanon, All Rivers, Recorded Average of Wet Years




*Source: Discussions with authorities in Lebanon*

** The wet months are taken as beginning in December.*

Fig 5-d: Litani, Recorded Average of Wet Years




*Source: Discussions with authorities in Lebanon*

There are about 13 other main rivers located around the country, though mostly along the coast, and tens of other smaller water courses and catchment areas.

There is a vast difference between wet years and dry years. The ratio of water discharge between lean and wet months is approximately 30:70. As a result, in a dry year, fresh water available from rivers can be as low as 500 MCM over six months. The worst months are June to November. Litani, the most significant river, can provide only about 100 MCM of fresh water over six months in a decennial dry year. Because of the vast differences between dry and wet years and seasonal variations within a year, Lebanon needs to build dams to store water.

## Groundwater and Groundwater Basins

There are eight main aquifers or groundwater sources in the country with a total estimated potential of 1,250 MCM which can fall to about 400 MCM during years of prolonged drought. Most of the aquifers are found along the coast and in southern Lebanon where precipitation is the highest. Rain and snow melt are the main contributions to groundwater. The geographical constraints and the mountainous nature of the country make it difficult to harness water from the ground and springs.

Groundwater abstraction is mainly through wells, most of which are unlicensed, and are mainly concentrated along the coastal areas and the southern valleys. About 45 per cent of the groundwater is used for irrigation and the amount is increasing. The data available is from the late 1990s, where the rest of irrigated area was estimated to be rain fed, and minimal new concrete data is currently available to base future estimates upon. A growing concern is that over-pumping will lead to sea water intrusion, especially around the Beirut area.

The government has recently started planning to improve conveyance systems and introduce sectoral and demand management practices.

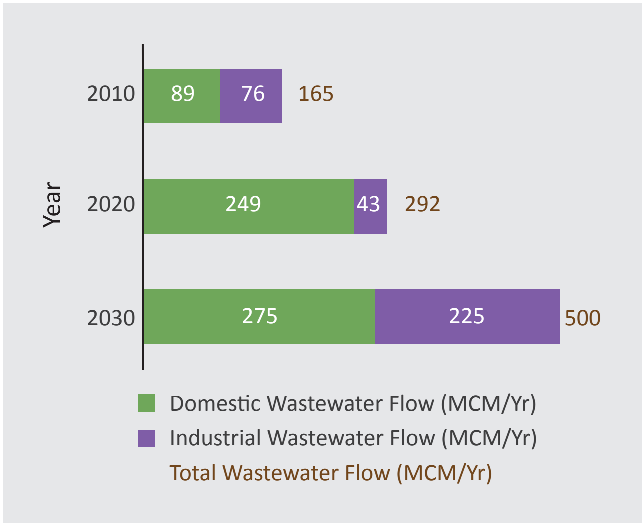
## Rainfall and Precipitation

Lebanon receives some of the highest rainfall in the region, approximately 8,600 MCM/year in a wet year, though over 40 per cent of this is lost to evaporation with another 1,250 MCM percolating into the ground and about 600 MCM flowing out of the country. Rainfall in Lebanon occurs mainly in the winter and about 90 per cent is received between November and April. There is a huge disparity between the rainfall received during these wet months and the dry season – for example in August when the need for rain is the highest for irrigation, the amount of surface water received in an average wet year is about 140 MCM. In dry years the precipitation falls by almost 60 per cent.

The precipitation varies from 2000 mm along the western mountain range to 700 mm in the Karaoum region and 250 mm in the northern Bekaa valley near the Syrian border.

## Marginal Water

### Fig 5-e: Total Wastewater Flow




*Source: Global Water Intelligence Report on 'Lebanon's Wastewater Programme' and EM Water's Water Reuse study*

Lebanon has proposed plans for the construction of approximately 35 wastewater treatment plants and the construction and rehabilitation of sewage systems. The construction of six of these has been completed but they are not yet operational. Till date Lebanon has only small scale wastewater treatment facilities as well as one wastewater treatment plant (WwTP) in Ghadir that provides primary treatment but no secondary treatment. There is a possibility that other planned plants will be constructed by 2020, provided construction moves according to the schedule.

## Future Changes in Supply and Demand

### Renewable Per Capita Freshwater Availability

Fig 5-f: Renewable Per Capita Freshwater Availability

| Year | Availability (MCM/Yr) | Population (in millions) | Per Capita (cubic metre/yr) |
|---|---|---|---|
| 2000 | 2550 | 3.77 | 676 |
| 2010 | 2550 | 4.25 | 600 |
| 2020 | 2550 | 4.58 | 556 |
| 2030 | 2550 | 4.85 | 525 |

*Source: Population Statistics taken from UN Population Statistics*

Fig 5-f is a basic per capita estimate assuming that all the renewable fresh water remains constant annually along with a rise in population. Yet in reality, these figures are somewhat artificial as the supply to the population around the cities is two or three times the supply to other parts of the country, thus the actual consumption levels varies.

### Water Balance Calculated Against Future Estimated Demand

Dr. Catafago's 2005 study shows that the demand is increasing around 40 MCM annually between 2010 and 2020, and will increase by 50-60 MCM thereafter. The supply here is calculated against the growing utilization rate and the potential exploitable water of 3,500 MCM in an average wet year. Thus, in an average wet year, the deficit is not significant until 2030. However, in a decennial dry year, the potential availability would be around 1,800 MCM which could increase deficit to almost 1 BCM in a decade's time.

The water demand during April to September represents about 85 per cent of the total annual demand, which are high irrigation months. Calculations for 2020 and 2030 depend on differences between dry and wet years. On the other hand, if adequate storage is created by 2020, along with other forms of marginal water, it should be possible to reduce the deficit to the minimum or even generate a small surplus in wet years. There is also a need for demand management strategies and better water conveyance systems.

### Scenario 1 - Assuming the Karaoum Reserve is Used to Full Capacity and There Are Additional Storage Facilities

Due to poor management, few reservoirs and under utilization of the existing reservoirs, the country does not effectively store the water during years of high rainfall and is unable to meet the growing demand.

Fig 5-g: Water Balance with Increasing Demand in Average Wet Year

| Year | Availability (MCM/Yr) | Utilization Rate (%) | Supply (MCM/Yr) | Demand (MCM/Yr) | Balance (MCM/Yr) |
|---|---|---|---|---|---|
| 2010 | 3,500 | 37 | 1,300 | 1,340 | -40 |
| 2020 | 3,500 | 47 | 1,645 | 1,740 | -95 |
| 2030 | 3,500 | 53 | 1,855 | 2,290 | -435 |

*Source: Dr. Catafago's 2005 Study on Lebanon's Water Resources, Bureau ARCS*

The Karaoum Dam can currently hold about 220 MCM of water. Assuming that some of the other proposed water storage facilities are completed by 2015, within the next five years, this could add an additional capacity of 100-150 MCM. The total available water in these facilities will then increase to a little less than 400 MCM. If the Karaoum Dam is well utilized, it will in reality only reduce the shortage for the southern regions and part of the Beqaa valley, and cannot be assumed that this water will be used for the rest of the country. According to experts, 110 MCM of the water in the dam will be used for the South and 90 MCM for the Beqaa. While the additional water from the reservoir will not mitigate the deficit in a dry year, it will prove useful for the agricultural areas around the valley, as well as ensure a minimal supply during years of drought.

### Scenario 2 – Accounting for Treated Wastewater as a Supplement to Freshwater Availability, as well as Additional Storage Capacity

Lebanon generated an estimated 249 MCM of domestic wastewater in 2001, of which industries generated an estimated 43 MCM[57]. According to the census of building and establishments, less than 60 per cent of the buildings were connected to the sewage network in 1998 (numbers included Beirut, South and North Lebanon, Bekaa Valley and Nabatiyeh among others. Beirut had the highest connectivity of 98 per cent at that time). There was only one large scale plant which was fully operational at Ghadir, south of Beirut, in 2004. The plant however provides only preliminary and primary treatment (grit and scum removal) and the water is then released into the sea. Many plans have been proposed to extend the range of this plant to secondary treatment. However no action has been taken till date. Analysis has revealed that the extension of the plant to secondary stage treatment could cost between $52-84 million, and would benefit anywhere between 1.3-1.8 million people.

In the late 1990s, the Ministry of Environment proposed the building of 35 wastewater treatment plants to re-use wastewater. Apart from Ghadir, seven Plants (including WWTP in Tripoli, Sidon and Tyre), are still under construction and the remaining have yet to secure funding. A few small scale community plants have been operational since 2001, but do not affect the overall supply and demand balance. In addition, Lebanon still needs to construct a fully functioning sewerage system for the whole country, which according to Global Water Intelligence, was estimated to cost around $1.152 billion as of 2002[58] value.

Assuming that all plants and other plans under construction are successfully executed, Lebanon could potentially treat 300 MCM of wastewater (out of a 500 MCM) a year by 2020. If effectively treated, this wastewater could be used for irrigation and small industry in the rural areas and reduce future water stress for this sector.

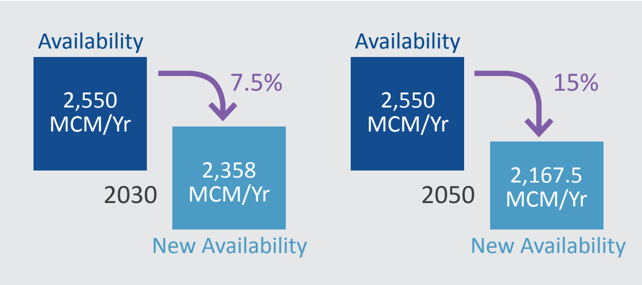
These wastewater plants are situated mostly along the southern part of the Mediterranean coast and are proposed to serve almost half the current population, of which 60 per cent is expected to be around the Greater Beirut Area. But the sources of funding for these projects are diverse and several are still under consideration and there is no guarantee that all the plants will be operational by 2020.

## Climate Change

Increase in temperature and rise in sea levels are potentially two of the biggest challenges facing Lebanon, though there has been no trends observed in past changes in precipitation. However, some studies do indicate that in the event of extreme changes in precipitation, it would affect the eastern side of the Assi River and the north east Bekaa Valley with flooding and soil erosion. While some studies estimate that the levels of precipitation will remain fairly constant, the temperatures are expected to increase by almost 2 ˚C by 2050 and 4 ˚C by 2080.

A major effect of this rise in temperature is water lost due to evaporation mostly along the Bekaa Valley. The increase in temperatures and the decrease in available surface water for irrigation will increase the demand in that sector. It is estimated that the amount of surface water available will reduce by approximately 15 per cent. The Figure 5-h shows the decrease of renewable water in 2030 and 2050 in a median year. However, there is no reliable or regional climate change model available which confidently predicts decrease in precipitation. The indication provided in Figure 5-h is one estimate. Climate change discourse in Lebanon mentions several other possibilities as well.

Fig 5-h: Decrease in Availability due to Climate Change




*Source: Lebanese Ministry of Environment, 2002 Climate Change Report*

The rise in sea level, combined with the increase in groundwater abstraction along the coast will result in intrusion of sea water. Beirut is expected to face severe consequences due to the rise in sea level, and increased salinity of its groundwater. Due to the increased mixing of fresh and salt water, the saline levels are almost five times the acceptable scientific amount, across most of the private wells in Greater Beirut. Awareness campaigns have been launched by non-governmental organizations, but currently Lebanon has no official mandate or position on climate change and its effects.



## Future Water Surplus/Deficit

Lebanon has abundant resources in wet years but suffers deficit in dry years, particularly in some regions. It is expected to face deficit by 2030 even in wet years and considering full use of storage capacity. This will have adverse impact on the farming community in the south, while the urban areas may suffer due to salt water intrusion.

Lebanon will have to boost their marginal water capabilities by reusing their available wastewater, exploring the use of desalination plants, as well as put in extensive measures to minimize water loss and control the growing demand. It will have to expedite its plans to build dams and reservoirs and use constructed storage capacity efficiently. Most important, it will need to examine its water governance structures. The process of reorganisation that began with merging of 21 water authorities into four decision making structures, besides Litani Water Authority, will need to be carried on. Lebanon will also benefit by harnessing its democratic spirit to involve the media and civil society not to treat the current water situation with complacency, but to be alert to future challenges and responsibilities.

# Syria | 5

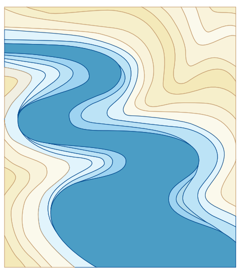
## Country Overview

The total available freshwater water resources in Syria are estimated at around 17 BCM as of 2010. The annual precipitation ranges from as little as 300 mm in the north-west regions around Aleppo and bordering Turkey, to 1,400 mm in the mountains and coastal areas. During years of severe drought, as was seen in 2006-2008, the estimates of water availability need to be lowered substantially.

There are 16 main rivers with their tributaries, of which six are trans-boundary in nature. Of these the Euphrates is the largest and flows downstream from Turkey. The Tigris also flows from Turkey and forms part of the border with Iraq, though its presence in Syria is minimal when compared to the Euphrates. The other main source of incoming water is the Orontes River which flows from Lebanon into Syria, and then onto Turkey. Syria currently has about 160 dams with a storage capacity of approximately 19.6 BCM, which may accommodate the entire water requirements for the country until 2015. Some analysts believe that the dam capacity could also be as high as 26 BCM, though they include dams which are still under construction. Most of these dams are only filled to part of their capacity with the exception of the larger ones such as the Fourat which is on the Euphrates, and the Lake Assad reservoir.

Syria's main hurdle is its topography, where the eastern mountain ranges hamper its access to coastal rain water. The two main cities - Damascus and Aleppo - have become deprived of a permanent source of freshwater. Most of the water conveyance systems are old and almost 50-60 per cent of the transported water is lost due leakage. There is a desert in the south east region, bordering Iraq and Jordan, where annual precipitation is less than 100 mm. The current focus in water policy has been on supply management, which





is gradually being changed to a strong emphasis on demand management.

According to the Scientific National Commission, there are already water shortages in the river basins with the exception of the coastal area and parts of the region surrounding the Euphrates River. The Commission and scientific experts engaged in water management study in the country have started to explore desalination as one of the options for drinking water for Syria to address future water problems, combined with interventions for a better pipeline system and improved irrigation methods.

## Summary of Water Sources

Within its political boundaries, Syria is divided into seven distinct basins: Barada and Awaj; Orontes; Coastal; Tigris and Khabour; Euphrates and Aleppo; Yarmouk; and Al Badia. The annual average surface runoff is estimated at about 10 BCM. Syria signed a protocol with Turkey to harness 6.75 BCM, after supplying Iraq with a share of the water. Thus the total water resources, estimated in Figure 6-a, are approximately 17 BCM annually. The dependency ratio in Syria of the total renewable water resource originating outside the country is estimated at more than 65 per cent. Syria is currently using all the available water and in certain areas over utilizing its resources; a situation which may be unsustainable in the long run.

### Rivers and River Basins

The Euphrates is the Syrian Republic's largest river and flows from Turkey, through eastern Syria and into Iraq. Of the total length, about 700 km of it is in Syria. The river lies in the north east region and the Euphrates basin around the river is the most fertile region in the country. The largest dam in the country the al-Tabqa Dam is located on the river and forms the Al Assad Lake which has a storage capacity of 14 BCM. The Tigris is the other river which originates in Turkey and flows through Syria into Iraq.

Fig 6-a: Break-up of Total Potential Renewable Freshwater Resources

| Hydrologic Basin | Surface Area (km²) | Average Annual Resources (million cubic metres) | | |
|---|---|---|---|---|
| | | Surface Water | Ground Water | Total |
| Barada & Awaj | 8630 | 20 | 830 | 850 |
| Orontes | 21634 | 1110 | 1607 | 2717 |
| Coastal | 5049 | 1557 | 778 | 2335 |
| Tigris & Khabour | 21129 | 788 | 1600 | 2388 |
| Euphrates & Aleppo | 51238 | 478 | 371 | 849 |
| Yarmouk | 6724 | 180 | 267 | 447 |
| Al Badia | 70786 | 163 | 180 | 343 |
| Total | 185180 | 4296 | 5633 | 9929 |
| Net Inflow from Turkey | | 6750 | | 6750 |
| **TOTAL** | | | | **16679** |

*Source: Dr. Faisal Rifai*

The 1998 Adana Accord between Turkey and Syria paved the way toward improved relations. Turkey has agreed to let a minimum of 15.768 BCM per year flow through the Turkish-Syrian border of which Syria has committed to give 9.145 BCM/year to Iraq. In 2008, Turkey allowed Syria to use one BCM /year from the Tigris water. Turkey argues that it provides more than the minimum guaranteed water while Syria accuses Turkey of supplying less than the stipulated amount. This confusion arises due to seasonal and yearly variation of river discharge. Either country can select discharge data at the border of a particular month in a particular year to prove its argument. This problem will continue until there is standardisation of measurements.

The Orontes River originates in Lebanon and flows into Turkey providing Syria with an annual yield of 320 MCM. An agreement was signed in 1994 between Syria and Lebanon for using the Orontes River water jointly in which Lebanon was given 80 MCM/year out of the average total of 400 MCM /year entering Syria. The 1994 agreement allowed Lebanon to build a dam for the irrigation of about 6,000 hectares, 4,000 of which are in northern Baalbek, while the remaining 2,000 hectares are in Hermel. As a result of the improved relations between Syria and Turkey, several agreements were signed, one of which was to build a dam at the crossing from Syria to Iskandarun called the Friendship Dam which started in 2008.

Syria and Lebanon also share the El Kebir River, which forms a natural border between them and empties into the Mediterranean Sea. It is difficult to determine exactly where the river originates as the larger catchment area lies in Syria, while the main underground basin lies in Lebanon. The river has a low flow, although in some years exceptional levels of flow have caused severe damage. In 1979, the river destroyed the iron bridge in the Al-Areeda area. The average annual flow is 15 MCM.

The Yarmouk River lies in the south west part of the country and delineates part of the boundaries between Syria and Jordan, before flowing into the Jordan River. The available water from the basin was estimated at 447 MCM, of which the groundwater is 267 MCM, though this has reduced over the years and now is half the amount. There was an agreement between Syria and Jordan to build a dam called Unity Dam (Sad el Wahda) from which 80 MCM was allocated for Jordan. The 1987 agreement allowed for Jordan to use 208 MCM, and the rest was for Syrian use, though in reality the amount of water used at present is much less due to increased development activity on both sides. There has been some contention and discrepancy in the amount of supply and demand among Syria, Jordan and Israel.

## Groundwater and Groundwater Basins

There are two main groundwater sources aquifers - those of the Anti-Lebanon Mountains and the Alouite Mountains; a number of springs discharge from these mountains. The springs and underground water supply mainly feed into the rivers that lie between Syria and Lebanon. The quality of groundwater appears to be better along the coast and areas of high rainfall, where the salinity levels are at 200 parts per million (ppm). The quality of the springs that feed the tributaries of the Jordan River is estimated to have a salinity of approximately 350 ppm to 500 ppm.

Experts have made varying estimates for the available ground water in Syria. Some estimates do not take into account the amount of water flowing out of the country, which creates a huge discrepancy in the estimated numbers. Therefore this report does not take the groundwater into account while calculating the total water availability.

## Rainfall and Precipitation

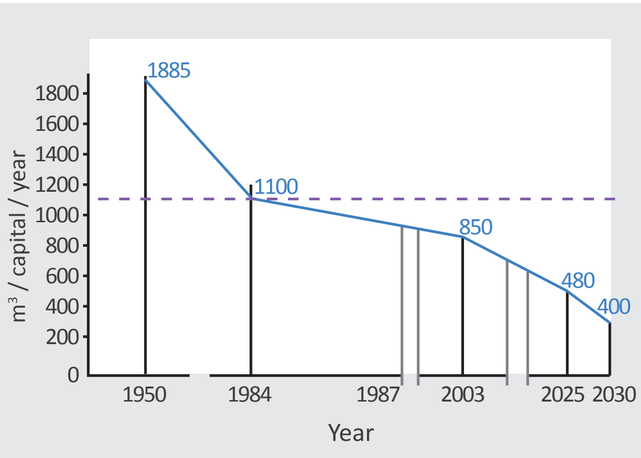
As mentioned in the overview, rainfall ranges from 1,400 mm in the mountains to 1,000 mm along the coast and 300 mm in the North West, and drops to less than 100 mm in the desert. It is estimated that rainfall contributes about 7.1 BCM to surface water, mainly to the rivers, which flow in the country. Over 50 per cent of this amount flows out of the country into the sea and to Syria's neighbours.

## Future Changes in Supply and Demand

### Renewable Per Capita Freshwater Availability

The 2010 population in Syria is estimated at a little over 22 million people, with a growth rate of less than 3 per cent per annum. Figure 6-b shows the per capita availability of water from 1950, and the projected availability till 2030.

Figure 6-b: Renewable Per Capita Freshwater Availability (1950-2030)




*Source: Dr. Faisal Rifai*

Syria is experiencing a water shortage, where in many parts of Southern Syria including Damascus, drinking water is available for only 13-15 hours a day; and in certain areas around Damascus, water is available only 2 or 3 times a week in drought years. There is a need for accurate information on the water situation and an improved database on water resources. The Syrian government has begun taking measures to tackle the issue and collaborate with international agencies to implement better policies and training for officials.

### Current Problems and Solutions

**Water Losses** - more than 80 per cent of the available water is used for agricultural purposes and only 16 per cent of farmers use modern irrigation systems. Water losses from seepage and evaporation are more than 40 per cent of the water used, due to old systems of water conveyance and distribution.

**Pollution of Water** - one of the problems facing water availability in the country is pollution which is affecting the quality of Syria's freshwater resources. The National Commission has proposed studies in coordination with UNDP and other UN branches to design ways to improve the water quality through mitigating pollution. Water is polluted from industrial waste, sewage and other sources, but there is little information on the total quantities of water that are being rendered unproductive as a result. A detailed study has been carried out in the Barada Basin where wells in the area were tested for the exact cause of pollutants, which indicated that nitrate concentrations is above 70 mg/litre rendering the water unfit for domestic consumption, but could be used for other purposes. This effectively means that increase in pollution of the water available for domestic consumption around Greater Damascus may affect water supply to over 10 million people.

**Better pipeline system to transport water** - there are plans under implementation in various areas to modernize the existing irrigation systems, rehabilitate the drinking water supply networks and improve the condition of the conveyance canals and pipes. JICA (Japanese International Cooperation Agency) is involved in one such project to lay down a network of pipelines to bring water from the Euphrates to the western parts of the country.

**Desalination Plants** - The Scientific National Commission and other experts conclude that desalination and the reverse osmosis (RO) process would be the most cost effective method to tackle future water stress. In 2002, 40 per cent of total wastewater produced (1,364 MCM) was treated and desalination stood at 3 MCM per year[59]. The Environment Ministry is currently conducting feasibility studies to start more desalination projects. In the future with water levels decreasing and population rise, if construction begins and the plants are completed by 2020-2025, over 60 per cent of the population could be using this desalinated water.

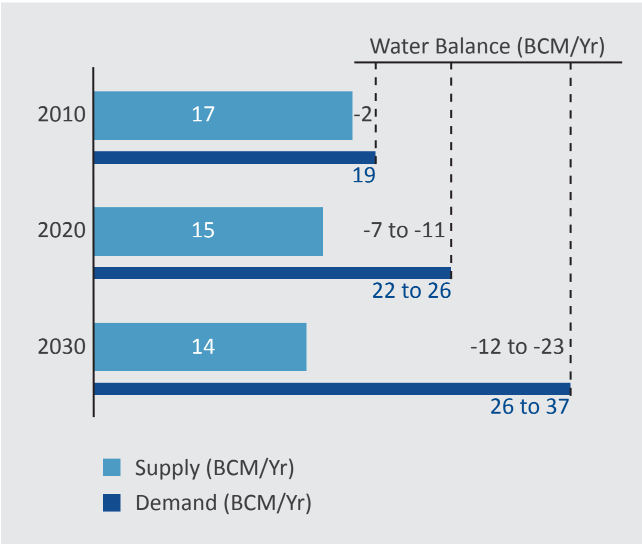
While the government is considering plans to implement desalination plants, how much water these plants are expected to produce or even what parts of the country they are expected to serve is still not known. It appears that the results of the studies reveal that for brackish and sea water, the RO process has been found to be satisfactory. After the initial investment of $180 million for the plants, the water should cost approximately $0.40-$0.55 per cubic metre[60]. Studies have also shown that the best regions for such plants would be East of Hamah for a large scale plant and several smaller ones in the Al-Badia and Al-Jezirah region. Beyond the initial studies implementation of these plans is still under investigation. Funding seems to be a major obstacle.

Estimates put Syria as an exporter of oil with reserves of 2.5 billion barrels of petroleum and production of almost 500,000 barrels a day which may be adequate sources for medium term energy to pursue a desalination strategy. With rising consumption within the country, the available energy resources for desalination will decrease within the next 15-20 years. It is estimated that the production is decreasing by approximately 20,000 billion barrels a year. With new technologies being developed in the field of desalination and waste water treatment, Syria could explore the use of alternative energies, such as solar energy, to power small scale desalination plants in the country.

## Water Balance Calculated Against Future Estimated Demand and Supply

Consultations with authorities indicate that demand is expected to rise at a rate of almost 40 per cent every ten years resulting in a deficit by 2020 and beyond. However, these are highly exaggerated estimates as compared to countries with similar levels of economic growth. A more realistic expectation would be a rise of 15-20 per cent per decade. While the demand, especially from the agricultural sector is high, the water shortages and decreasing supply would ensure that the actual consumption and utilization is kept at a lower rate. In Figure 6-c, the balance is calculated between the actual supply and projected range of demand, which shows a current deficit of 2 BCM. The figure also shows a decrease in supply over the next 20 years, which is a result of several factors such as climate change, pollution and decrease in precipitation.

Fig 6-c: Water Balance with Increasing Demand and Limited Supply




*Source: Demand figures from discussions with Irrigation Minister of Syria*

The water deficit in Syria at present is increasing at alarming rates, which will result in several consequences in the future. Less water available for agriculture would also lead to food shortages. On the other hand, any increase in the supply, especially of the natural resources, could result in over pumping, increase in salinity levels, pollution, sedimentation and other ecological consequences. Therefore it is important that the government explore additional means of supplementing their natural water to ensure that the natural resources are not exploited. It is also necessary to manage the growing demand through controlled demand management practices in all sectors.

The development cooperation authority of Japan, JICA, has participated in the interventions to tackle the growing water shortage. Previously, JICA had completed a $50 million project to replace 100 km of pipes in Damascus and the surrounding areas, which is expected to reduce loss of water through leakage from 60 per cent to 20 per cent. It must be noted that while less water will be lost during effective transportation, this does not increase the net availability, but just the amount that will be withdrawn and supplied.

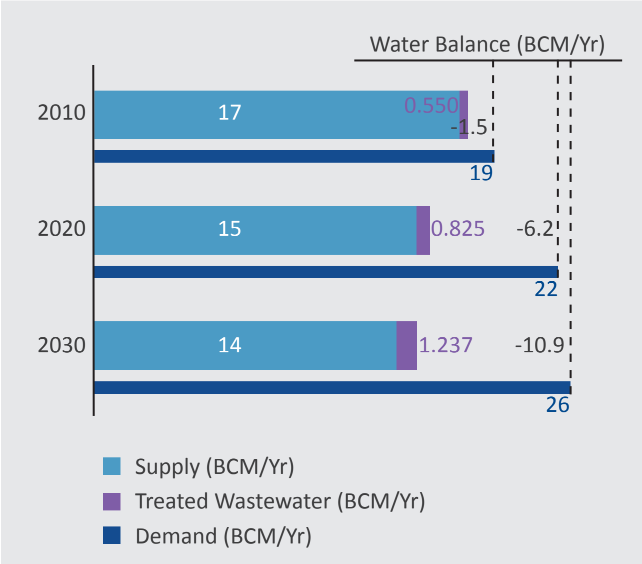
## Scenario 1 - Increase in Supply using Marginal Water

Over a period of ten years the amount of treated wastewater in Syria has increased by more than 50 per cent from 330 MCM in 1993 to 550 MCM in 2002. The 2010 amount of treated wastewater was a little over 550 MCM. Most of the treatment plants have been built in the cities of Damascus, Alleppo, Homs, the coastal region and Salamieh, with the treated wastewater re-used in irrigation. While plans are underway for a hundred percent treatment of all wastewater, implementation is slow.



Figure 6-d shows an increase in the supply assuming that there is a 50 per cent increase of treated wastewater every 10 years (just as there was between 1993 and 2002), starting with 550 MCM in 2010 (since no new plants are functioning yet). Here the water balance is calculated by adding the treated wastewater amount to the supply, and then against the demand.

Fig 6d: Water Balance with Marginal Water




The treated wastewater is a marginal amount compared to the increasing demand and is not sufficient to counter the growing deficit. It is extremely important that Syria invest in building more wastewater treatment plants, as well as establish more desalination plants and explore the reuse of treated drainage water from agricultural lands where more than 80 per cent of the available water is used. While large scale plants are costly to build, and use up valuable land area, small scale plants can be constructed in the short term to alleviate stress in certain key areas. This source may meet part of the needs of the agricultural sector that would be impacted the most by a water shortage.

## Scenario 2 - Decrease in Availability from the Barada Basin

The water level of the aquifer in the Barada Basin located under Greater Damascus is said to be retreating and has dropped from 50 m below ground to 200 m in the last 20 years and is expected to drop further to 400 m below ground level by 2030. The biggest cause of this is the large number of private wells that have been drilled in the region and the uncontrolled over-pumping that occurs without regulation. This uncontrolled use would reduce the availability of water in the area. The Basin almost dried up during the 2007 drought, which caused stress on the population due to the lack of drinking water. This problem was further exacerbated by an influx of around one million refugees from Iraq. The additional burden on the water supply systems based on estimates would be around 30-50 MCM annually in Damascus. The refugees from Iraq, as well as those who migrate internally are also placing a strain on water resources in other cities such as Aleppo.

The water available in this basin is chronically in the negative and has been since 2000, where the demand is approximately 200 MCM more than the availability, which stands at about 380 MCM. The basin is also susceptible to future climate change patterns such as low rainfall and precipitation.

Since the early 1980s, over 4 BCM of water has been lost from the basin and the trend is expected to continue with a projected deficit of approximately 200 MCM/year or 2 BCM every ten years. This will hamper any major development activity planned in and around the capital city of Damascus.

### Scenario 3 - Geopolitical Equations

Syria and Israel have sometimes considered normalizing relations. A peace treaty was almost reached in 1999 between Syria and Israel, but never went through due to certain obstacles. In the event of any treaty that is signed, Israel will want assurance that their supply of water from the Lake Kinneret (Tiberias) is not interrupted. It can be assumed that it will be unlikely that Syria will receive any substantial amount of water from this area, even if it assumes full or partial control as any peace treaty will have a water sharing component in it. Israel might agree to give Syria a token amount of water, but this will not be any more than 100-150 MCM, which not make much difference to Syria's overall demand and growing deficit. Thus, while such a scenario might be possible in the future, the water available will not affect the Syrian water balance. The main quid pro quo that Israel will offer will be in terms of land and redrawing borders.

The relations between Syria and Turkey are improving since 2008. It is possible that Turkey may offer more water on a permanent basis. Syria will have to share it with Iraq. However, in the best of circumstances, considering Turkey's developmental needs and Iraq's demands, Syria may at best expect an additional input of 1 BCM per year.

## Climate Change

With the rising temperatures and changing patterns of rainfall and precipitation, Syria is expected to experience unpredictable weather with extremes, towards the end of the century. The rainfall seems to have decreased by 10 mm over the last 50 years and is expected to continue to decrease at the same rate over the course of the century. With Turkey potentially facing similar patterns, this could result in a 30 per cent drop in the Euphrates flow after 2100. However, some researchers predict that while storm activity over the eastern Mediterranean would indeed decline, moisture-bearing winds would be fed inland more often and diverted by the Zagros Mountains, bringing an increase of over 50 per cent in annual precipitation to the Tigris- Euphrates region. There is a need to examine and check these predictions with other models because a 50 per cent increase in rainfall in such an important agricultural area is a much more hopeful scenario.

Other experts also claim that with the rising temperature and lack of adequate rainfall, the region will get drier, and during the same period approximately 60 per cent of the land in Syria will face the threat of desertification.

The biggest impact of this will be seen in the agricultural sector where lack of rainfall, less water in the rivers and decreasing groundwater will affect the productivity, directly affecting food security and the economy. Syria experienced the results of a long drought in 2007-2009 where the lack of rainfall and inadequate water management caused the wheat production to fall by more than half. The country normally stores and exports excess wheat. It was forced to import wheat and other grains at the beginning of 2009, and has been working closely with the Food and Agricultural Organization (FAO) to provide food to the people. The drought, coupled with the lack of preparation and storage facilities, also caused the evacuation of 160 villages in the northeast of the country. These numbers steadily rose over the course of 2009-2010, resulting in a large number of people migrating to nearby towns and cities, creating further stress on their economy and water resources. In the future, if another similar prolonged drought occurs, combined with other effects of climate change, it will prove extremely devastating for the country. A factor less investigated, though equally important, is how climate change is affecting the land quality and consequently resulting in new threats to livestock and herders, as well as the ecosystems of the ranges.

In the part of Syria's prime agricultural land that is along the Mediterranean Coast, there exists a threat from rising sea levels and saltwater intrusion into groundwater sources. Currently Syria's main concern is improving their age old methods of irrigation and to apply effective methods of water management. Any future drought in Syria would exacerbate the conditions facing water supply for irrigation, domestic needs and industry in an already water-stressed country.



Accurately assessing the impact of climate change on Syria requires preparing a climate simulation model for the Middle East region with the Tigris Euphrates Region as its major core. Simulating the climate of the region is a challenge for climate models, due in part to the high natural inter-annual variability, the topography of the region - which includes multiple mountain ranges and inland seas - and the presence of a slight cooling trend in recent decades despite the global trend which some reseachers describe as warming. The proposed regional model could extend from the Zagros Mountains in Iran, Tauros Mountains in Turkey to include the Gulf, Saudi Arabia, the Red Sea and Mediterranean Seas. The period of time (possibly 2010-2100) will be simulated so that the climate of the model represents a realistic mode of possible change in the future. This model of the region will be useful to both Turkey and Iraq as well, in assessing the future impact of climate change in their countries.

## Future Water Surplus/Deficit

Syria is using almost all its renewable fresh water resources which is extremely unsustainable in the long run. Without increasing their marginal water capacities, reducing water losses and controlling their demand, the country is sure to experience severe water stress within the next ten years. It cannot be assumed that the future geo-political situation will change and drastically alter the water balances. Climate change and unpredictable weather patterns could also exacerbate the situation in the future. The north-eastern part of the country is especially vulnerable to severe water stress during periods of low rain. Special care also needs to be taken of Barada basin where the capital and political centre is located in the interests of social harmony in the country.

# Iraq 6

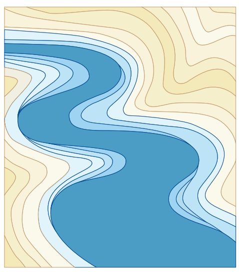
## Country Overview

Iraq has a variable renewable freshwater availability. In 2009, it was estimated to be 57-58 BCM of water; though the long term past trends indicate that the average could be 72-73 BCM. Over 50 per cent of the surface water is external and flows into Iraq from its neighbours. With a current population of a little over 28 million, the per capita availability is above 2,000 cubic metres per year.

The 2003 war resulted in a major setback to the water management and transportation facilities. Iraq is also facing a major problem where water is used for producing electricity, rather than oil and gas, and there is little investment in the water sector. In a paper specially prepared for SFG, Prof. Mukdad Ali Al-Jabbari of Baghdad University lists some of the factors that have led to water problems in Iraq. These need to be considered while evaluating the situation in the country:

- War, international sanctions and lack of financial resources.
- Lack of policy and management of underground water resources and no plans to control over-pumping and pollution of these resources.
- Lack of coordination within agencies in the country, as well as with international agencies and riparian states.
- Changes in climate and seasonal patterns.
- A divide between food production and population requirements.





The country can be roughly divided into three geographical zones with mountains in the north and east, desert in the south and west, and fertile plains in the middle between the two main rivers. The average annual rainfall is estimated to be 216 mm and the rainy season ranges from November to April. Summers are dry and extremely hot with temperatures rising to 45-47 ˚C.

The country has a dam storage capacity of over 50 BCM but due to evaporation about 10 per cent or 5 BCM is lost every year. The Haditha Dam on the Euphrates with a capacity of 7 BCM, and the Mosul Dam on the Tigris with a capacity of over 10 BCM are two of the largest in the country and irrigate a combined area of over three million hectares of land. Most of the other dams were destroyed during the two Gulf Wars and are currently under reconstruction. The Ministry of Water Resources and Irrigation has begun signing deals to build more dams and is currently concentrating on Kirkuk and the surrounding areas. The Ministry is largely concerned about long term planning and water availability, though implementation is lacking.

### Cost of Conflict

In 1991, it was estimated that safe clean water reached 100 per cent of the urban population and over 50 per cent of the rural population. Today after years of war, less than 25 per cent of the country is connected to a water supply. The situation has worsened by a severe drought since 2007, threatening desertification in southern Iraq. Though the availability might suggest that there is a lot of water, the infrastructure is unable to meet the needs of the population. With drought and no diversion plans, the once famed marshlands have all but dried up, displacing thousands of people.

The destruction of critical water networks and infrastructure has also resulted in rampant incidences of cholera and diarrhoea with children being most affected. The war has left close to four million people food-insecure which creates further stress on the existing water situation and economy. These are a few highlights of the key consequences of the last two decades of war faced by Iraq and the resulting severe water problems. While it seems that Iraq has plenty of water, and taking an overall assessment on the availability there clearly is an excess amount, the problems lie in management, infrastructure, transportation and policy implementation.

## Summary of Water Resources

Fig 7-a: Break-up of Iraq's Potential Renewable Freshwater Resources

| Water Source | Availability in 2009 (billion cubic metres) | Past Long Term Trends (billion cubic metres) |
|---|---|---|
| Euphrates | 9.2 | 27 |
| Tigris | 22.6 | 19 |
| Other Rivers | 24 | 24 |
| Ground Water | 1 - 2 | 1 – 2 |
| **Total Renewable** | **56.8-57.8** | **72-73** |

*Source: Dr. Mukdad Al-Jabbari*

### Rivers and River Basins

There is only one river basin in Iraq, the Shatt Al-Arab, which is formed by the confluence of the Euphrates and the Tigris and flows along the Iran border into the Persian Gulf. The Tigris flows straight from the Turkish snow-capped mountains to the Iraqi plains, while the Euphrates twists in its path and travels over a longer distance before it reaches the Iraqi desert. As Dr. Mukdad Ali Al-Jabbari points out, in a specially commissioned paper written for SFG, the difference in discharge patterns between the two has important implications in water management practices.

Within Iraq, the Tigris is fed by several rivers, which contribute a little over 24 BCM to the total availability of the river. Of these tributaries, the Lesser Zab and the Diyala are two major rivers which originate in Iran and supply Iraq with over 10 BCM of freshwater. The Diyala River and the surrounding valley are located between Baghdad and Mosul and is an extremely fertile region. With recent dam development in Iran, the Diyala is fast becoming a source of tension between the two countries. As mentioned elsewhere in this report, Syria is committed to ensure a minimum of 9.2 BCM of the Euphrates to Iraq. While this is a minimum guaranteed flow, actual flow fluctuates and can be more or less than the benchmark flow.

To increase transport efficiency and improve water quality, a number of new water courses were constructed in the southern part of the country, the biggest of which is the Third River or the Saddam River. It was completed in 1992 and functions as a main drain for the agricultural area between the Euphrates and Tigris.

### Groundwater and Groundwater Basins

Iraq has good quality groundwater, especially in the mountain regions of the northeast and along the Euphrates, though it gets worse in the south. The deep groundwater is estimated to be in the range of 200 BCM and the exploitable amount is approximately 1.2-5 BCM depending on computation methods. For the purpose of calculations in this report, an amount of 1.2 BCM is taken as the amount of groundwater available, based on 2009 figures.

### Rainfall and Precipitation

While the average rainfall is a little over 200 mm, the mountain regions in the north east receive as much as 1,200 mm annually. The southern areas, which constitute 60 per cent of the country, receive less than a 100 mm annually. With the increasing temperature in the region and more water being lost due to evaporation, the water quality is likely to worsen over the coming decades.

Iraq has suffered drought in 2007-2010, 1999 and 1961. Iraq's poor harnessing capabilities have also worsened the situation. Three droughts over half a century indicates that Iraq does not have a history of extremely frequent long droughts, though the future is unpredictable.

## Future Changes in Supply and Demand

### Renewable Per Capita Freshwater Availability

Current Population - 28 million
Growth Rate - 2 per cent

Fig 7-b: Renewable Per Capita Freshwater Availability

| Year | Population (in millions) | Availability (BCM/Yr) | Per Capita (cubic metres/yr) |
|---|---|---|---|
| 2010 | 28 | 57 | 2035 |
| 2020 | 34 | 50 | 1470 |
| 2030 | 42 | 43 | 1023 |

*Source: Population statistics from Dr. Mukdad Al-Jabbari and UN population statistics*

Figure 7-b shows a decline in per capita availability, as the supply levels decrease and the population increases. The availability decreases from 2000 cubic metres per annum, to just above the internationally stipulated threshold levels of 1000 cubic metres in 2030. These estimates are made on the basis of 2010 statistics, which was a third consecutive year of drought. On the positive side, if long term trends are used as the basis for calculations, Iraq could continue to have 2000 cubic metre per capita availability for the foreseeable future. On the other hand, if water discharge from neighbouring countries is reduced, evaporation is excessive, and water sector is not managed efficiently per capita availability can decline.

According to some experts, future agricultural projects by Syria and Turkey will consume a total of 21.7 BCM of the Euphrates, leaving only 8 BCM for Iraq. A part of this amount will also be lost to evaporation, which is extremely high in parts of Iraq, leaving less than 6 BCM for use. The combined amount used along the Tigris River will be almost 40 BCM, and after allowing a stipulated amount to flow down to the Shatt Al-Arab and keep the river alive, less than 9 BCM will be available to Iraq.

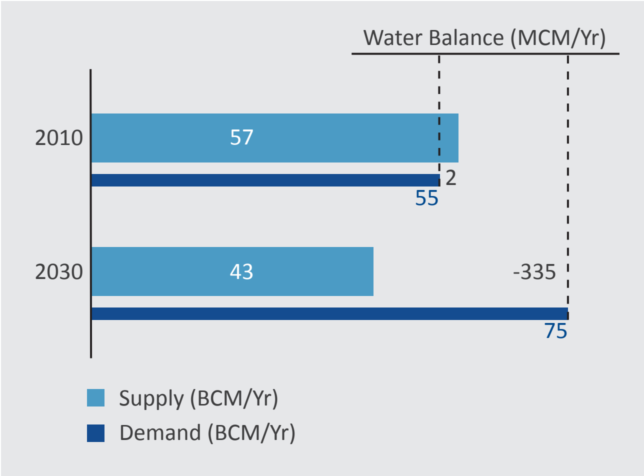
In Iraq, the agricultural sector will be the worst affected, as loss of one billion cubic metres of water results in 62,500 hectares of land that cannot be cultivated. This will in turn lead to a food security issue, and stress on the economy. Mathematical models and future estimates have also found that the salinity levels will increase in the Euphrates in the future to almost 1275 ppm, as compared to current figures of 550-750 ppm, which will render the water unusable. While international organizations set standards for water quality, each country develops their own standards depending on local factors. In Iraq, water with a salinity of 250-300 ppm is considered suitable for drinking, and in some regions of the country this can be as high as 600-700 ppm. Water that is more saline can be then used for irrigation and other purposes.

The Water Ministry has laid out plans to repair existing infrastructure and to put into place new projects to ensure better management. International agencies such as the World Bank, USAID and Japan have also begun reconstruction work to repair damaged networks, sewage systems and water purification plants. Along with the United Nations, work has already begun on over 80 water supply plants and 12 sewage plants in several parts of the country. According to the development plans under discussion and Iraq will need at least 75-85 BCM of water annual in the coming few decades.

## Water Balance Calculated Against Demand

The current water demand in Iraq is estimated to be 55 BCM, which calculated against a total supply of 57 BCM, leaves the country with a surplus of 2 BCM of water. In the past, the demand in the industrial sector increased at a high rate from 1.5 BCM to almost 10 BCM. One of the reasons to explain this is the sanctions imposed and the rapid growth in population. Today, in the post war situation demand for domestic consumption and agriculture is increasing at a higher rate. In reality though, the current demand is fluctuating due to the poor supply systems, severe drought over the last few years and less water flowing down from Turkey, Syria, and Iran.

### Fig 7-c: Water Balance with Increasing Demand




*Source: Dr. Mukdad Al-Jabbari*

While the water balance in the country is showing a surplus in 2010, the situation is likely to deteriorate at a fast rate. Some estimates show that the 2010 demand is almost 62 BCM, though these estimates take into account the water lost due to evaporation, which is not considered here. Also in the calculations for 2030, water lost by evaporation is not taken in to account.

Prof. Mukdad Al-Jabbari states in his paper prepared for SFG that the demand could be as high as 75 BCM in 2030, but these estimates assume that a large amount of water, almost 20 BCM, will be diverted to restore the Marshlands which in the present state is unlikely and unrealistic, though extremely necessary. This report, based on calculations and other trends, expects that the demand in 2030 will in fact be 75 BCM, allowing for growth in population and increase in agricultural and industrial activity. Any water used for marshland restoration will be above this 75 BCM, though it is unlikely to be as high as the projected 20 BCM.

## Climate Change

After years of resisting, especially during the Saddam era, the Iraqi government formally ratified the Kyoto Protocol in January 2008. This is an extremely important step towards exploring and creating policy to counter the future effects of climate change. Very little work has been done on the future effects of climate change in the country and from examining past trends desertification is likely to be one of its biggest problems. Experts have estimated that almost 90 per cent of the land could be subject to desertification over a period of time (at a rate of 0.5 per cent annually). There has also been a noticeable increase in the evaporation rates. Years of heavy rainfall could in some areas slow down the process.

Dust storms, a normal phenomenon in the region during the summer months, have worsened in the last couple of years due to decrease in vegetation and low rates of rainfall. The number of dust storms has increased from 19 days a year to 40 days a year. The climate is extremely harsh in the summer and with forest degradation and improper irrigation methods, the land is deteriorating. While this damage is the worst in the south, the rate of desertification for the future, in this region specifically, is yet unknown. The Ministry of Agriculture has filed a proposal for funds to implement plans to combat the immediate needs and to conduct further study for the future. Internally the only response of the government to the changes in climate and its recent effects was to issue an emergency fund to farmers without any shift in policy or management[61]. The government is also demanding more water from Turkey, Syria and to an extent Iran to counter the drought and the severity of the situation.

Salinization of agricultural lands has been a major issue in Iraq due to poor irrigation methods and bad drainage networks which has led to a salt accumulation in the soils. The severe drought over the last two years has exacerbated the situation as the government has been unable to implement measures to address the state of affairs. While this is not a direct consequence of climate change, the situation could worsen in the future with the effects of climate change. Some other expected impacts of climate change include decrease in soil moisture, increasing amount of soil erosion, changes in the shape and state of wetlands, all of which will ultimately affect agricultural production and food security. There is also an expected shift in climate zones, intensity of droughts, changes in vegetation, and major risks to the wildlife.

Research conducted on the Euphrates in Turkey predicts that the river could reduce by almost 30 per cent which will affect Iraq to a certain extent; though the extent of this is still unknown. Research is still ongoing for the Tigris River in Turkey and no specific numbers are available. Experts are yet to determine the long term effects of climate change on the Tigris and its tributaries, and to quantify these potential changes. The quality of the water is found to be very good at the Turkish border where it enters Iraq, but it gradually deteriorates southwards. In the future this will prove extremely dangerous for the health and quality of the Shatt Al-Arab. Impact of climate change in internationally shared waters will also greatly increase the potential for political conflict.

While there has been recognition of the need for regional collaboration on the impacts of climate change, this needs to be translated into concrete action. Coordination amongst riparian countries on data collection and future estimates will help to more accurately predict future impacts.

## Future Water Surplus/Deficit

Currently Iraq is passing through dysfunctional politics and a crisis of governance. If over the next ten years Iraq rebuilds water systems and ensures efficient management and distribution, it will be able to satisfy the need of its growing population and expanding economy. In the best case scenario, the country could have a positive balance to harness and store, and possibly even export water. In order to realise such an outcome, Iraq will need cooperative agreements with other riparian countries. It will need to take initiatives for integrated water management in shared river basins. In order to have a basin level cooperation, common standards and goals will be required. The prospect of Iraq's self sufficiency in water is thus dependent on efficient management at home and cooperative relations with its neighbours.

# 7 Turkey

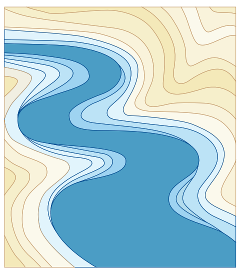
## Country Overview

Water in Turkey covers approximately 1.6 per cent of the country's surface. Turkey has an annual renewable water availability of approximately 220 BCM and an average surface potential within the country of 193 BCM a year. Allowing for groundwater leakage and runoff into the rivers and basins, the country has a total economically exploitable water potential of 112 BCM a year. This amount is roughly divided into 98 BCM of surface water (rivers and lakes) and about 14 BCM of groundwater.

If the entire amount of 112 BCM is harnessed, the per capita availability would be approximately 1,600 cubic metres a year (at the current population of 71 million). Yet Turkey only uses 40 per cent of the existing water, amounting to a per capita consumption of 630 cubic metres in 2008. It should also be noted that if Turkey harnessed its entire surface potential of 193 BCM the per capita availability would stand at 2,750 cubic metres a year, though this is not realistic and hence is not considered as a future possibility.

Turkey is divided into 25 hydrological basins which cover the entire country. The northern region around the Black Sea and the eastern parts of the country receive some of the highest rainfall, over 2,500 mm a year. The central parts of the country receive less rainfall, about 250 mm and with fewer rivers running through them. The most fertile area is around the Euphrates Tigris basin (with a 31 per cent surface runoff) and the Ceyhan and Seyhan Rivers. These rivers, along with the several other fast flowing rivers in the southern part of the country, empty into the Mediterranean Sea, and have a combined potential of 35 BCM annually. The Ceyhan-Seyhan Basin has a potential of 12-16 BCM, of which the demand is approximately 8 BCM. There are significant seasonal variations, with a lean period of 8-9 months accounting for half the discharge.





Much of the 4 BCM surplus from the Ceyhan-Seyhan basin would be generated in wet months.

Population densities are highest around the cities of Istanbul, Ankara, Izmir, and Adana. Both Izmir and Ankara experience major water shortage during periods of low rainfall or drought and the DSI (State Hydraulic Works Department) is also looking into better storage and transportation for these cities during such periods. Plans are being discussed and implemented to bring water from the Black Sea region to Istanbul, Ankara and parts of central Anatolia, though the terrain might not be favourable to do so; and to better integrate the dams around the Euphrates Tigris basin to serve all of eastern Anatolia.

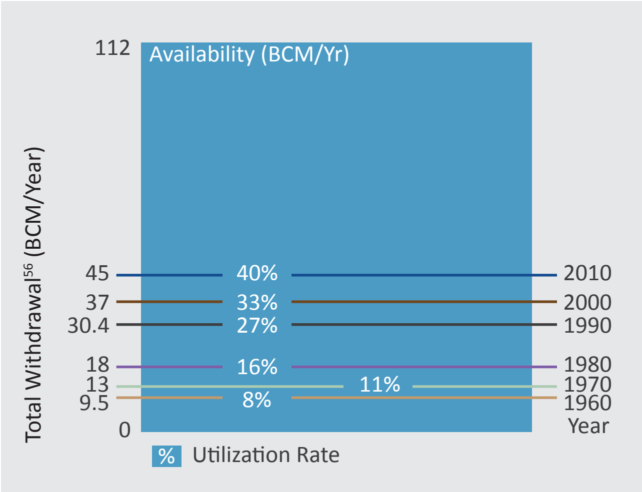
Out of 60 per cent that flows to the sea or seeps underground, DSI is conducting feasibility studies and have proposed several measures to harness and use the rest of the water by the year 2023. One of the measures is to build dams across the country to harness the water. The dams can also help collect water in wet months for use in the dry period. The DSI has proposed modern irrigation methods to use less water in the agricultural sector and increase usage in the industrial sector. Seven river basins (out of 25), mostly in the west, are already in a serious state of water shortage, with abstractions exceeding 200 percent of the annual renewable resource. If all of the 8.5 million hectares of the "economically irrigable" area is developed, the World Bank[62] found that almost 18 basins will face serious water shortages. This situation raises serious doubts about the sustainability of the prevailing policies in the irrigation sector.

Turkey currently has 2000 dams and water projects, of which the largest 260 dams have a storage capacity of 140 BCM. In the future if these dams were to be filled to capacity during periods of high rainfall it would alleviate water stress during periods of drought. The DSI has also stated in its 2009 report that the country will need another 730 small scale dams to fully utilize the surface potential of 193 BCM. While this is an ambitious venture, the current plans are to ensure that 112 BCM of water are effectively used by 2023.

As Dr. Aysegul Kibaroglu of the Middle East Technical University states in a specially commissioned paper for SFG, "Turkey's water policy can best be characterized by her desire to gain independence from imported energy sources, to increase production levels of agriculture and to achieve food security." Yet, if all these plans were put into place it would effectively mean that the country would be utilizing its entire freshwater availability annually, which is an extremely unsustainable situation. This does not allow for years of less rainfall, drought or other extreme situations.

## Utilization Rate

Fig 8-a: Utilization of Total Available Freshwater Resources




*Source: Analysis from the FAO Yearbook and the SHI graphs. http://webworld.unesco.org/water/ihp/db/shiklomanov/part'3/HTML/Tb_21'TU.html*

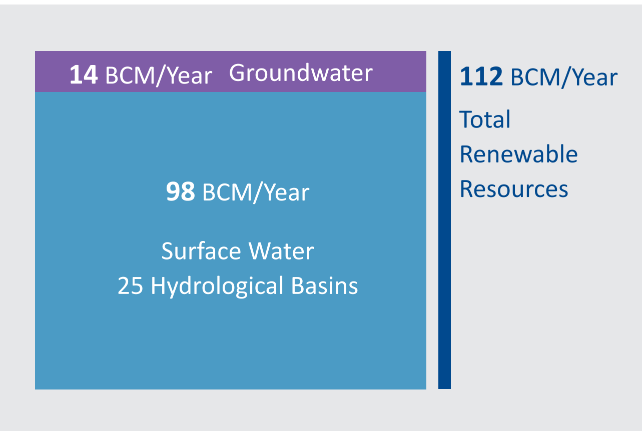
Over 70 per cent of the current water supply is consumed by the agricultural sector with the rest shared by the industrial and domestic sectors. At present about 90 per cent of the groundwater has been harnessed of which 55 per cent is used for the agricultural sector.

The past utilization rate is calculated against the potential availability of 112 BCM (as is done later in the report for the present and for the future). The current utilization rate is 40 per cent of the availability leaving approximately 67 BCM of water flowing to the sea and into neighbouring countries. Over the last two decades the utilization has increased at a rate of 20 per cent every ten years, and future calculations have been based on this rate of increase.

Over the last 40 years, there is a correlation between the dams that have been built and the steady increase in the utilization rate. During the 1980s and 1990s, dam building was well underway and by the late 1990s almost 30 per cent of the water was being harnessed and stored by these dams.

## Summary of Water Sources

Fig 8-b: Break-up of Turkey's Potential Renewable Freshwater Resources




*Source: DSI 2009 Report*

### Rivers and River Basins

Turkey is divided into 25 hydrological basins, and over a hundred main rivers and tributaries. Of these, 22 are river basins and the rest are enclosed basins with no outlet into the sea. These 25 basins have a total surface water runoff of about 193 BCM a year and an estimated potential of approximately 98 BCM. Two river basins, the Euphrates and the Tigris, contain the largest volume of flow of all the rivers in Turkey - 28.5 per cent of the nation's total surface flow (17 per cent in the Euphrates and 11.5 per cent in the Tigris). Dogu Karadeniz (East Black Sea) with an 8 per cent contribution, Dogu Akdeniz (East Mediterranean) with a 6 per cent contribution and Antalya with a 5.9 per cent contribution are other relatively water-rich basins. The Seyhan and Ceyhan rivers collectively contribute 8.2 per cent of the total flow.

The water potential of several of these basins far exceeds their actual extraction, while some of them are over exploited. An analysis of the consumption patterns show that less than 20 per cent of the total potential of these basins is being harnessed. Turkey has already built hundreds of dams and hydroelectric power plants to harness the water and produce energy and further plans are underway to ensure that all the water is accessible by 2023 (the year that marks a hundred years of the country's independence). Turkey currently generates about 48,000 GWh/year, which is 35 per cent of its hydroelectric potential and hopes to further increase this potential in the future.

### Groundwater and Groundwater Basins

The use of groundwater by modern methods began in 1932 and the country has consistently upgraded its methods of harnessing groundwater while ensuring minimal damage. The possession of groundwater is under state control which ensures that there is no contamination in private areas and no over pumping. Exploitable groundwater resources are approximately 14 BCM a year of which almost 90 per cent is used and allocated. Of this amount 55 per cent is used for irrigation (including private farms) and the rest for domestic and industrial purposes.

Since 2004, research began on the effects of earthquakes on groundwater systems and their potential future damage. Research and risk assessments are also being conducted on future potential contamination of groundwater in certain basins due to earthquakes.

### Rainfall and Precipitation

The rainfall and precipitation varies across regions in Turkey, with the highest received around the Black Sea coast in the north. The vast difference in rainfall and the concentration of water in certain parts of the country is one of the main causes of water shortages. Approximately 70 per cent of the precipitation falls between the months of October to April, with very little rain in the summer months. The average annual precipitation, taken over the last 50 years, has been approximately 640 mm, and has a decreasing trend of 29 mm/100 years. Almost 55 per cent of the rainfall and precipitation is lost to evaporation. Evaporation in the southeast region is particularly high.

The DSI estimates that with the changes in climate, temperatures are expected to increase by 2 degrees Celsius over the century during the summer months, resulting in a decrease in rainfall by 5-15 per cent during these months.

### Marginal Water

With 129 municipal wastewater treatment plants, Turkey's treated wastewater amounts to approximately 2.2 BCM. Currently most of this water is being used in the agricultural and domestic sector and studies have shown that these existing plants have the capacity to treat all wastewater generated. A majority of these plants are located in the central and southern parts of the country. Reuse of waste water in agriculture would lower the demand on freshwater and help realize sustainable use of the natural resources. The DSI has not outlined any specific plans for the increase of wastewater treatment and re-use for the future.



## Future Changes in Supply and Demand

### Renewable Per Capita Freshwater Availability (Assuming that the entire exploitable water is harnessed)

2008 Population - 71.5 million
Growth Rate - 1.3 per cent

Fig 8-c: Renewable Per Capita Freshwater Availability

| Year | Availability (BCM/Yr) | Population (in millions) | Per Capita (cubic metres/yr) |
|---|---|---|---|
| 2010 | 112 | 73.3 | 1,527 |
| 2020 | 112 | 83 | 1,350 |
| 2030 | 112 | 93.7 | 1,195 |

*Source: DSI and UN Population Statistics*

The State Hydraulic Works has outlined plans to harness and utilize the entire exploitable water of 112 BCM by 2023. Their projections indicate that by 2023 the agricultural sector will need 72 BCM, bringing 8.5 million hectares of land under irrigation; 22 BCM will be used by the industrial sector, and 18 BCM by the domestic sector. The 2009 daily consumption is 270 litres per day in the household sector, and DSI aims to reduce this figure to 150 litres per day by employing water saving methods.

Based on overall water use and energy projections, Turkey considers herself not to be a water rich country. With 1,600 cubic metres per capita per year (2008) and an expected decline to approximately 1,125 cubic metres per capita per year in 2023, Turkey is moving from a relatively water-endowed country to one where water availability will reach critical levels. This projection is why Turkey's major agency for water resource development, the General Directorate of State Hydraulic Works (DSI), argues that dam construction is a vital and unavoidable program for the country. Turkey, having developed only about

40 per cent of her water potential would be in dire need of producing and providing cheap energy, and improving the living standard of citizens by providing adequate water.

### Water Balance Calculated Against Future Increase in Demand

The demand is expected to increase by approximately 1 BCM a year (or 10 BCM every 10 years) which if measured against the current withdrawal rate shows that the country is already running at a deficit and this deficit is expected to increase within the next few decades. In addition to the 2023 DSI Plan, a five year action plan was prepared by the government for the provision of water to 81 cities[63].

It is important to explain that Figure 8-d provides a supply that is calculated based on an increasing utilization rate, and the demand calculated based on previous estimates and realistic projections for the future. It is possible that within the next decade the demand might increase marginally from 1 BCM to 1.5 BCM annually but it is unlikely that it will be any more. These estimates are based on mathematical calculations and projections, taking into account the rise in population, changes in climate, projections for industrial expansion, and past trends.

The DSI has projected the overall water demand to reach 112 BCM by 2023, matching freshwater resources. To expect that demand will more than double in less than 15 years from 46 BCM in 2010 to 112 BCM and then suddenly freeze at 112 BCM from 2023 onwards is unrealistic. It is difficult to understand how demand can suddenly increase five fold from 1 to 5 BCM annually for the next 15 years. It is equally difficult to understand how Turkey will sustain its resources once it crosses 100 per cent utilization. It would be more realistic to assume the current, or a slightly higher rate of growth, for demand and utilization.

### Scenario 1 - Accounting for an Increase in Utilization Rate

One option to meet the demand and ensure that there is still a suitable water balance is to increase the utilization of the renewable water, which is what the DSI is working towards. For the supply to exceed the demand, the utilization rate would have to increase by

Fig 8-d: Water Balance with Increasing Demand

| Year | Availability (BCM/Yr) | Utilization Rate | Supply (BCM/Yr) | Demand (BCM/Yr) | Balance (BCM/Yr) |
|---|---|---|---|---|---|
| 2010 | 112 | 40% | 44.8 | 46 | -1.2 |
| 2020 | 112 | 48% | 53.7 | 56 | -2.3 |
| 2030 | 112 | 57% | 63.8 | 66 | -2.2 |

*Source: Supply-demand calculations based on past trends and previous figure*

Fig 8-e: Water Balance with Increasing Utilization Rate

| Year | Availability (BCM/Yr) | Utilization Rate | Supply (BCM/Yr) | Demand (BCM/Yr) | Balance (BCM/Yr) |
|---|---|---|---|---|---|
| 2010 | 112 | 40% | 44.8 | 46 | -1.2 |
| 2020 | 112 | 50% | 56 | 56 | 0 |
| 2030 | 112 | 63% | 70.5 | 66 | 4.5 |

*Source: Supply-demand calculations based on past trends and previous figure* over 25 per cent every 10 years and not at the current rate of 20 per cent. At a 25 per cent increase it would mean that by 2020 there would be no deficit and within the following decade the country would show a positive balance.

### Scenario 2 - Accounting for Marginal Water

Another option would be to effectively manage the increasing demand by supplementing freshwater supply with marginal water. Urban waste water treatment reuse has been recently put on the agenda of the water administrations in Turkey. In this respect, the first large scale treatment plant was commissioned in Istanbul in 2007. With this project 700,000 cubic metres on daily basis (256 million cubic metres annually) urban wastewater is treated. Treated wastewater is used in irrigating parks and gardens and in small industry.

Assuming that the marginal water from treated wastewater remains the same, which is currently 2.2 BCM, it could supplement the supply and reduce future stress. The calculation in Figure 8-f is based on the increased utilization rate of 25 per cent every 10 years. Then 2.2 BCM of marginal water is added to the supply after 2010. The calculations in Figure 8-f show that this water will alleviate water stress in the short term, and will result in a positive balance in the long term.  By 2030, Turkey could have a surplus of more than 6 BCM of water.

Wastewater treatment is extremely necessary, not only to alleviate the potential deficit in the future, but also to ensure that the water resources do not get polluted, and there is less demand on freshwater sources. The country should also explore the possibility of increasing the marginal water supply, in the coming few years from 2.2 BCM to at least 4 BCM. It is also important to ensure that all marginal water capabilities are combined with an increasing utilization rate and demand management measures.

### Desalination

Interest in the use of desalination technologies for drinking water production has increased in Turkey in recent years due to the severe drought experienced in last few years. Desalination technology is mostly used in the Aegean coast and by tourist facilities. The municipality in Avsa Island in the Marmara Sea initiated the construction of a desalination plant of 10,000 cubic metre capacity, that will be operational in 2011. While total capacity of desalination plants was only 3,600 cubic metres a day or 1.3 MCM a year in 2002, by 2009 it was nearly 11 MCM, and this is expected to triple in five years.

The environmental impacts of desalination process on marine habitats, rising water temperatures, utilization of land for industrial zones on aquifers mainly when there are long pipes conducting seawater and brine, and noises as outcomes of the high-pressure pumps and energy recovery turbines are highly contested by civil society organizations.

Fig 8-f: Water Balance with Marginal Water

| Year | Availability (BCM/Yr) | Utilization Rate | Supply (BCM/Yr) | Wastewater Treatment (BCM/Yr) | Demand (BCM/Yr) | Balance (BCM/Yr) |
|---|---|---|---|---|---|---|
| 2010 | 112 | 40% | 44.8 | 2.2 | 46 | 1 |
| 2020 | 112 | 50% | 56 | 2.2 | 56 | 2.2 |
| 2030 | 112 | 63% | 70.5 | 2.2 | 66 | 6.4 |

*Source: WWT figures from Department of Environmental Engineering, METU, and calculations from previous figures*

## Future Geo-Political Projections

### Scenario 3 – More Water Released to Syria and Iraq

With the implementation of the Southeast Anatolia Project (GAP), both Iraq and Syria have claimed that less water is flowing downstream. In the event of agreements reached with Syria and Iraq, Turkey will most likely only release an additional 3 BCM annually, to be shared by these countries. Here the 3 BCM of water is deducted from the total freshwater availability, assuming that the water will be released from the shared water resources to the downstream countries. The utilization and supply within Turkey are then calculated on the remaining water available. The calculations are done for 2020 and 2030, allowing at least the next 5-7 years for agreements to be reached and pipelines to be constructed before water is exported.

Calculations in Figure 8-g have been done taking into account the increased utilization rate, from Figure 8-e, and adding the marginal water to the supply and then calculating the balance. Figure 8-g shows that even with exporting 3 BCM of water in 2020 and beyond, Turkey will have a positive water balance with the increased utilization rate and sustained marginal water capabilities.

## Climate Change

Research from agencies such as the UN has shown that towards the end of the century Turkey will begin experiencing major effects of climate change. The temperature is expected to rise by 2-3 degrees Celsius; which is expected to be higher in the summer in the eastern regions where they are estimated to increase by 4 degrees Celsius by 2061. The rise in temperature is projected to affect the Euphrates and the amount of water in the river could potentially decline by 30 per cent by the end of the century. Precipitation is largely expected to remain the same over the next 30 to 40 years, and could possibly drop after 2080. Accordingly, climate effects will result in a decrease of the overall hydroelectric capacity which may be as much as 5-10 per cent. Some estimates state that the precipitation could increase in the fall season, especially over the Euphrates Tigris basin and the north east parts of the country. Reports also state that precipitation could come in the form of rain and not snow, which could result in flooding and soil erosion, though no detailed research has been conducted on this topic yet.

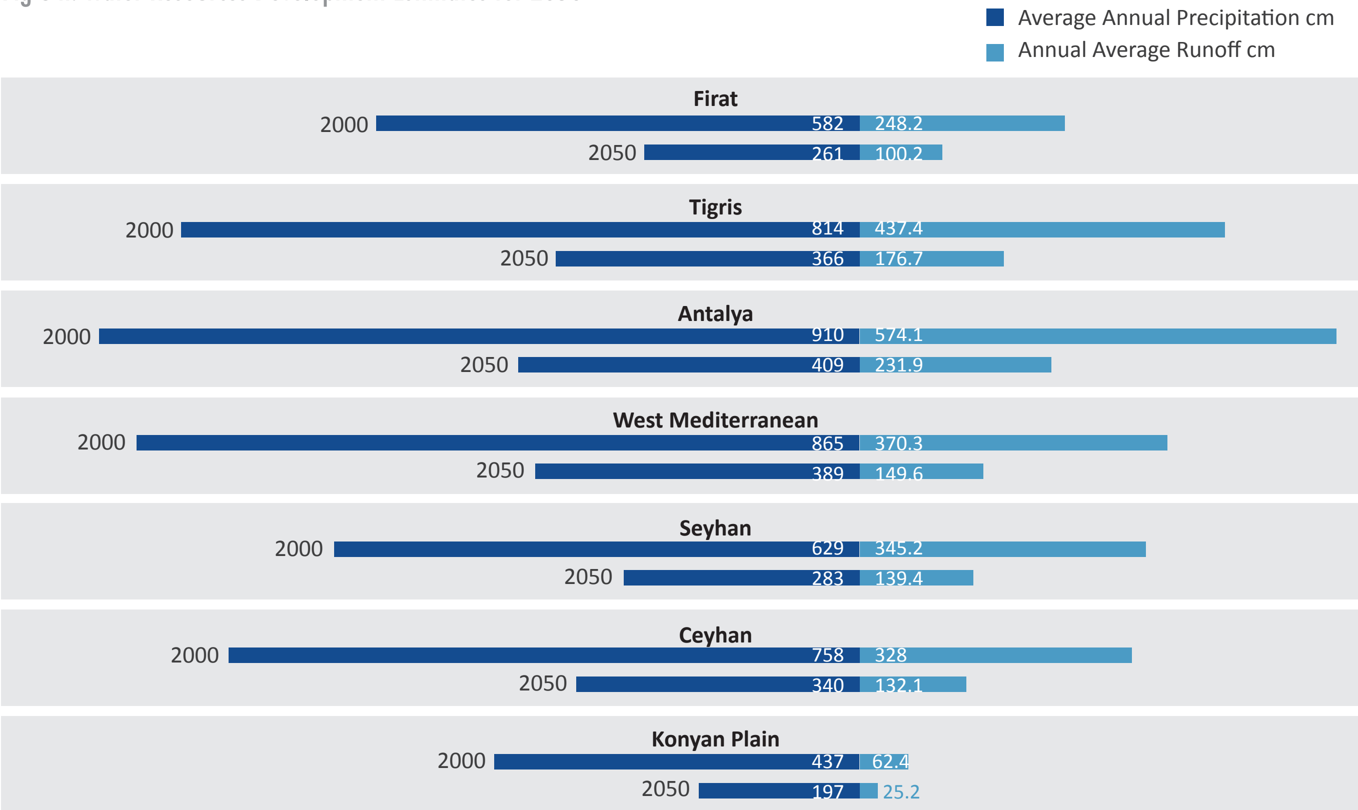
Much of the Turkish coast is experiencing, or will experience a rise in sea level within the generally accepted range of 1-2 mm/yr. While Turkey is not especially vulnerable to this rise, a further rise could lead to flooding in major coastal cities and along the Seyhan-Ceyhan basin, as well as an intrusion of saltwater. While this is a long term threat effective

Fig 8-g: Water Balance after Additional Water Released to Syria and Iraq

| Year | Availability (BCM/Yr) | Utilization Rate | Supply (BCM/Yr) | Wastewater Treatment (BCM/Yr) | Demand (BCM/Yr) | Balance (BCM/Yr) |
|---|---|---|---|---|---|---|
| 2010 | 112 | 40% | 44.8 | 2.2 | 46 | 1 |
| 2020 | 109 | 50% | 54.5 | 2.2 | 56 | 0.7 |
| 2030 | 109 | 63% | 68.6 | 2.2 | 66 | 4.8 |

*Source: Calculations based on figures from previous figures*

Fig 8-h: Water Resources Development Estimates for 2050




*Source: Dr. Zekai Sen, "Water for Energy: Hydropower is vital for Turkey" in Kibaroglu et al*

coastal management systems are required and the Ministry of Environment is planning a mechanism for impact assessment. The rise in temperature could also affect the Ceyhan River, with the flow reducing by almost 40 per cent by the end of the century, though more research is required on this subject.

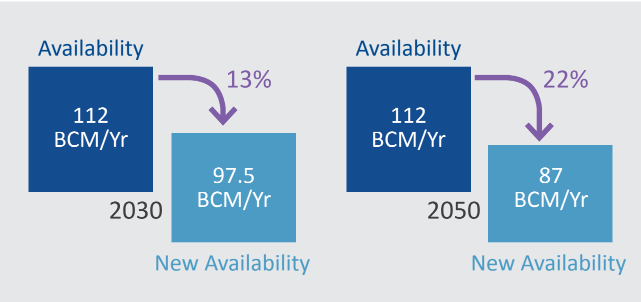
A brief study was conducted, based on the UNFCC guidelines, along the Gediz and Buyuk basin in western Turkey. Based on several scientific models, results on the climate change scenarios show that the surface water in this region could potentially decrease by 20 per cent in 2030 and by 35 per cent in 2050. Together, these two basins contribute only 1.4 per cent or 1.5 BCM of the total surface water in the country. Due to the difference in environmental patterns, rainfall and precipitation and topography it cannot be assumed that the rate will be the same for other basins around the country.

The Turkish National Assembly set up a research commission in 2007 to address the causes and effects of global warming in the country. This was done post the 2006-2007 drought, which was followed by the driest and hottest winter in recent history. One of the biggest worries is the desertification of the Konya Basin.

Figure 8-i shows a median percentage of the rate of decline taking into account all the major rivers and basins across the country. Thus the average rate of decline in availability would be approximately 13 per cent by 2030, higher in some parts such as in western Turkey and lower in the south eastern areas.

Thus, the calculations show that with this rate of decline, the total renewable fresh water availability will reduce drastically across the country creating water stress with the rise in population and demand.

Fig 8-i: Decrease in Availability due to Climate Change




*Source: DSI 2009 Report and IISD report*

On 3 June 2008, the administration revealed a five year Emergency Action Plan spanning from 2008 to 2012. The Minister of Environment and Forestry Professor Veysel Eroglu had briefed the Cabinet that, "seven provinces need urgent action because of decreasing drinking water resources and 34 provinces will face a water crisis starting in 2010. The remaining 40 provinces will have enough water until 2023."[64] Accordingly, it was determined that in the time span from 2008 to 2012, some provinces situated in southeast, western and central Anatolia, namely Sirnak, Sinop, Nevsehir, Erzurum, Corum, Aydin and Ankara were in urgent need of water supply.

## Ankara Region and Central Turkey[65]

Ankara is the capital and second largest metropolitan area of Turkey, with a 2009-2010 estimated population of 4.5-5 million people. It is located in drought prone central Anatolia, and persistent dry conditions caused sudden cuts in public water supply in the summer of 2007. The 2007 drought left Ankara with only 5 per cent of its total dam and reservoir capacity and the capital city was facing water cuts that lasted days at a time. Some municipalities were without water for up to 10 days.

Currently, the water sources around Ankara, including the dams, have the capacity to supply the city with 1.5 BCM of water annually. With a population of a little over 4 million, the per capita availability is extremely low at 375 cubic metres a year. An emergency plan was implemented over the course of one year and in August of 2008 water from the Kizilirmak River east of Ankara was piped 146 km to serve the growing water demand. The river currently has an annual exploitable yield of 3.5 BCM of which less than half is currently being utilized by neighbouring towns and villages. Ankara is among the most developed cities in Turkey, and the water crisis created a public uproar, and though current supply is sufficient to meet demand, serious doubts persist regarding the quality of Kizilirmak water for drinking.

The academic community and public health experts claimed the water was polluted and its addition to the system without special treatment deemed the water undrinkable. Gokcek and Ankara Water and Sewerage Administration (ASKI) technical advisors maintained that the Kizilirmak water was properly mixed with other water sources before being distributed to the public so the chemical concentrations were diluted to acceptable drinking water standards.

While climate change and drier summers are a contributing factor, it is mainly the lack of water management, small storage rate and transportation that have resulted in Ankara, as well as the other major cities facing a shortage. Several water policy experts have repeatedly pointed out that delay in implementing plans that have been discussed by the government was a much bigger cause of the recent crisis[66].

## Desertification

There are currently 66,000 illegal wells in the Konya Basin which are over-pumping water and depleting the groundwater reserves. It has been found that since 1975, the levels in the groundwater have decreased by over 14 metres of which 80 per cent has occurred within the last decade. The basin contributes to a little over 2 per cent of the total availability or 2.6 BCM. Current water availability is around 500 MCM.

Experts estimate that the basin faces complete desertification by 2030 and the current plan is to divert water from Goksu River in the south to the basin via a tunnel. The river has an annual potential of 3.9 BCM and it is estimated that once the project is completed, 414 MCM of water will be transferred annually. The tunnel is expected to be completed within the next five years, and is expected to solve the desertification problem in the basin[67].

Lake Tuz, located a 100 km northeast of the Konya is also facing a similar threat of desertification and severe pollution. Known as the Salt Lake, it is the country's second biggest lake and produces 70 per cent of the salt consumed. Due to higher summer temperatures and an abundance of wells, the water levels are shrinking. The estimates on the levels vary and the government has not outlined any major plans for the Lake.

## Future Water Surplus/Deficit

Turkey is currently utilizing 40 per cent of its exploitable resources and has plans to utilize the entire amount of 112 BCM by 2023. A 100 per cent utilization of the resources is extremely unrealistic and will lead to a water stress situation. It would prove more useful if the exploitable water was harnessed and stored for years of less rainfall or drought and also be made available for its neighbours.

Turkey's demand is increasing at a rapid rate of almost 1 BCM a year or 10 BCM over a decade and the current supply will be unable to meet the projected demand rates. The figures in this report show that if the utilization rate were increased at a rate of 25 per cent every decade, the demand would be met leaving the country at a balanced state by 2020 with a potential surplus of 4-6 BCM or more by 2030 and beyond.

While most of the calculations show a slight deficit in the water balance it is important to keep in mind that this will occur only if the demand increases at that high rate and if the supply is unable to meet the demand. This does not mean that Turkey has a dearth of water resources; on the contrary the country has more than 60 BCM of freshwater which is not effectively harnessed. If the utilization rate increases at a steady rate until 2030, the country will still have a surplus of available water in its basins to the amount of almost 50 BCM.

Thus if the supply meets the demand, from freshwater as well as marginal water, over the next twenty years and beyond, Turkey will have an available surplus in natural resources of 40-60 BCM of freshwater to utilize, and a potential harnessed amount of 2-4 BCM to supply to the Jordan Valley countries which are expected to face catastrophic deficit despite additional water and efficient demand management.

Whether Turkey will actually export water or not depends on several factors. First, Turkey will only consider exporting water from its national rivers such as Manavgat, Ceyhan, Seyhan, and others. It will not export water from trans-boundary rivers such the Tigris and Euphrates. The exportable surplus of 2-4 BCM from national rivers is uneven through the year. In the lean season of 8-9 months, it can be as low as 100 MCM per month or 300-500 MCM per quarter. During such a period, Turkey will require water for its domestic use. It will still be able to export at least 1-1.5 BCM water in the wet and average months. Further, if Turkey's plans of constructing dams succeed as intended, it may be able to release some water during the lean period as well.

Turkey thus, has the possibility to release up to additional 3 BCM of water from Euphrates to Syria and Iraq and export 1-2 BCM of national river waters to the Jordan Valley countries. The decision will essentially be political. If Turkey's relations with Syria and Iraq improve and if the three countries along with Lebanon and Jordan move towards forming a Community of Water and Environment, Turkey will be inclined to release extra 3 BCM water to Syria and Iraq. Also, if Israel agrees to share Turkish water on a fair basis with the Palestine Authority and Jordan, Turkey will be inclined to export at least 1.5 BCM water to the three Jordan Valley countries, which can help address the chronic deficit in the valley. The Turkish public opinion will not allow export of water if the Israel-Palestinian conflict gets worse.

Turkey will thus influence prospects of peace, cooperation and sustainability in its water relations with neighbouring countries. If this possibility is not exploited, the region will miss another opportunity. In the 1980s, President Ozal of Turkey had proposed a 30-year plan to export water from national rivers to Israel and Arabian Gulf countries via pipelines in Syria. This opportunity has been lost forever due to depletion of resources and particularly the situation in the lean season. Whether another opportunity of linking the region through water will be taken or lost, depends on surplus or deficit of statesmanship in the region.

# GLOSSARY

*Renewable Freshwater Availability*: refers to the total quantity of replenishable water that a country derives from its surface water (rivers) and groundwater resources - also known as the safe yield. Renewable implies that, under normal circumstances, this amount or yield is replenished every year by precipitation or snowfall; freshwater implies that the water has a lower concentration of salts as compared to saltwater or brackish water; and availability refers to the actual amount that can be or is harnessed in a given period of time. The standard unit of measurement for renewable freshwater availability in this paper is Million Cubic Metres per Year (MCM/Yr) or Billion Cubic Metres per Year (BCM/Yr).

*Marginal/Additional Water*: refers to other forms of water besides freshwater that can be used for domestic, industrial or agricultural purposes. Desalinated water, treated wastewater, brackish water and water harvesting fall under this category. In certain cases water from peace treaties and fossil aquifers are also included under this term.

*Withdrawal*: refers to the total amount of water that is harnessed or pumped from a country's renewable freshwater resources on an annual basis.

*Utilization Rate*: is the percentage of water withdrawn from the total renewable freshwater yield. According to international standards, a utilization rate of more than 40 per cent is considered unsustainable. In other words, countries are expected to withdraw less than half of their renewable freshwater yield annually. In the case of the Middle East many countries have exceeded this level and some countries withdraw all of their renewable freshwater and more.

*Over-pumping*: is a withdrawal of water that exceeds the safe yield. Water that has been over-pumped from lakes or groundwater aquifers cannot be replenished with a regular or an average level of precipitation and this can lead to a cumulative deficit of water over the years. Over-pumping often leads to water pollution.

*Supply*: refers to the quantity of water that is actually provided to the population. In countries with an abundant availability of freshwater, the supply might represent only that amount of freshwater which is harnessed successfully. In countries that suffer from a severe lack of freshwater resources, the supply might represent renewable available freshwater plus any additional or marginal water that is used to try and satisfy growing demand. (It must be noted that supply includes water losses through water supply system leaks and illegal water connections).

*Demand*: is the amount of water that is actually required by the domestic, industrial and agricultural sectors.

*Water Balance*: refers to the overall water deficit or water surplus that a country incurs between the total quantity of water supplied to and the total quantity of water demanded by the various sectors (agricultural, domestic, industrial).

*Bluewater, Greenwater, Greywater*: Bluewater is freshwater which can be found in rivers and groundwater aquifers. Greenwater is rainwater that either evaporates directly from the soil or is taken up by plants before it reaches rivers and groundwater. Greywater is wastewater generated from domestic activities such as dish washing, laundry and bathing and can be re-used to water lawns and other similar activities, in order to save freshwater.

# ENDNOTES

[1] Paper written for SFG by Abu Mayla, Prof Abu Amr, and 'Assessment of Restrictions on Palestinian Water Sector Development – table 1.2' World Bank. 2009 http://siteresources.worldbank.org/INTWESTBANKGAZA/Resources/WaterRestrictionsReport18Apr2009.pdf

[2] 'Rising Temperatures, Rising Tensions: Climate change and the risk of violent conflict in the Middle East', International Institute for Sustainable Development (IISD), 2009.

[3] Chloride concentrations vary from anywhere between 230 mg/litre 300 mg/litre.

[4] Definition of Karst: An area of irregular limestone in which erosion has produced fissures, sinkholes, underground streams, and caverns. Karstic (adj.)

[5] The dynamic capacity in a dam is a specific percentage of water that can be released at any given time, allowing a part of the water to remain in the dam. This dynamic capacity is a percentage of the total holding capacity and is unique for each dam or reservoir.

[6] 4th IPCC Report in Climate Change, released in 2007

[7] Hasankeyf is an ancient city located on the Tigris and is considered to be of special importance to the Kurdish community in the province. The historical significance of the city has prompted several international groups to mount campaigns against the Ilisu Dam Project, which has lead to international attention and fervour.

[8] Some environmentalists warn that the Dead Sea might turn white as gypsum sediment precipitates, and then green due to microbial blooms.

[9] Concerns have been voiced with regards to a tourism project in the Arava Valley that aims to build 200,000 new hotel rooms between the Red and Dead Seas with a plan to populate the area with 3 million people.

[10] The Arava Valley sustains farming communities in Israel known as kibbutzim. These communities rely on groundwater aquifers for their supply of water and are not connected to Israel's National Water Carrier. The Arava region is placed on a fault line and should the region suffer an earthquake, the pipeline could rupture, contaminating the groundwater and cutting the kibbutzim off from its only freshwater supply.

[11] National Investigation Committee Report to the Knesset on "Subject of management of the Water Economy in Israel", March 2010.

[12] Paper written for SFG by Dr. Aysegul Kibaroglu

[13] Paper written for SFG by Dr. Faisal Rifai

[14] National Investigation Committee Report to the Knesset on "Subject of management of the Water Economy in Israel", March 2010.

[15] Ministry of National Infrastructures Water Commission, 'Water in Israel Consumption and Production 2001', December 2002. In 2000, the agricultural sector consumed 1,120 MCM, while the domestic and industrial sectors consumed 660 MCM and 120 MCM respectively.

[16] The 3 tributaries that form the headwaters of the Jordan River, namely Banias (Golan Heights), Hasbani (Lebanon) and Dan (Israel), converge 6 km inside Israel at Mount Hermon, at about 70 km above sea level to form the Upper Jordan River. The Upper Jordan River consequently flows through the Hula Valley and into Israel's only natural freshwater lake - Lake Kinneret (Lake Tiberias or the Sea of Galilee).

[17] The split in allocations of water supply have been calculated according to Article 40 of the Oslo Agreement – 2009 report on Palestine.

[18] Desalinated seawater capacity authorized by the Israeli government for 2010 in 2008. Yossi Dreizin, 'Integrating Large Scale seawater desalination plants within Israel's water supply system', 2007-2008.

[19] 430 MCM is the figure given on the Ministry of Environmental Protection website, while 377 MCM is the figure received after addition of individual marginal water sources.

[20] Dreizin, Yosef, 'Wastewater Reuse - Risk Assessment: The Israeli case study' Water Commission, Israel, 2007. http://www.ildesal.org.il/pdf/wastewater_reuse_risk_assessment.pdf

[21] Dreizin, Yosef, 'Integrating Large Scale Seawater Desalination Plants within Israel Water Supply System.' Israel Water Commission, Desalination Division, January 13, 2007. http://www.desline.com/articoli/8895.pdf

[22] 'Marginal Water Sources' Water Sources, Israel Ministry of Environmental Protection, 2003. http://www.sviva.gov.il/bin/en.jsp?enPage=e_BlankPage&enDisplay=view&enDispWhat=Object&enDispWho=Articals^l2054&enZone=Water_Sources

[23] Dreizin, Yosef, 'Wastewater Reuse – Risk Assessment: The Israeli case study' Water Commission, Israel, 2007. http://www.ildesal.org.il/pdf/wastewater_reuse_risk_assessment.pdf

[24] Dreizin, Yosef, 'Integrating Large Scale Seawater Desalination Plants within Israel Water Supply System.' Israel Water Commission, Desalination Division, January 13, 2007. http://www.desline.com/articoli/8895.pdf

[25] Bachmat, Prof. Yehuda & Khalid, Abdul-Latif, 'The 1999 Drought and Its Hydrological Impact'. Hydrological Service of Israel & Palestinian Hydrology Group, 1998-1999. http://www.ipcri.org/watconf/papers/yehuda.pdf

[26] 'Quality of Water Sources-Coastal Aquifer' Israel Ministry of Environmental Protection, January 23, 2005. http://www.sviva.gov.il/bin/en.jsp?enPage=e_BlankPage&enDisplay=view&enDispWhat=object&enDispWho=Articals%5El2059&enZone=Quality_Water&enVersion=0&

[27] The Mountain Aquifer is composed of mainly limestone, which is an extremely porous stone and therefore susceptible to contamination and pollutants.

[28] Pe'er and Safriel, 'Climate Change Israel National Report: Impact, vulnerability and adaptation' Ministry of Environment, Ben Gurion University & Hebrew University– Negev, October 2000. http://nasa.proj.ac.il/Israel-Research/Climate_Change_Israel_National_Report.html

[29] Between 1967-1994 the Israeli authorities issued only approximately 38 permits to Palestinians for drilling new wells or to replace existing wells.

[30] A recent U.N. report found that Palestinians in some of the hardest-hit communities were spending as much as 30 per cent to 40 per cent of their income on water delivered by truck.

[31] Barghouti, Marwan,. 'Existing and Future Water Status in Palestine' An-Najah National University, Nablus. Paper written for SFG, March 2010.

[32] ibid

[33] It must be noted however that the amended version of the Johnston Plan envisaged supplying roughly 200 MCM of the Jordan River to the Palestinians via the East Ghor Canal – Source: 'Water resources in oPT, current and future'. Dr. Ayman Rabi, Palestinian Hydrology Group (PHG).

[34] 'Assessment of Restrictions on Palestinian Water Sector Development – Table 1.2' World Bank, 2009. http://siteresources.worldbank.org/INTWESTBANKGAZA/Resources/WaterRestrictionsReport18Apr2009.pdf

[35] A 2007, World Bank paper (Making the Most of Scarcity) gives the per capita availability in West Bank and Gaza Strip, taken in 1999, as 75 and 125 cubic metres/yr respectively. This must be because the figure is calculated against the actual supply and

not the renewable freshwater resources. In order to keep a standardized format – per capita availability will always be calculated by renewable freshwater available and not virtual, purchased, over-pumped or marginal water (FAO 2005 statistics are more accurate and are used as the base figure in many research papers).

[36] Fischbach, Michael, 'The West Bank and Gaza: A population profile' Population Reference Bureau. April 2002. http://www.prb.org/Articles/2002/TheWestBankandGazaAPopulationProfile.aspx

[37] Summarized by Eng. Almotaz Abadi. 'Integrated Water Resources Management Plan (IWRMP)' USAID and (Palestinian Water Authority (PWA), 2003.
http://emwis.infinitytechs.com/general/ResearchAndDevelopment/integrated%20water%20resources%20management%20plan.pdf

[38] Rabi, Ayman, 'Water Resources in Occupied Palestinian Territory: Current and Future Projections' Palestinian Hydrology Group for water and environmental resources development, April 2009.

[39] Israel's Hadera plan proposed to pump water from the Mediterranean, desalinate it and then sell it to the Palestinians. Palestinians were opposed to this plan because they believed that if not for the occupation they would be able to access seawater from the Mediterranean themselves and then desalinate it indigenously.

[40] According to Palestine Water Authority Chief, Shaddad Attili in an interview with Palestine Monitor, dated 18th September 2008.

[41] Zimmo, Imseh, 'Experiences with Use of Treated Wastewater for Irrigation in Palestine' Friends of Environment and Water (FEW) and House of Water and Environment (HWE), 2000
http://www.hwe.org.ps/Projects/Research/From%20Conflict%20to%20Collective/workshop/Experiences%20with%20Use%20of%20Treated%20Wastewater.pdf

[42] 'Prospects of Water Desalination in the Gaza Strip', Ismail Mahmoud, 2003.

[43] Tagar and Qumsieh. 'A Seeping Time Bomb: Pollution of the Mountain Aquifer by Solid Waste', Friends of the Earth Middle East, January 2006.

[44] Zafer Alem Op.cit

[45] Annual median is given as roughly 120 MCM but calculated median is 252 MCM.

[46] Annual median is given as roughly 50 MCM which matches with calculated median of 52MCM

[47] Ministry of Water and Irrigation and GTZ 2004. Op.cit

[48] ibid

[49] 'Namrouqa, Hana, 'Govt. Seeking Funding for National Red Sea water project' Jordan Times, March 30 2010. http://www.jordantimes.com/index.php?news=20522&searchFor=dead%20sea

[50] 2008 SOWAMED presentation by Muhammad Shantanawi. Op.cit.

[51] The 1999 drought was so extreme that Jordan had to sign a $4 million agreement with the United Nations World Food Program to help them cope with famine and other effects resulting from the shortage of freshwater.

[52] 'Jordan Ministry studying establishments of Five New Dams' Water solutions Middle East, March 2009.
http://www.watersolutionsme.com/images/pdf/JordanMinistrystudyingestablishmentoffivenewdams-09Mar09MENAFN.pdf

[53] Dr. Jnad and Sibai, 'Water and adaptation to Climate Change in the Arab Region' Water Resource Department, The Arab Centre for the Studies of Arid Zones and Dry Lands (ACSAD), 2008-2009.
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# ANNEXE I - WORKSHOPS

Strategic Foresight Group hosted three international workshops on Water Security in the Middle East in order to gain input for this report. All workshops were supported by the Swiss Agency for Development and Cooperation (SDC) and the Swedish International Development Agency (Sida), with support from Political Affairs Division IV for Human Security of the Swiss Federal Department of Foreign Affairs, as a part of the overall sponsorship of the initiative.

On 15-16 February 2010, two workshops were held in Montreux, Switzerland, attracting the participation of 60 leading policymakers, including members of Parliament, former Cabinet Ministers, senior leaders of Water Commissions and heads of research institutions from across the Middle East. Workshop I on February 15, 2010 focussed on Iraq, Lebanon, Syria and Turkey. Workshop II on February 16, 2010 focussed on Israel, Jordan and the Palestinian Territories. HRH Prince Hassan bin Talal of Jordan delivered the keynote address to launch the initiative. While two workshops were separate, participants from Turkey and Jordan were invited to attend both workshops.

On 17 May 2010, a High Level Plenary on *Our Common Future: Water, Environment and Energy Community* was organised at WANA Forum in Amman, Jordan. It had three components. The first component was a Vision Conversation with HRH Prince Hassan bin Talal of Jordan. The second component was a Strategic Dialogue with Members of Parliament, advisers to Heads of Government and heads of water authorities from West Asia as well as senior diplomats from Sweden and Switzerland. The third component was an Open House with WANA Forum participants from across Asia, ranging from UAE to Yemen and Iraq to Japan. Finally, a paper on water scarcity and drought in West Asia and North Africa was presented by a representative of the WANA Forum.

On 26-27 September 2010, an international workshop on regional cooperation for sustainable water management was held at Sanliurfa, Turkey. The workshop was co-hosted by AK Party of Turkey and the General Directorate of State Hydraulic Works (DSI). The workshop was attended by 40 participants from Iraq, Jordan, Lebanon, and Turkey at the level of heads of water ministries and water authorities, Members of Parliament, advisers in the Prime Minister's Offices, former Cabinet Ministers, and academic experts closely working with the government. In addition, there were scholars from Syria and diplomatic representatives from Sweden and Switzerland.

The reports of all the workshops are available on Strategic Foresight Group website (www. strategicforesight.com)

## Participants at the Montreux Workshops

### Guest of Honour

- HRH Prince El Hassan bin Talal of Jordan

### Hosts

#### Government of Switzerland

- Dr. Martin Dahinden, Director General, Swiss Agency for Development and Cooperation
- Ambassador Thomas Greminger, Head of Political Affairs Division IV for Human Security, Federal Department for Foreign Affairs
- Mr. François Münger, Head, Water Initiatives Division, Swiss Agency for Development and Cooperation

- Ambassador Jean-Daniel Ruch, Special Representative for the Middle East, Federal Department for Foreign Affairs
- Mr. Thomas Walder, Senior Water Specialist, Water Initiatives Division, Swiss Agency for Development and Cooperation
- Mr. Mario Carera, Senior Advisor, Office of the Special Representative for the Middle East Federal Department for Foreign Affairs
- Ms. Karin Siegenthaler, Assistant, Water Initiatives Division, Swiss Agency for Development and Cooperation
- Ms. Justine Hessler, Intern, Office of the Special Representative for the Middle East Federal Department for Foreign Affairs

### Government of Sweden

- Mr Dag Juhlin-Dannfelt, Deputy Head of the Department for the Middle East and North Africa, Ministry of Foreign Affairs

### Strategic Foresight Group

- Mr. Sundeep Waslekar, President
- Ms. Ilmas Futehally, Executive Director
- Ms. Ambika Vishwanath, Research Analyst

### Advisory Group Member

- The Rt. Hon. Lord John Alderdice, Former Speaker of the Northern Ireland Parliament, United Kingdom

## Participants in Workshop I at Montreux

### Iraq

- Dr. Kamal Field Al Basri, Chairman, Institute for Economic Reform, former Deputy Finance Minister
- Prof. Adel Sharif, Director, Center for Osmosis Research& Application, University of Surrey
- Prof. Muqdad Ali Al-Jabbari, Senior Founder, Euphrates Tigris Initiative for Cooperation (ETIC), Baghdad University
- Dr. Maha Rasheed, Water Engineer, Ministry of Irrigation
- Ms. Zahraa Hameed Jasim, Senior Correspondent, National Iraqi News Agency

### Lebanon

- Dr. Selim Catafago, President, National Authority of the Litani River
- Dr. Riad Al Khouri, Dean of Business School, Lebanese French University at Erbil
- Dr. Karim Makdisi, Professor, Dept. of Political Science, American University Beirut
- Dr. Tarek Majzoub, Professor, Faculty of Law, Beirut Arab University

### Syria

- Dr. Abdullah Droubi, Director, Water Division, Arab Centre for the Studies of Arid Zones and Dry Lands
- Dr. Kamil Shideed, Assistant Director General, International Cooperation, International Center for Agricultural Research in the Dry Areas
- Dr. Ayman Abdel Nour, Editor in Chief, All4Syria, Blog & Online Newspaper
- Ms. Mokhlesa Al-Zaeim, Former Water Policy Advisor to Govt. of Syria, Currently with GTZ, Yemen Office

### Turkey

- Mr. Yasar Yakis, Member of Parliament & Former Foreign Minister, Chairman of the European Union Committee
- Mr. Saban Disli, Member of Parliament, Chief Economic Adviser to the Prime Minister of Turkey
- Mr. Emin Onen, Member of the Parliament, Deputy Chairman of External Affairs, AK Party
- Mr. Akif Ozkaldi, Deputy Director General, State Hydraulic Works - DSI

- Ambassador Mithat Rende, Director General for Economic Affairs, Ministry of Foreign Affairs
- Dr. Aysegul Kibaroglu, Professor, Department of International Relations, Middle East Technical University
- Mr. Salim Fakioglu, Deputy Head of Planning, State Hydraulic Works - DSI
- Dr. Ibrahim Gurer, Dean, Faculty of Engineering, Gazi University

### Arab League

- Ms. Chahra Ksia, Director, Water Center, League of Arab States

### Jordan (Link Participant from Workshop II)

- Dr. Munther Haddadin, Former Minister, Ministry of Water and Irrigation & Former President, Jordan Valley Authority
- Dr. Musa Keilani, Editor, Al Urdon Newspaper
- Dr. Bassam Hayek, Director, El-Hassan Eco Tech Park, Royal Scientific Society

### Others

- Dr. Marwa Daoudy, Visiting Professor, University of Geneva
- Mr. Osamu Itagaki, Water Expert in Syria, Japanese International Cooperation Agency
- Ms. Anthi Brouma, Program Officer, Global Water Partnership-MED

## Participants in Workshop II at Montreux

### Israel

- Dr. Ephraim Sneh, Chairman, Center for Strategic Dialogue & Former Cabinet Minister of Health and Transportation
- Eng. Saul Arlosoroff, Former Water Commissioner & Member of Mekerot Board
- Prof. Yair Hirschfeld, Director General, Economic Cooperation Foundation
- Dr. Amnon Kartin, Lecturer at the Dept of Geography, Tel Aviv University
- Prof. Uri Shamir, Professor of Water Resources and Engineering, Technion University
- Dr. Itay Fischhendler, Head of Environmental Policy, Planning and Management Program, Department of Geography, Hebrew University of Jerusalem
- Ms. Karin Kloosterman, Founder, Green Prophet Blog

### Jordan

- Dr. Munther Haddadin, Former Minister, Ministry of Water and Irrigation & Former President, Jordan Valley Authority
- Maj Gen. Mansur Rashid, Chairman, Amman Center for Peace and Development
- Dr. Mohamed Saidam, Director, Environmental Monitoring Research Unit, Royal Scientific Society
- Dr. Elias Salameh, Professor of Hydrology and Hydrochemistry, University of Jordan
- Dr. Musa Keilani, Editor, Al Urdon Newspaper
- Dr. Bassam Hayek, Director, El-Hassan Eco Tech Park, Royal Scientific Society

### Palestine Territories

- Dr. Sahar Al-Qawasmi, Member, Palestine Legislative Council & Member, Parliamentarians Network for Conflict Prevention and Human Security
- Eng. Marwan Abdelhamid, Former advisor to the President of the Palestine Authority
- Dr. Jamal Yosef Al-Dadah, Head of Planning Department, Palestinian Water Authority (Gaza)
- Dr. Ayman Ismail Rabi, Founder, Palestinian Hydrology Group
- Mr. Mahmoud Labadi, Former Director General, Palestine Legislative Council & Former Director, Aid

Coordination

- Eng. Monther I A Hind, Director General and Founder, Palestine Wastewater Engineers Group

### Turkey

- Mr. Yasar Yakis, Member of Parliament & Former Foreign Minister, Chairman of the European Union Committee
- Mr. Saban Disli, Member of Parliament, Chief Economic Adviser to the Prime Minister of Turkey
- Mr. Emin Onen, Member of the Parliament, Deputy Chairman of External Affairs, AK Party
- Mr. Akif Ozkaldi, Deputy Director General, State Hydraulic Works - DSI
- Ambassador Mithat Rende, Director General for Economic Affairs, Ministry of Foreign Affairs
- Mr. Salim Fakioglu, Deputy Head of Planning, State Hydraulic Works - DSI
- Dr. Ibrahim Gurer, Dean, Faculty of Engineering, Gazi University

### Arab League

- Ms. Chahra Ksia, Director, Water Center, League of Arab States

### Lebanon (Link Participant from Workshop I)

- Dr. Riad Al Khouri, Dean of Business School, Lebanese French University at Erbil

### Others

- Mr. Osamu Itagaki, Water Expert in Syria, Japanese International Cooperation Agency
- Ms. Anthi Brouma, Program Officer, Global Water Partnership-MED

## Participants in the High Level Plenary at Amman

### Chair

- Mr Sundeep Waslekar, President, Strategic Foresight Group

### Vision Conversation

- HRH El Hassan bin Talal, Chairman, WANA Forum

### Strategic Dialogue I

- Hon. Saban Disli, Member of Parliament, Economic Adviser to the Prime Minister of Turkey
- Dr Karim Nashashibi, Economic Adviser to the Prime Minister of the Palestinian Authority
- Dr Selim Catafago, President, Litani River Authority
- Hon. Emin Onen, Member of Parliament, Deputy Chairman for Foreign Affairs of AK Party of Turkey
- Dr Kamal Field Al Basri, Director of Iraq Institute for Economic Reforms
- Dr Dureid Mahasneh, former Secretary General of the Jordan Valley Authority

### Strategic Dialogue II

- Ambassador Jean-Daniel Ruch, Special Representative for the Middle East of the Government of Switzerland
- Dr Francois Muenger, Global Head of Water Initiatives, Swiss Agency for Development and Cooperation
- Mr Dag Juhlin-Danfeld, Deputy Head of the Middle East Division, Ministry of Foreign Affairs of Sweden
- Ms Annika Johansson, Regional Water Coordinator, Swedish International Development Agency

### Invited Interventions

- Dr Ismail Serageldin, Director, Bibilotheca Alexandrina
- Dr Jauad El Kharraz, Researcher, Euro-Mediterranean Information System on know-how in the water sector (presentation of WANA Forum draft paper on water scarcity and drought in the region)

### Open House

- Contributions from WANA Forum members from across Asia

## Participants at the Sanliurfa Workshop

### Guests of Honour

- Mr. Nuri Okutan, Governor of Sanliurfa
- Prof. Dr. Hasan Zuhuri Sarikaya, Undersecretary, Ministry of Forestry and Environment of Turkey

### Iraq

- Dr. Sadek Baker Al-Jawad, Water Advisor in the Prime Minister's Office
- Dr. Hussein Jabir Al-Wasetti, Head of Agriculture and Water Section, Prime Minister's Office
- Prof. Mukdad H Al-Jabbari, Senior Founder, Euphrates Tigris Initiative for Cooperation (ETIC), Baghdad University
- Dr. Kamal Field Al Basri, Chairman, Institute for Economic Reform, former Deputy Finance Minister

### Jordan

- Ms. Maysoon Al'Zoubi, Secretary General, Ministry of Water Resources
- Dr. Munther Haddadin, Former Minister for Water Resources
- Dr. Hazim El-Naser, Former Minister for Water Resources
- Mr. Faris Shawkat Al Mufti, Senior Ambassador, Ministry of Foreign Affairs
- Mr. Rafat Assi, Director, Environmental Consultations and Projects, Royal Scientific Society
- Dr. Musa A Keilani, Former Ambassador, Editor in Chief, Al Urdon Newspaper
- Dr. Mohammed Saidam, Research Consultant, Water and Environmental Engineering
- Mr. Riad al Khouri, Economist and Management Expert, (Simultaneously based in Jordan, Iraq, Lebanon)

### Lebanon

- Ms. Nayla Rene Moawad, Former First Lady
- Dr. Basem Ramzi Shabb, Member of Parliament
- Mr. Chamel Mouzaya, Former Member of Parliament
- Dr. Selim Catafago, President of the Board of the Litani River Authority
- Ms. Karma Ekmekji, Head of International Affairs, Prime Ministers Office
- Ms. Iman AbdEl Aal, Treasurer, Association of Friends of Ibrahim Abd El Al, and Governor, World Water Council

### Syria

- Dr. Faisal Rifai, Co- Founder, Euphrates Tigris Initiative for Cooperation (ETIC)
- Dr. Majd Jamal, Assistant Director General, ICARDA (International Organization based in Syria, not representing Syria)

### Turkey

- Mr. Yasar Yakis, Member of Parliament, Former Foreign Minister, Chairman of the European Union Committee of the Parliament
- Mr. Saban Disli, Member of Parliament, Economic Advisor to the Prime Minister
- Mr. Emin Onen, Member of Parliament, Deputy Chairman of External Affairs, AK Party
- Mr. Akif Ozkaldi, Deputy Director General, State Hydraulic Works
- Mr. Murat Yavuz Ates, Deputy Director General, Energy Water and Environment, Ministry of Foreign Affairs
- Mr. Sait Umucu, Regional-Director, DSI Sanliurfa Regional Directorate
- Mr. Ömer Özdemir, Head of Department of Water

Supply and Sewage Disposal, State Hydraulic Works

- Mr. İsmail Güneş, Head of Department of Surveying and Planning, State Hydraulic Works
- Mr. Salim Fakioğlu, Deputy Head of Department of Surveying and Planning, State Hydraulic Works
- Ms. Asli Oral, Head of Department, Transboundary Waters, Ministry of Foreign Affairs
- Ms. Simla Ozkaya, Advisor, Transboundary Waters, Ministry of Foreign Affairs
- Prof. Ayşegül Kibaroğlu, Middle East Technical University
- Prof. Ahmet Mete Saatçı, Vice Secretary General, Fifth World Water Forum
- Dr. İdil Yılmaz, Coordinator, Fifth World Water Forum

## Government of Sweden

- Mr Dag Juhlin-Dannfelt, Deputy Head, Department for the Middle East and North Africa, Ministry of Foreign Affairs

## Government of Switzerland

- Mr. François Münger, Head, Water Initiatives Division, Swiss Agency for Development and Cooperation
- Mr. Mario Carera, Senior Advisor, Office of the Special Representative for the Middle East, Federal Department for Foreign Affairs
- Mr. Johan Gely, Program Manager, Water Initiatives, Swiss Agency for Development and Cooperation
- Ms. Nadia Benani, Regional Program Officer for the Swiss Cooperation Office in Amman, Swiss Agency for Development and Cooperation

## Strategic Foresight Group

- Mr. Sundeep Waslekar, President
- Ms. Ilmas Futehally, Executive Director
- Ms. Ambika Vishwanath, Project Coordinator and Research Analyst

## Workshop Coordinators

- Ms. Zeynep Erul, Foreign Policy Expert, AK Party
- Mr. Uğur Büyükhatipoğlu, Deputy Regional-Director, DSI-Sanliurfa Regional Directorate
- Mr. Hamza Özgüler, Section Director, International Hydrological Relations, Surveying and Planning Department, State Hydraulic Works
- Ms. Aylin Kübra Onur, Environmental Engineer, International Hydrological Relations, Surveying and Planning Department, State Hydraulic Works

# ANNEXE II - CONSULTATIONS

## Consultations with Individuals

- Mr. Abdullah Gul, President of Turkey
- Mr. Shimon Peres, President of Israel
- Prince Hassan bin Talal, Royal Palace of Jordan
- Mr. Dan Meridor, Deputy Prime Minister of Israel
- Dr. Waled Muallam, Minister of Foreign Affairs of Syria
- Ms. Nayla Moawad, Former First Lady of Lebanon
- General Michel Aoun, Former Prime Minster of Lebanon
- Dr. Marouf Bakhit, Former Prime Minister of Jordan
- Mr. Nasser Lozi, Chief of Royal Court of Jordan
- Eng. Mohammad Jamil Al-Najjar, Minister of Water and Irrigation of Jordan
- Dr. Nader al-Bunni, Minister of Irrigation of Syria
- Judge Dan Bien, Chairman, Special Knesset Committee of Israel
- Mr. Yasar Yakis, Former Foreign Minister of Turkey
- Mr. Bakhtiar Amin, Former Cabinet Minister of Iraq
- Dr. Hazim El-Naser, Former Water Minster of Jordan
- Dr. Munther Haddadin, Former Water Minster of Jordan
- Eng. Zafer Alem, Former Water Minister of Jordan
- Dr. Ephraim Sneh, Former Deputy Defence Minister of Israel
- Mr. Avshalom Vilan, Member of Parliament and Chairman of Farmers Association of Israel
- Mr. Emin Onen, Member of Parliament of Turkey
- Mr. Karim Nashashibi, Advisor to the Prime Minister of Palestine Territories
- Ms. Karma Ekmekji, Advisor to the Prime Minister of Lebanon
- Mr. Saban Disli, Advisor to the Prime Minister of Turkey
- Dr. Uri Shani, Water Commissioner of Israel
- Dr. Fadi Comair, Director General, Minister of Water Resources of Lebanon
- Dr. William Habib, Secretary General, Ministry of Foreign Affairs of Jordan

## Consultations with Organizations

- Arab Forum for Environment and Development, Lebanon
- Iraqi Institute for Economic Reform, Iraq
- Royal Scientific Society, Jordan
- State Hydraulic Works, Turkey
- Weizmann Institute of Science, Israel

# ANNEXE II - CONTRIBUTIONS

This report draws heavily from research papers provided by regional experts and commissioned by SFG, as listed below, and sourced by the name of the author in the text of the report.

## A. Commissioned Joint Papers by Israeli and Palestinian Experts

- Professor Dr. Yousef S. Abu Mayla, Director, Institute of Water and Environment, Al Azhar University, Gaza, Palestine Territories and Professor Dr. Eilon M. Adar, Director of Water Sciences and Technologies, Blaustein Institutes for Desert Research, Ben - Gurion University of the Negev, Israel
- Dr. Monther Hind, Director General and Founder, Palestine Wastewater Engineers Group, Palestine Territories and Dr. Clive Lipchin, Director of Research at Arava Institute for Environmental Studies, Israel

## B. Commissioned National Perspective Papers

- Eng. Zafer Alem, former Minister for Water Resources, Jordan
- Dr. Aysegul Kibaroglu, Professor, Department of International Relations, Middle East Technical University, Turkey
- Prof. Muqdad Ali Al-Jabbari, Professor at College of Sciences, Baghdad University, Iraq
- Dr. Marwan Haddad, Professor and Director, Water and Environmental Studies Institute (WESI), An - Najah National University, Nablus, Palestine Territories
- Dr. Faisal Rifai, Founder and Executive Director, Euphrates Tigris Initiative for Cooperation (ETIC), Syria

## C. Non Commissioned Papers / Notes Contributed by Regional Experts

- Dr. Ibrahim Gurer, Dean, Faculty of Engineering, Gazi University, Turkey
- Dr. Selim Catafago, President, National Authority of the Litani River, Lebanon
- Dr. Maha Rasheed, Water Engineer, Ministry of Irrigation, Iraq
- Eng. Marwan Abdelhamid, Former Advisor to the President of the Palestine Authority, Palestine Territories
- Dr. Ayman Ismail Rabi, Founder, Palestine Hydrology Group, Palestine Territories
- Dr. Kamil Shideed, Assistant Director General, International Cooperation, International Centre for Agricultural Research in the Dry Areas, Syria
- Dr. Abdullah Droubi, Director, Water Division, Arab Centre for the Studies of Arid Zones and Dry Lands, Syria
- Mr. Akif Ozkaldi, Deputy Director General, State Hydraulic Works - DSI, Turkey
- Dr. Musa Keilani, Editor, Al Urdon Newspaper , Jordan
- Dr. Ephraim Sneh, Chairman, Centre for Strategic Dialogue; former Cabinet Minister of Health and Transportation, Israel
- Eng. Saul Arlosoroff, Former Water Commissioner; Member of Mekerot Board, Israel

## D. Articles Commissioned by Green Prophet Blog

On behalf of SFG, Green Prophet, an influential Israeli environmental blog (www.greenprophet.com) posed questions to academics, policy-makers and activists in Israel and collated their responses, which were posted and debated on their blog.

# ACKNOWLEDGEMENTS

In addition to consultations, workshops and research paper contributions, a number of leaders, diplomats and experts provided formal or informal support for the success of this project. Strategic Foresight Group expresses its sincere gratitude to all of them.

- HRH Prince Hassan bin Talal, Royal Palace of Jordan
- Mr. Yasar Yakis, Former Foreign Minister, Turkey
- Mr. Saban Disli, Member of Parliament and Advisor to the Prime Minister, Turkey
- Mr. Emin Onen, Member of Parliament Deputy Chairman of Foreign Affairs of AK Party, Turkey
- Mr. Akif Ozkaldi, Deputy Director General, State Hydraulic Works, Turkey
- Dr. Ephraim Sneh, Former Cabinet Minister, Israel
- Dr. Marwan Al-Jabbari, Co-Founder, Euphrates Tigris Initiative for Cooperation, Iraq
- Dr. Paul Salem, Director, Carnegie Middle East Centre, Lebanon
- Dr. Kamal Field, Former Deputy Finance Minister, Iraq
- Dr. Martin Dahinden, Director General, Swiss Agency for Development and Cooperation
- Mr. François Münger, Head, Water Initiatives Division, Swiss Agency for Development and Cooperation
- Mr. Jean Daniel Ruch, Ambassador, Office of the Special Representative for the Middle East, Federal Department for Foreign Affairs of Switzerland
- Dr. Martin Aeschbacher, Ambassador, Embassy of Switzerland in Syria
- Mr. Mario Carera, Senior Advisor, Office of the Special Representative for the Middle East, Federal Department for Foreign Affairs of Switzerland
- Mr. Thomas Oertle, Deputy Chief of Mission, Embassy of Switzerland in Syria
- Dr. Thomas Walder, Water Initiatives Division, currently in Peru, Swiss Agency for Development and Cooperation
- Dr. Johan Gely, Program Manager, Water Initiatives Division, Swiss Agency for Development and Cooperation
- The Rt. Hon. Lord John Alderdice, Chairman, Liberal Democratic Party in the House of Lords
- Mr. Vidar Helgeson, Former Deputy Foreign Minister, Norway
- Mr Dag Juhlin-Dannfelt, Deputy Head, Department for the Middle East and North Africa, Ministry of Foreign Affairs of Sweden
- Ms. Ingrid Sandström, Regional Water Programmes Team MENA/Iraq, Swedish International Development Cooperation Agency (Sida)
- Ms. Annika Johansson, Counsellor, Regional Water Cooperation, Embassy of Sweden in Jordan

Besides, Strategic Foresight Group was privileged to receive significant intellectual input from Engineer Zafer Alem, former Water Resources Minister of Jordan, who passed away in August 2010, while work on this project was in progress. Strategic Foresight Group pays respect to his memory.

Finally, Strategic Foresight Group would like to thank Swiss Agency for Development and Cooperation, as well as Political Affairs Division IV (Human Security) of the Swiss Federal Department of Foreign Affairs, and the Swedish Agency for International Development. In addition, Strategic Foresight Group acknowledges support from the AK Party and the State Hydraulic Works (DSI), Turkey for co-hosting the workshop in September 2010; Majlis El Hassan and the WANA Forum for co-hosting the High Level Plenary in May 2010. While Strategic Foresight Group is indebted to all supporters, it takes sole responsibility for the final output of the project and any errors or omissions that may be unknowingly associated with it.

# NOTES

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# About Strategic Foresight Group

Strategic Foresight Group is a think tank based in India with global reach. It enables policy makers to anticipate and shape future in uncertain times. It develops scenarios, crafts innovative concepts in peace and conflict, analyses global paradigm shifts, and engages senior political leaders in initiatives for change.

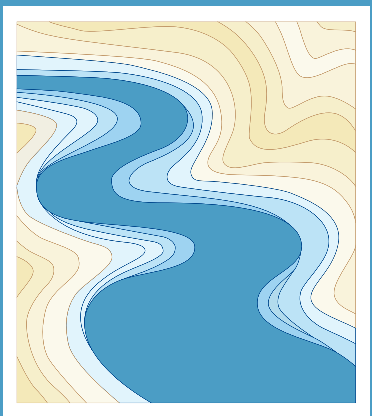
Strategic Foresight Group (SFG) is known for developing the Cost of Conflict tool measuring actual and opportunity costs on a multitude of parameters in a conflict zone. Its reports on conflicts in Asia and the Middle East have been welcomed by Cabinet Ministers of the concerned countries. SFG has partnered with the Alliance of Liberals and Democrats in the European Parliament and the League of Arab States, to bring together Western and Islamic political leaders to formulate joint approaches to deconstruct terror. In June 2008, SFG had organised an international conference on Responsibility to the Future, which was co-hosted by the United Nations Global Compact and inaugurated by the President of India. It recommended that SFG should address the problem of water security. The SFG report on the Himalayan watershed was launched at the Singapore International Water Week in June 2010 and has led to discourse on collaborative solutions between Asian countries with river basins in the central and eastern Himalayas.

SFG reports have been discussed in the United Nations, Alliance of Civilizations, floor debates and committee meetings of the Indian Parliament, UK House of Commons and House of Lords, World Economic Forum, and other prestigious institutions. Its report on Cost of Conflict in the Middle East has been translated in Arabic by the Institute for Peace Studies at Bibliotheca Alexandrina and in Spanish by the European Institute of the Mediterranean. Senior SFG functionaries and SFG reports have been quoted in several hundred newspapers, television channels and websites from almost 60-70 countries including The International Herald Tribune, Newsweek, Financial Times, The Guardian, New York Times, Businessweek, CNN, BBC World Television, CCTV (China), Xinhua, Reuters, Associated Press, and almost all major newspapers in Asia and the Middle East.

www.strategicforesight.com

# THE BLUE PEACE

## Rethinking Middle East Water



This report redefines water as an opportunity rather than a source of potential conflict in the Middle East, and it demonstrates how concrete policy measures can achieve this objective. The recommendations contained in this report provide countries in the region an opportunity to make a new beginning with several different building blocks, which can be built at preferred times, at varying pace and in different locations. Such an approach offers a manageable opportunity to construct the desired future, rather than suddenly facing a new paradigm imposed by nature, climate change, technological breakthroughs, global politics, and new philosophical concepts.

The scope of the report covers seven countries – Israel, the Palestinian Territories, Jordan, Lebanon, Syria, Iraq and Turkey. The report provides detailed scenarios for water availability for each country under different circumstances by 2030. It defines key regional objectives. It not only recommends new policy measures, but also explains how to implement them in a politically viable way.

The report introduces a new form of peace based on mutual stakes in survival and prosperity between different people and also between people and nature – the Blue Peace. In the 21st century, no two countries with abundant supply of blue water will go to a war. Also, countries that actively seek peace and cooperation will be assured of clean water for their people. The Blue Peace will be a key determinant of the new global security architecture and the Middle East can make a beginning.

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