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Water Modeling Technologies: A Key to Unlocking Water Conflict in the Middle East?

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Abstract: Several cases of armed conflict in the Middle East have a root cause in competition over resources, with water being the focus of conflict. Water will increasingly become a critical trigger for future conflict as supplies become scarcer and as population pressures continue to grow. With existing talks between riparian countries surrounding the Jordan River and the Tigris-Euphrates Basins either being absent or ineffective, there is a pressing need to develop a new approach to resolve water issues in the Middle East. In this context, water modeling technologies may offer a new and unique tool for regional discussions.

Keywords: *Middle East water conflict, water modeling, Jordan water crisis*

The Arab Human Development Report (2009) emphasizes the importance of the relationship between resource pressures, environmental sustainability, and human security in the Middle East region. The impact of environmental factors on regional security and stability is increasingly being recognized as a trigger for potential future conflict.

Several instances of armed conflict in the Middle East over the past sixty years have water disputes as a root cause. The region has witnessed thirteen developmental disputes over water since 1950, eleven of which resulted in armed conflict or military maneuvers including, many argue, the 1967 War (Gleick 1993; Wolf 1995). This number reaches thirty-five when counting conflicts where the military target or the military tool was water. An example of the former would be when Israel led two air raids in 1969 to destroy the newly-built East Ghor Canal based on the suspicion that Jordan was over diverting the Yarmouk River. An example of the latter is when Turkey threatened to restrict water flow to Syria in 1990 to force it to withdraw support for Kurdish rebels.

Going forward, the conflict over water will be exacerbated by continued population and demographic pressures, increasing resource consumption, decreasing resource availability, climate change, desertification, and other factors. This will make water the most valuable strategic commodity in the region, far outweighing the importance of oil. This is echoed by Dr. Ismail Serageldin, the Former World Bank Vice President, who said that many of the wars of the 20th century were about oil, but the wars of this century will be about water (Serageldin 1997).

Various experts claim the Middle East has long entered a stage of water poverty, based on available per capita renewable water resources one seventh the worldwide average. It is believed that by the year 2025, three hundred million people in the Arab world will be living under conditions of what the UN defines as "absolute water scarcity" with about 500 cubic meters of water per person per year. To put this in perspective, the US currently uses close to 70,000 cubic meters of water per person per year (Joint Arab Economic Report 2001; Watkins 2006).

What makes the water situation in the Middle East all the more critical is that water resources are spread over several countries, yet the management of these resources are largely national tasks.

The main supply of freshwater in the Middle East for the countries of Turkey, Lebanon, Syria and Iraq are surface water sources while the main supply for the countries of Jordan, Palestine and Israel are ground water resources. The major international rivers in the region include:

1. The Jordan River (including its largest tributary the Yarmouk), shared by, Jordan, Palestine, Israel, Lebanon, and Syria;
2. The Tigris and the Euphrates, both shared by Iraq, Syria and Turkey;
3. The Orontes (or Assi), shared by Lebanon, Syria, and Turkey; and
4. The Nile, shared by ten riparian countries.

For the purposes of this study, the focus will be on the first two. There are also a number of shared renewable ground water aquifers in the border areas between:

1. Syria and Turkey,
2. Israel and Lebanon,
3. Jordan and Syria,
4. Iraq and Syria; and
5. Israel and the West Bank.

Others are non-renewable aquifers containing fossil water:

1. The basalt aquifer beneath Jordan and Saudi Arabia; and
2. Beneath the Arabian Peninsula shared by Iraq, Jordan, and Syria.

On the transboundary level, any disruption in either surface or ground water in any of these countries will have serious implications for other riparian countries. Although both the quantity and quality of water is affected by any disruption, the focus of this study will be on the quantity.

The inability of any one country to effectively manage its water resources in isolation from other riparian countries has resulted in the establishment of formal agreements on the management of shared water resources. However, none have resulted in the creation of mechanisms for shared management that are considered to be comprehensive and equitable. The main reason is that cooperation remains heavily influenced by prevailing political conditions. Existing mechanisms to discuss water issues are either seen as confidence building measures, negotiating platforms, or places where technical grievances can be aired, but rarely resolved.

The use of modeling and simulation technologies has been a hitherto overlooked concept in Middle East hydro-politics. These could offer decision-makers with a new and additional tool, as well as approach, to accelerate joint understanding of resource issues and herald cooperation on joint basin management. System dynamics modeling approaches have been emerging as a key management tool addressing transboundary water issues, first in the United States, and now elsewhere. These models can assess multiple future population growth estimates, resource demand and resource management scenarios surrounding a river basin, and evaluate the costs and benefits of different approaches to manage that basin. The models with short run times allow users to simulate many alternative resource management strategies in short periods, making the models valuable for substantive discussions and for informing and educating stakeholders, policy makers, and citizens. Successfully completed model realizations allow stakeholders to thoroughly evaluate the long-term consequences of competing resource management strategies. The completed model allows stakeholders to:

> Evaluate in a rigorous way the long-term consequences of competing resource management strategies. The collaborative discovery process associated with this work, the insight gained by the stakeholders and the modelers, and the model results themselves all combine to assist in the development of strong, scientifically-derived resource management plans, often with a greater degree of consensus among stakeholders than might otherwise have been achieved (Pasell et al. 2010).

The unique characteristic of modeling technologies as apolitical, non-ideological, and science-based tools make them well-suited for the Middle East. The Royal Society in the United Kingdom has focused extensively on the role that scientific communities and technological tools can play in furthering stability in zones of conflict.

The uniqueness of what the Royal Society refers to as "Science Diplomacy" is that it is difficult, if not near impossible, to replicate the universality, transparency, and rationality of scientific values in the political context. Just as importantly, the Royal Society also concludes that establishing and nurturing links between the scientific and foreign policy communities informs scientists and policy makers alike: the former about the realities of policy making; and the latter about the role and limits of science in policy (The Royal Society 2010).

Publicized Use of Systems Dynamics Modeling

A pioneering case for modeling technology began over ten years ago by Sandia National Laboratories and resulted in the creation of a resource model to assist in community-based planning for a three-county region centered on the Rio Grande in New Mexico. Population growth and drought had been main factors contributing to the decision of the Rio Grande community to mobilize and develop a solution to balance their water supply with the pressing demands of a wide range of stakeholders. Coupled with the wide seasonal variation and the semi-arid region, these conditions seem in fact quite similar to the Middle East. The model sought to provide a quantitative basis for comparing alternative water conservation strategies in terms of water savings and costs; to help the public understand the complexity of the regional water system and to engage the public in the decision-making process. The latter was seen as a key factor to the success of this effort.

Construction of the model began in January 2002 and working versions of the model were released and applied to the regional planning process in spring and summer of 2003. While Sandia National Laboratories were responsible for developing the model within the system dynamics framework, organizations from the community were responsible for ensuring that the views of the public and key constituency groups were represented and academic institutions were involved to facilitate group discussions (Tidwell et al. 2004). Selection of the appropriate architecture for the planning model needed to integrate the disparate physical and social systems important to water resource management, while providing an interactive environment for engaging the public (Tidwell et al. 2004).

The result was a PC-based system dynamics model that could generate simulations in less than 10 seconds using sixty-six variables to simulate combinations of hydrological, economic, or demographic conditions. This interactive modeling platform allowed users to visualize problems and their potential solutions and develop different management strategies for each. It could also take into account a variety of new fictional developments into the simulations.

This tool eventually assisted decision-makers and other stakeholders to prepare a 50-year water plan for the Rio Grande River Basin. Discussing the case of the Rio Grande is not meant to diminish from the particularities of Middle East water conflicts. There are many factors in the Middle Eastern context, such as the recent history of conflict and the primacy of ideological politics, that are entirely absent in the case of New Mexico. The discussion of this case is merely meant to illustrate that the technological tools that would allow for joint management over regional river basins are available should the political will also be available and should the prevailing political conditions also allow for it.

Middle Eastern Cases Where Modeling Could Be Used

The Jordan River Basin

The Jordan River is a good example of the complexity of transboundary water issues in the Middle East as it is shared by five countries that have historically been at conflict (Figure 1). Despite the projections that the Jordan River is expected to drop by 80 percent by the end of the century as a result of both climate change and overuse, there is still no basin-level cooperation for its joint management or use (Brown et al. 2009). Excessive dam building and diversion has severely depleted the amount of water flowing in the River and its main tributaries. The future of the Jordan River is also affected by the currently negligible flow of water from Lake Tiberias, also called Sea of



Figure 1. The Jordan River and its feeder rivers are effectively shared by Lebanon, Syria, Israel, Jordan and Palestine (modified from http://en.wikipedia.org/wiki/File:JordanRiver_en.svg).

Galilee, which is subject to the continued conflict between Syria and Israel. In the 1960's the flow of the Jordan River at the Dead Sea was measured at 13,000 million cubic meters (MCM) annually. Today, the flow measures about 100-200 MCM in a wet year and about 10 percent of that in a dry period (Waslekar 2011). Overuse of some parts of the Zarqa River (a tributary located in Jordan) has reduced base flows into the Jordan River to such an extent that most of its summer flow is comprised of treated wastewater.

Likewise, flows of the Yarmouk River (which originates at the border between Jordan and Syria) have decreased by 80-90 percent over the past ten years mostly due to Syrian over-extraction and dam construction (Waslekar 2011). The complexity of the water situation is exacerbated by other political calculations. As a Syrian decision to increase the flow of water of the Yarmouk River will help Jordan but, would also be favorable to Israel, the river has at times been one of several pressure tools for Syria in its broader negotiations with Israel on any number of other topics. The same is also true of Syria's use of the Yarmouk vis-à-vis Jordan.

Jordanian-Syrian discussions on water have not had a positive track record. In 1987, Jordan and Syria signed an agreement that determined the division of water between the two countries, specified the number of ditches that could be built along the river and proposed a joint dam (Treaty Series 2001). At the time, Jordan's share was set at 300 MCM. Presently, Jordan receives only 50-100 MCM. Since the time of the agreement, Jordan has complained that Syria has set up more than 40 dams, ditches, and pumping facilities to store water along the river. Jordan and Syria have regularly disagreed over these figures as well as the amount of Syrian water being extracted for use. A Jordanian initiative spearheaded in the 2006 period led to an agreement to geologically study the Yarmouk Basin. Terms of reference were developed for a Jordanian and a Syrian company to jointly conduct the study as a means to avert disagreement. For reasons believed to be motivated by other regional political considerations, Syria rescinded on this agreement, claiming that the basin could not be studied in its totality because an important part of it was under Israeli territory. Given that Jordan and Syria are estimated to jointly cover 90 percent of the Basin, the Jordanian suggestion was to model the remaining 10 percent. This was the first such mention of modeling tools in bilateral discussions on water. Syria rejected the proposal and blocked Jordanian technical teams from installing recorders in Syria to verify Syria's data (originally seen as a confidence-building measure). Syria was also against the existence of direct channels of communication and cooperation between the two companies that were meant to prepare the basin study.

Since the conclusion of separate Palestinian-Israeli and Jordanian-Israeli peace treaties in 1993 and 1994 respectively, the three sides have established consultative mechanisms to discuss water issues. In January 1995, the Executive Action Committee Team (EXACT) was born out of multi-lateral working groups that were formed to advance the Middle East Peace Process. Supported by the governments of the United States, European Union, Canada, and France, the Committee meets twice each year to plan, coordinate, and direct

project implementation and to share information and keep dialogue open regarding shared water resources (EXACT online portal). Although there has been a genuine willingness on all sides to address water issues, the results have been at times mixed. One success of EXACT has been the Water Data Banks Project that consists of a series of specific actions to be taken by each party to foster the adoption of common, standardized data collection and storage techniques, improve the quality of the water resources data collected in the region, and improve communication among the water experts in each country (EXACT online portal). The project's goal to enable the exchange of consistent, compatible, and reliable water data and information to support decision-making at both local and regional scales is an important starting point for substantive discussions on water. There is an understanding that addressing capacity gaps, improving data, and harmonizing practices are vital; they are only the foundation through which there can be more substantial joint water management in the future. Water discussions between all sides are still heavily influenced by political developments, foremost amongst them is the Palestinian-Israeli peace process. The absence of a long-lasting and genuine peace between Palestine and Israel and the lack of progress on the establishment of an independent Palestinian state make any cooperation between Jordan and Israel difficult, let alone the cooperation between the Palestinian Authority and Israel.

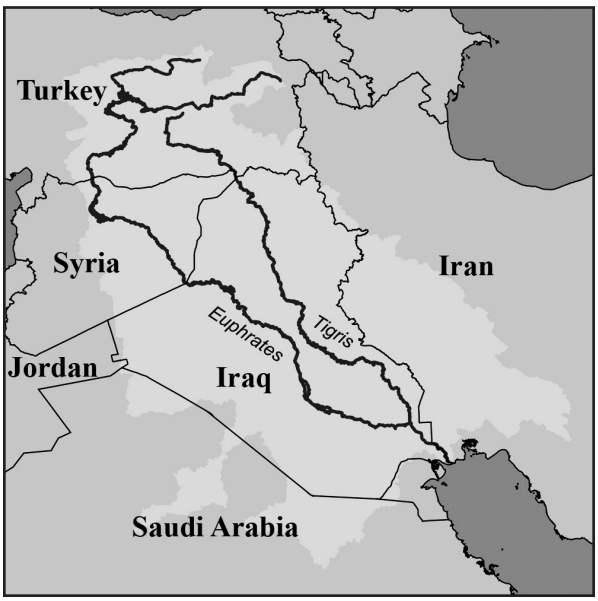


Figure 2. The Euphrates and Tigris originate in Turkey. While the Euphrates flows continues through both Syria and Iraq, the Tigris flows through Iraq only (modified from http://en.wikipedia.org/wiki/File:Tigr-euph.png).

The Euphrates-Tigris Basin

Turkey, Syria, and Iraq all share the Tigris-Euphrates Rivers that originate in eastern Turkey and flow southwards into the Arabian Gulf passing through Syria and Iraq (see Figure 2). The rivers are connected when they merge at the Shatt al-Arab in Iraq. The waterways have long been a source of contention and conflict between the three countries.

The long-term flows of Tigris and Euphrates is declining on account of natural, as well as man-made, factors. The Euphrates River may shrink by 30 percent by 2100 on account of climate change only. There are 32 major dams on the Euphrates and Tigris, with 8 under construction and 13 more planned (Brown et al. 2009). As a result, total storage of dams on the Euphrates is five times its average annual flow with a projected deficit of 2-12 billion cubic meter (BCM) by 2020 if all plans are realized and a surplus of 8-9.7 BCM in the Tigris (Waslekar 2011).

Syria and Iraq have long argued that Turkey's various implemented and planned development projects, including the ambitious 21-dam South-Eastern Anatolia Project (UNEP 2008), have already, and will further, decrease the flow of water running from Turkey to Syria. This in turn would have a direct impact on water agreements between Syria and Iraq over the Euphrates. The project consists of 21 large dams and a price tag of more than $20 billion. Turkey currently has 2000 dams and water projects, of which the largest 260 dams have a storage capacity of 140 BCM (Waslekar 2011).

As with the earlier case, there is also a great amount of contradictory data from each country about the extent of irrigated land, current and projected demand, and economic and industrial development. Turkey claims that both Syrian and Iraqi water needs are overestimated and claim bad management and water loss in both countries is

at the root of their problems. Turkey also maintains that both rivers are sovereign rights of Turkey, as President Suleyman Demirel said during the inauguration of the Ataturk Dam, "Neither Syria nor Iraq can lay claim to Turkey's rivers any more than Ankara could claim their oil. This is a matter of sovereignty. We have a right to do anything we like" (Bulloch and Darwish 1993).

While several bilateral and trilateral meetings have been held, no formal agreements have been reached. A Joint Technical Committee (JTC) between Turkey and Iraq was established in 1980, which Syria joined in 1983. The JTC held sixteen meetings over a decade but did not fulfill any of its objectives. In 1987, an agreement between Turkey and Syria guaranteed the latter a minimum flow of the Euphrates of approximately 15.7 BCM per year or 500 m/s (United Nations Treaty Collections). As per a previous agreement, Syria is obliged to allow about 9.2 BCM to Iraq, leaving 6.7 BCM for its own use. Since the construction of the Ataturk Dam, Syria has accused Turkey of violating this agreement and allowing less water to flow downstream and has supported Kurdish rebels to place pressure on Turkey (Jongerden 2010; Kinzer 1999).

More recent cooperation has proved more fruitful. In 2007, at the behest of Turkey, the three countries agreed to reinstate the JTC meetings which had stopped since 1992. At the first such meeting, numerous areas were defined for cooperation, but most rested on information sharing. The greatest instance of cooperation came in 2009 when an agreement was reached to set up joint measurement stations on the Tigris and Euphrates rivers to track the flow and condition of the river (Joint Statement meetings 2009). This has been a monumental step in the cooperation between the three countries; however, the results of the agreement are yet to be seen. Skeptics believe that the agreement was largely ad hoc and in response to the prolonged drought that Iraq had been witnessing that season.

How Modeling Technologies Can Help

Existing water discussions in the Middle East are for the most part short-term in nature in that agreements are ad hoc and crisis-driven. Even when there is some level of longer-term discussion, as is the case between Jordan, the Palestinians, and Israel, the discussion is not yet at the point where it is basin-level. This is primarily because all three sides likely see that there is little sense in begining such an endeavor when a number of basin countries are not represented. Systems dynamics modeling tools allow for countries already engaged in meaningful discussions to begin such talks using simulated data in lieu of the missing data. At worst, this will raise capacity and awareness about these technologies in anticipation of a time when a greater number of basin countries will be represented in some form or another.

One of the reasons why the system dynamics model is suitable for the Middle East is that it is stakeholder driven. In the context of Middle Eastern hydro-politics, this means that the model will be able to represent the various, at times contradictory, data presented by each country. As the cases of the Jordan River and Euphrates-Tigris Basins illustrate, riparian countries regularly claim drastically differing and contradictory data about their water situation, usage, and needs. At times, contradictory claims can simultaneously be true because countries can focus on data collected in a particular season and/or location to support their claim. System dynamics models are able to adjust for this occurrence by allowing for all data to be incorporated and represented in scenario building. This would lead to a radical shift in the existing discussions on water away from accusations about accuracy and towards projections built around each version of the "truth." The purpose of eliminating the issue of data provenance would inform policy-makers about the impact of their own activities, whether real or fabricated, on the larger picture. This tool would also work where there is data secrecy on water issues, as is the case in Syria.

There is also chance that system dynamics models will encourage the region to shed the zero-sum formulation that has characterized discussions on water in the region. A concept of collective security can only be established when water discussions begin to focus on the basin-level. This is because basin-level discussions inherently suggest a longer-term view of water. This could have the impact of discouraging countries from pursuing shorter-term gains at the expense of longer-term costs. In a sense, whether Syria is genuinely

extracting its share of the Yarmouk or well above it becomes less relevant than a simulation illustrating that current practices will render the entire basin unusable in a given number of years.

Even in cases where conflict is ongoing, as in the Syrian-Israeli case, systems dynamics modeling can encourage some level of understanding without the need for direct talks. As Lake Tiberias is a joint and important resource for all riparian countries, the shared interest in preserving it needs to be enacted in some way. Should Syria and Israel separately use the same systems dynamics modeling tools, it could be the only way in which the Tiberias could be managed in the absence of direct talks.

The Euphrates-Tigris Basin illustrates that there is a need for greater democratization in resource planning between upper riparian countries like Turkey on the one hand and lower riparian countries like Syria and Iraq on the other. This is possible when systems dynamics modeling tools are used because each country will have access to the same tools and no one country will be able to dictate a best course of action. Technology of this sort levels the playing field and decreases instances where weaker states are coerced into unfavorable and unsustainable agreements.

Adopting modeling technologies in water discussions in the Middle East will play an important role in raising awareness of the complexity of regional water issues among the general public. Currently, the general public in most Middle East countries are unaware of the seriousness of their own water situation and also of the extent to which the solution depends on the success of regional cooperation. A broader discussion about the basin-level issues in the region using modeling tools can be an opportunity to educate the public on both of these issues. Extremism and ideological politics are on the rise in the region and tools of this sort could serve to instill a sense of realism and pragmatism in dealing with neighbors, whether Arab or Israeli, as the models are science-based and rooted in fact. What the general public does not seem to recognize is that even the most ardent of adversaries need to depend on each other (or reach unspoken understandings) on issues like water for survival. Adopting a stakeholder driven model will allow civil society to play a greater role in these discussions and will take away the burden on governments to reach solutions on these issues alone.

Finally, the adoption of such integrated modeling tools can offer the region a more comprehensive view of water as it relates to a wider range of socio-economic issues. In the case of Jordanian-Israeli-Palestinian talks, for instance, there has been, to a certain extent, some level of stove-piping when examining water issues in isolation of other issues such as energy or public health. For instance, His Royal Highness Prince Hassan Bin Talal of Jordan has long called for an energy/water nexus as the building blocks of a new Middle East. In his proposal, the parallel is drawn to the role that coal and steel played in stabilizing post-war Europe (NATO Defense College 2010). Should this type of thinking prevail, modeling tools would be needed because they can incorporate as wide as needed a range of inputs. This type of tool could also be used to prioritize investment opportunities or weigh the environmental and social impact of some water schemes. The use of such modeling tools in the Jordanian-Israeli-Palestinian context would reemphasize the importance of technology in the three-legged stool that also includes people and processes as the two other legs.

Conclusion

The Middle East has witnessed tumultuous changes in 2011 and 2012. It is still unclear whether these changes will yield long-lasting positive results. No matter what the outcome, water will remain a persistent and common problem requiring a common solution by all countries in the region. Water modeling technologies could very well be the common solution that would lay the foundation for future joint basin management. Adopting such innovative solutions can reduce the threat of water scarcity and simultaneously contribute to prosperity and peace. While peace is needed for cooperation in water, a collaborative and sustainable approach to water management can build peace. This change in paradigm – from viewing water as an obstacle to viewing water as an opportunity – is the subject of the most exhaustive regional study of water conducted by the Mumbai-based Strategic Foresight Group. The best chance to create that change in paradigm is through water modeling technologies.

Water modeling tools are not predictive tools and should not be resisted because of this concern. All regional countries can stand to benefit from their adoption. The tools are instructive in nature and will allow for a roadmap and commonality of approach in resolving the water issues that have afflicted the region for so long.

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Al-Sharif Nasser bin Nasser is the Managing Director of the Middle East Scientific Institute for Security (MESIS) based in Amman, Jordan. In this position, Mr. Nasser focuses on developing and implementing regional and national training programs in the areas of energy, environment and borders with a specific focus on non-proliferation issues. He also works to raise awareness on critical issues by creating a neutral space for scientific communities to interact and discuss shared vulnerabilities and opportunities across the Middle East region.

Nasser is also the first director of the European Union's soon-to-be-inaugurated Regional Centre of Excellence on CBRN issues located in Amman, Jordan which will serve five Arab countries.

Prior to that, Nasser worked in the office of His Majesty King Abdullah II of Jordan where he last served as Senior Analyst in the Foreign Affairs Directorate. During that time, he managed several bilateral and thematic files and led analytical studies on Jordan's regional and international relations.

Nasser is also involved with numerous organizations. He served as the Chairman of a leading insurance company in Jordan, and currently serves as the Vice-Chairman of a public national commission offering support to injured and disabled veterans as well as the President of a charity that offers therapeutic riding services to children with special needs.

He received his master's degree in Near Eastern Studies from Princeton University and his undergraduate degree in Environmental Science and Policy and Business Management from Clark University in Worcester, Massachusetts. Nasser is also the chair of the Princeton alumni committee in Jordan. He can be contacted at shnasser@mesis.jo or Middle East Scientific Institute for Security (MESIS) P.O. Box1438 Amman 11941, Jordan.

References

Arab Human Development Report. 2009. Challenges to Human Security in the Arab Countries. *United Nations Development Program*; Regional Bureau for Arab States. United Nations Publications: New York.

Brown, O. and A. Crawford. 2009. *Rising Temperatures, Rising Tensions: Climate change and the risk of violent conflict in the Middle East.* International Institute for Sustainable Development: Winnipeg.

Bulloch, J. and A. Darwish. 1993. *Water wars: Coming conflicts in the Middle East*. Gollancz: London.

Gleick, P.H. 1993. Water and conflict: Fresh Water Resources and International Security. *International Security* 18: 79-112.

HRH Prince El Hassan. 2010. Supranational Security and the Energy Ellipse. Speech at NATO Defence College, Rome.

Joint Arab Economic Report. 2001. Arab Monetary Fund, Arab Fund for Economic and Social Development, League of Arab States and Organization of Arab Petroleum Exporting Countries (in Arabic): Cairo.

Joint Statement of the First Meeting of the High Level Strategic Cooperation Council Between the Syrian Arab Republic and the Republic of Turkey, Damascus, December 22-23, 2009. Available at: http://www.mfa.gov.tr/turkiye---suriye-ydsik-1_-toplantisi-ortak-bildirisi_-22-23-aralik_-sam.en.mfa.

Jongerden, J. 2010. Dams and Politics in Turkey: Utilizing Water, Developing Conflict. *Middle East Policy* XVii, no. 1, Spring: 137-148.

Kinzer, S. 1999. Where Kurds Seek a Land, Turks Want the Water. *New York Times*.

Passell, H., M. Reno, J. Roach, V. Tidwell, and W. Khairy. 2010. Collaborative, Stakeholder-Driven Resource Modeling and Management. In *Handbook of Research on Hydroinformatics: Technologies, Theories and Applications*. T. Gamelseid (Ed.) IGI Global Press: Hershey: 37.

The Royal Society. 2010. New Frontiers in Science Diplomacy: Navigating the changing balance of power. London.

Serageldin, I. 1997. Water Diplomacy and the 21st Century: From Conflict to Cooperation. Associated Event of the Fifth World Bank Conference, Washington, DC, 10 Oct. 1997.

Tidwell, V., H.D. Passell, S.H. Conrad, and R.P. Thomas. 2004. System dynamics modeling for community-based water planning: Application to the Middle Rio Grande. *Aquatic Sciences* 2004: 357-372.

Treaty Series: Treaties and international agreements registered or filed and recorded with the Secretariat of the United Nations Vol. 1870 I Nos. 31875-31939: *United Nations Treaty Collections* 279-297.

United Nations, Syrian Arab Republic and Turkey: Protocol on Matters Pertaining to Economic Cooperation Signed at Damascus on 17 July 1987 Vol. 1724, 1-30069: *United Nations Treaty Collections* 3-8.

United Nations Environment Programme. 2008. Vital Water Graphics: An Overview of the State of the World's Fresh and Marine Waters 2nd Edition. United Nations Environment Programme.

Waslekar, S. 2011. The Blue Peace: Rethinking Middle East Water. Strategic Foresight Group: Mumbai.

Watkins, K. 2006. Beyond scarcity: Power, Poverty and the Global Water Crisis. United Nations Development Program. *Human Development Report*. Palgrave Macmillan: New York.

Website Maintained by the Executive Action Team (EXACT), the Multilateral Working Group on Water Resources and Water Data Banks Project, Available at: http://exact-me.org/index.htm.

Wolf, A.T. 1995. *Hydropolitics Along the Jordan River: Scarce water and its impact on the Arab-Israeli conflict*. United Nations University Press: New York.