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Water Politics In The Middle East A Multicase Approach To Regional Water Shortage

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WATER POLITICS IN THE MIDDLE EAST:
A MULTICASE APPROACH TO REGIONAL WATER SHORTAGE

by

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ABSTRACT

Water shortage is a salient issue in the Middle East commonly overshadowed by more sensational topics such as the oil crisis and the Arab-Israeli Conflict. There is a debate among scholars as to whether water shortages in the Middle East will destabilize the region into armed conflict. Realists argue that non sustainable water sources will be the catalyst which will inevitably lead states to fight one another in a zero-sum game over limited water resources. Liberal Functionalists argue that there are precedents for multilateral cooperation and a technical approach may hold the key to providing solutions to the current water crisis. This research will examine three case studies from the Middle East region: the Jordan River Basin, the Tigris and Euphrates River Basin, and the Disi Aquifer on the border of Jordan and Saudi Arabia. Limited to a specific geographic region, these cases are indicative of water shortages that have or will become potential geostrategic centers for the water crisis.

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TABLE OF CONTENTS

LIST OF FIGURES

UNITS AND CONVERSIONS FACTORS

Units of water

mcm	million cubic meters
bcm	billion cubic meters = 1,000,000,000 m^3 = 1 km^3
ppm	parts per million
m^3	cubic meter (1 cubic meter = 1,000 liters)
m^3/p/year	cubic meters/person/year
mg/l	milligrams per liter

Units of land

1,000 m^2	= 0.10 hectare = 0.247 acres
1 km^2	= 100 ha = 1,000,000 m^2

Source: (Allan J. , Water, Peace and the Middle East: Negotiating Resources in the Jordan Basin, 1996)

PART I: THE WATER SHORTAGE CRISIS

CHAPTER 1: OVERVIEW AND LITERATURE REVIEW

Water shortage is a worldwide phenomenon. However, the water crisis in the Middle East is not only an environmental concern but a critical issue that influences political stability in the region. Most water sources are shared amongst more than one riparian, defined "as a person [or state] who owns land on the bank of a natural watercourse or body of water."[1]

The water shortage in the Middle East is caused by several factors. An inequitable allocation of water resources, poor water resource management, and increasing water demand as a result of overpopulation are among several reasons for the water shortage. Other variables which affect the water supply: ecology, water resource mismanagement, overpopulation, rising industrial and agricultural demands, consumer overconsumption, and preexisting interstate relations.

International law regarding these shared water sources often fails to protect states' water rights. Upstream states will often employ the doctrine of absolute national sovereignty in order to secure more water for their own interests. Downstream riparians protest in favor of the doctrine of absolute national integrity "according to which lower riparians are entitled to unaltered water volume and quality." (Libiszewski, 1994) It is not surprising that conflicts over water inevitably arise especially in a region where water is naturally scarce.

From these two doctrines, two opposing perspectives can be inferred. The *doctrine of absolute national sovereignty* is grounded in realist principles of self help and self interest. Competition over scarce resources leads headwater states to siphon water away from their

[1] http://dictionary.reference.com/browse/riparian

downstream neighbors. The *doctrine of absolute national integrity* on the other hand operates under the assumption of the existence of a mutually beneficial governing body of international law which protect states' access to water. The doctrine of absolute national integrity is quintessentially the liberal antithesis to the realist doctrine of absolute national sovereignty.

Hence, this research endeavors to analyze the water situation in the Middle East using the competing perspective of realism versus liberalism, or rather neorealism versus liberal functionalism. Classical realism assumes that conflict is rooted in the selfishness and competitiveness of human nature. Neorealists argue that the absence of legally binding international law is what allows competition and conflict to take place.

Functionalism is found in the Liberal Institutionalism or neo-liberal institutionalist school of thought. Functional integration theory became relevant during the cold war era and would later become instrumental in European integration (Smith, 2005, p. 213). David Mitrany was the founder of the functional approach to international relations. In his treatise *The Functional Theory of Politics,* Mitrany outlined the process in which regional integration could be made possible. In lieu of framing a constitution and expecting states to relinquish part of their sovereignty outright, the functional approach was a gradual process that began with limited international cooperation on transnational issues. Technical expertise would be employed and the success from such transnational projects would lead to further cooperation on other transnational issues, a process which Mitrany termed "ramification." (Griffiths, 1999, p. 191)

Will the water shortage in the Middle East ultimately lead to conflict? Realists argue that self interest and the lack of international law will make conflict very likely. However, liberal functionalists, on the other hand are optimistic that cooperation is mutually beneficial and as a

result, states can be motivated to cooperate. In this study, the dependent variable is the presence of conflict over water. This is defined as military confrontation or formal complaint from one state to another. The independent variables consist of: 1) nature or severity of water scarcity 2) state's national interests in regards to water usage; and 3) bilateral relations amongst riparians.

Using these variables several hypotheses are constructed. The first hypothesis: as water scarcity increases, conflict is more likely to occur. The second hypothesis: state's national interests in regards to water usage will influence states' decision to cooperate with other states on water issues. The third hypothesis: preexisting bilateral relations amongst riparians will influence states' decision to cooperate with other states on water issues

Theoretical Significance

Mitrany's utilitarian approach to international cooperation yields a practical policy approach for addressing the water crisis in the Middle East. Implementing a functional approach in interstate relations to solve the water problem would allow states to evade the task of creating a bureaucracy and immediately address the problem at hand. Joint projects would foster communication and possibly encourage more cooperation in the future, or it is hoped. This may gradually allow Middle Eastern states to transcend their adversarial relationships and gradually ease mutual security disputes.

Mitrany's work evokes the larger issue of supranationalism. Supranationalism is defined "as a concept in integration theory that implies the creation of common institutions having independent decision making authority and thus the ability to impose certain decisions and rules on member states." (Smith, 2005, p. 580) Ernst Haas, a critic of functionalism, also believed that

cooperation on what he called ‘low politics’ on such areas as trade barriers should be the initiative before cooperation on ‘high politics’ is possible. (Griffiths, 1999, p. 181)

Literature Review

Miriam Lowi’s Water and Power: The Politics of a Scarce Resource in the Jordan River Basin

Lowi’s Water and Power: The Politics of a Scarce Resource in the Jordan River Basin describes the Middle East region as having a long history of water conflict. According to Lowi, there are several precedents for water conflict in the Middle East and this history has left behind a “legacy of using violent methods to resolve water disputes.” (Morris, 1996) Over half of the population of the Middle East relies on water shared by neighboring states. For this reason, water “has profound significance in terms of security and economics and a primary focus of resource competition.”

Applying both realist and liberal schools of thought, Lowi investigates why states reject the notion of cooperation and what incentives might convince states to cooperate. Her findings suggest “that cooperation does not necessarily emanate from acknowledgment of one’s best interests and that states in dominant positions do not feel the necessity to cooperate if the situation favors them.” (Morris, 1996) For instance, the dispute over water sharing in the Tigris and Euphrates River water system between Turkey, Syria, and Iraq demonstrates the reluctance for dominate players to acquiesce to their downstream neighbors complaints for more water:

> Turkey has threatened to cut the flow of Euphrates water to Syria because of alleged Syrian support for Kurdistan Workers’ Party activities in southeastern Anatolia.

> Additionally, Turkey argues that since Syria and Iraq continue to use ancient open-canal irrigation techniques, leading to large losses from evaporation, the criteria of rational use rather than strict equal sharing should be the basis for usage of the Euphrates River basin. As Turkey is the both the upriver state and the most powerful of the three, its interpretation has prevailed. (Morris, 1996)

Often, conflict over water is but one aspect of a larger conflict. Lowi asserts that cooperation may prevail notwithstanding the overlaying political conflict when: "(1) the water conflict rises higher on the threat scale, and (2) the dominant power in the conflict takes the lead in enforcing a cooperation regime." (Morris, 1996) However, water shortage can be ideologically charged. According to Zionist ideology, a secure source of water was necessary for agriculture which was the means by which Israel would establish a presence in the Middle East. For Palestinians, the shortage of water threatened both their livelihood as farmers and hence their ability to remain on their land. As a result, "both sides saw land and water issues as a zero-sum game, with each as the other representing a threat to their very existence." (Morris, 1996)

Lowi discredits functional solutions by pointing to two failed functionalist efforts. In the 1950s the Johnston Plan and then the Maqarin Dam scheme of the 1970s demonstrated that "the political costs of cooperation outweighed the resource benefits that could be derived." (Morris, 1996) When both sides realized that cooperation would strengthen the other, then negotiations failed.

According to functionalists, cooperation in the norm. They therefore do not have a thorough explanation for why states do not cooperate. Increased cooperation is the result of increased economic and social interdependence. States should consider each other as allies not

enemies. Hence, “the liberal’s analyses are prescriptive: they suggest how cooperation can be achieved, not why it is rejected.” (Lowi, 1995, p. 4)

Neoliberals recognize that a compliance problem exists. With no agency to enforce international law, agreements between states are unreliable. States, therefore would stand to gain much from following their own agenda. Borrowing from realism, neoliberals see the compliance problem as a major impediment to cooperation. The anarchy of the system creates uncertainty, “the costs of verifying compliance and sanctioning cheaters would be very high.” (Lowi, 1995, p. 4)

According to realists, cooperation is not the norm and so realists fail to provide an explanation as to how states can be encouraged to cooperate. Although cooperation does happen, realists see it as a pretense for establishing power and domination. Therefore, the likelihood of cooperation is determined by the balance of power. The theory of hegemonic stability “states that order in world politics is dependent upon the leadership of a single dominant power and that the maintenance of order requires the persistence of hegemony.” (Lowi, 1995, p. 5) Hence, cooperation happens when it serves the interests of the hegemonic state.

Liberals on the other hand, have written at length on how to achieve cooperation. In order to encourage cooperation, the payoff structure must be altered to be more conducive to cooperation. This would entail increased focus on non governmental organizations such as “specialized agencies, interest groups, transgovernmental policy networks, multinational corporations, and epistemic communities.” (Lowi, 1995, p. 5)

Following World War II, functionalists claimed that peace would be achieved if “power politics was checked, national sovereignty sacrificed, and efforts made toward material unity in

an increasingly interdependent world." (Lowi, 1995, p. 5) This would be achieved by the creation of supranational organizations aimed with the task of bypassing ideological issues in an effort to unify states economically through a shared international body.

Cooperation would result from a process called "spill over" in which integration in less controversial areas would spread to cooperation in more contentious issues. Increasing cooperation in economics, technology, and welfare would bind governments and encourage states to set aside their ideological differences.

Neofunctionalists were less idealistic than functionalists. They acknowledged the difficulty in separating welfare from politics. Spillover was not automatic and the decision to cooperate was influenced by the values and ideology of the decision makers. According to the neofunctionalists the opportunity for individual gain, coupled with the perception that cooperation would be cost free is a major incentive for states to cooperate.

Neoliberals do not take for granted that cooperation is difficult to achieve. Cooperation on economic and welfare issues is more feasible than military and security issues. Neoliberals further state that three conditions must be met for states to consider cooperation as a viable option: "states must have mutual interests; they must stand to gain from their cooperation. Second, variations in the degree of institutionalization account for variations in state behavior. And third, states do not expect others to threaten them with force." (Lowi, 1995, p. 6) If there is no mutual interest, states will be less likely to cooperate.

Neoliberals agree with realists that anarchy discourages states from cooperation. This is because the uncertainty of the international system leaves states to cooperate. However, international organizations create the sense of security needed to encourage states to trust each

other. The norms and patterns of behavior typified by these institutions create a sense of trust among states necessary for interstate relations.

Not fulfilling commitments is punished by cognitive. Hence, “a direct connection is thus established between a state’s present behavior and anticipated future benefits.” (Lowi, 1995, p. 7) This reciprocity must be continuous in order to be successful. This echoes the concept of spill over. Whereas, cooperation will spread only if it continues uninterrupted.

Assuming epistemic communities are responsible for promoting and regulating cooperation, how can more of these institutions be established? How precisely do they promote cooperative agreements? Neoliberals claim that “a hegemonic state or group of states supply institutions when it sees a potential profit in organizing collaboration.” (Lowi, 1995, p. 7) Economic reasons also provide a motive for states to cooperate with other states.

Lowis’ Water and Power analyzes water conflict through the comparison of the competing realist and liberal perspectives. She also uses rational and extended game theoretical models of political behavior in addition to what she terms a hegemonic theory of cooperation. Her realist take on the water conflict focuses on “history, culture, and ideology.” (Lowi, 1995, p. 8)

As far as resource literature is concerned, realism and liberalism are competing theories which seek to answer two questions: 1) why do states reject cooperation when it seems in their best interest and, 2) what would motivate states to cooperate in the first place? Liberal institutionalists advocate the creation of a unitary administrator of water basin resources. In fact, the US government tried to implement functionalist objectives twice in the Jordan River Basin, both with unsuccessful results.

Lowi argues that politics can not be separated from the practical issues of water resource issues. According to her, "when a dispute over water resources is embedded in a larger political conflict, the former can neither be conceived of as a discrete conflict over a resource, nor be resolved as such. The riparian dispute in a protracted conflict setting is not simply about water; it takes on many of the attributes of the interstate conflict. Indeed, the parties involved view the riparian dispute and the political conflict as one and the same." (Lowi, 1995, p. 9)

Lowi emphasizes the distinction between "high" and "low" politics. She argues that states which have unresolved disputes in "high" politics will be less likely to cooperate on "low" politics. Since cooperation is often "impeded by the persistence of political rivalry," resolution of political rivalries must be achieved before functional cooperation is possible. For example, an informal agreement between Israel and Jordan from 1956 to 1963 made it possible for the establishment of "a few delimited cooperation arrangements in highly specific technical matters of mutual concern." (Lowi, 1995, p. 9)

Moreover, states will be more likely to cooperate in certain situations than others. States which are heavily dependent on the water resource in question will be more motivated to cooperate. Secondly, cooperation is more likely to occur if, according to hegemonic theory, the regional hegemon stands to benefit from such cooperation. Realistically, upstream states have less incentive than downstream states to cooperate for the very reason that they control the headwaters.

Literature on Integration Theory

The issue of water shortage entails more than just the technical logistics of making more water available to people. It includes the theoretical work of integration theorists such as Karl W. Deutsch, Ernst Haas, Robert Keohane, David Mitrany, John Ruggie, and Alexander Wendt. Deutsch, Mitrany, and Haas focused on integration, particularly the integration of Europe into what would later form the European Union. Mitrany, as aforementioned, formulated the theory of functionalism which sought to erode state sovereignty by building bridges of international trade and interdependence. Haas, a critic of Mitrany, argued that work towards transnational issues could not be solved without the involvement and coordination of state elites. Deutsch coined the term 'security community' as "the framework of relations among states in particular regions." (Griffiths, 1999, p. 175) Ruggie and Keohane were more concerned with global integration. Wendt broke with the realist and liberal debate and reinterpreted integration theory through a constructivist framework.

Karl Deutsch characterized regional cooperation as either amalgamation or integration. Amalgamation centers on a supreme decision-making centre whereas integration involves the confluence of several states to form a 'pluralistic security community'. This 'pluralistic security community' would make the likelihood of armed conflict remote. According to Deutsch, "integration and amalgamation overlap, but not completely." (Griffiths, 1999, p. 178) Amalgamation requires the imposition of states to a supreme decision making body therefore Deutsch felt the establishment of pluralistic security communities was preferred over amalgamation.

Ernst Haas sought to amend what he saw as the shortcomings of functionalism and advanced his own integration theory called neofunctionalism. Unlike Mitrany, Haas was incredulous that technical issues could be separated from politics. Therefore, he contended formal institutions were necessary to oversee the technical aspect of transnational cooperation. These institutions would be more efficient if they operated autonomously from these nation states. Hence, states would inevitably tradeoff part of their sovereignty in order for the transnational institution to be successful. (Griffiths, 1999, p. 183)

Mirroring Mitrany's concept of ramification, cooperation would spread or 'spill over' into other sectors. Like Mitrany, Haas believed spill over would ultimately lead to regional integration. Haas was less optimistic that economic interdependence and altruism alone would be enough to encourage political elites divide their loyalties between the state and a supranational body. It was his contention that regionally similar states were more likely to integrate, specifically, the states which ultimately formed the European Union.

Literature on Regional Water Crisis

Jan Selby identified three discourses in the water crisis literature: ecological, technical, and political. The ecological discourse focuses on the increasing demand for scarce water supplies by a growing population. The technical discourse places blame on mismanagement and inefficiency of water resources. The political discourse attributes water shortages to an uneven distribution of power and resources. (Selby, 2003, p. 21)

The ecological discourse asserts that overpopulation and global climate change strains an already scarce water supply. Water resources are finite and the addition of more people only shrinks the water available per capita. Malin Falkenmark quantified world water scarcity by

creating a ‘water stress index’ which deems the Jordan River basin as an area suffering from ‘chronic water scarcity.’ (Selby, 2003, p. 23) Israel with a growing population of six million and Jordan and Palestine both with populations of three million have exceeded the carrying capacity of their shared water source. From the ecological standpoint, a policy addressing the problem of overpopulation will simultaneously alleviate water scarcity.

The technical discourse has a more optimistic outlook. Water crises are the result of technical, economic, and policy mismanagement and inefficiency. (Selby, 2003, p. 26) Scholars who affirm the technical discourse will point to the lack of “dams, pipelines, new distribution lines, desalination plants, wastewater treatment plants, and irrigation systems.” (Selby, 2003, p. 27) Economists claim that water is also undervalued and therefore proper measures to manage it more efficiently are not undertaken. Some political scientists see the water crisis as an administrative and institutional failure and that better water policies would rectify the problem. Therefore, the basis for the argument made by the technological discourse is that the water system infrastructure is weak and defective and hence a technical solution is needed to address the problem.

The political discourse describes an interstate system which has produced resource inequalities between states. The water problem does not necessarily lie in a shortage of water but rather, the inequitable allocation of water resources. The political discourse invokes terminology such as dependency and world systems theory which characterize the world as having a prosperous Global North and a lesser developed Global South. It is the structure of the world system that promotes these water resource inequalities which favor wealthy powerful nations

over developing ones. The premise of the political discourse can be relegated to division of the state internally or the differences inherent to states within the state system.

The political discourse concerning the Jordan River almost exclusively focuses on the inequalities between neighboring states, i.e. Israel's allocation of water to the detriment of Palestinian supplies. Jad Isaac, a major proponent of the theory of resource inequity in the Middle East points to overconsumption by Israelis: "85 percent of the West Bank's groundwater resources were consumed by Israelis and only 15 percent by Palestinians." (Selby, 2003, p. 30) Israel's water consumption per capita was three times higher than Palestine.

According to the political discourse, the water crisis will be resolved only when each respective state's water rights are recognized. However, this leads to the question of how water rights should be defined. What would constitute a fair share of water resources among states? Scholars such as Zarour and Issac argue for a 'nature's apportionment' which would bestow 80 percent of water resources in the West Bank to Palestine. (Selby, 2003, p. 31) Shuval argues that water resources should be allocated according to population size and agricultural and industry needs. Then there is the legal aspect of enforcing water allocation measures. What legal basis should compel states to yield possession of water resources to another state?

Other overlooked aspects of the water crisis are the process of water reclamation and the vast amounts of consumption by agriculture and industry. Water reclamation includes desalination, or turning salt water into potable water, and water purification involves the removal of waste from sewage water. Water intended for use in agriculture is referred to as 'virtual water.' (Selby, 2003, p. 37) By importing food that was grown using water elsewhere, a state can

effectively reduce the demand for domestic water. Tony Allan asserts that perhaps 25 percent of the need for water in the Middle East is solved by importing food.

However, the most pronounced debate regarding scarcity is fought between realists and liberals. The water crisis in the Middle East can be viewed as a realist versus liberal debate over whether water shortages will launch states into conflict or conversely, encourage states to cooperate. (Selby, 2003, p. 19) Realists play the role of pessimists and forecast a cataclysmic future where states will engage in power struggles for control of water resources. Liberals criticize realist assertions of coming water wars as inconsistent with the history of state behavior in the Middle East; they assert that there is no precedent in contemporary Middle Eastern history in which water was the primary cause for going to war.

Realist arguments often make their case using Malthusian assertions and point to historical conflicts like the 1967 Arab Israeli War which was preceded by a water dispute between Israel and Syria and Jordan over the Jordan River. In addition to the ecological discourse there is also the socio-economic viewpoint provided by Malthusian theory which contends that economic prosperity shall lend itself to overpopulation thereby placing great demand on natural resources. This unsustainable demand, according to Malthus, would eventually lead to famine and conflict over dwindling resources.

Liberals see the chance for a more positive outcome on the horizon. Mostafa Dolatyar and Tim Gray offer three reasons based on functionalist theory as to why Middle Eastern states are unlikely to go to war over water: firstly, they claim there is no precedent for water being the main cause for going to war in the Middle East; second, states are unlikely to engage in war because ‘water is too precious to risk by going to war’; and lastly, ‘moves towards settlement of

water disputes could promote efforts at achieving wider peace objectives.' (Selby, 2003, p. 48) Jan Selby finds fault with both arguments claiming realist and liberal interpretations are oversimplified and naïve.

How does your topic fit into the literature?

Over three decades of literature have been dedicated to the topic of water shortages in the Middle East. Some scholars attribute water shortages to inequitable allocation of land and water resources in the region while others focus on increasing agricultural activity, burgeoning populations, lack or underuse of desalination technology, and water mismanagement. This study will be a comprehensive examination of all of the aforementioned factors.

Integration theorists have concentrated their efforts on describing the process by which European regional integration would be possible, but fall short of applying this theory outside the European continent. This study will fill the gap in the literature by pursuing a normative analysis of the water crisis in the Middle East based on a functionalist framework. The apolitical and utilitarian nature of the functionalist approach will hopefully draw states to this multilateral approach toward water conflict resolution.

Research Design

Although water shortages are found throughout the Middle East and North Africa, I have narrowed the scope of this study to include the nation states of Israel, the Palestinian territories, Jordan, Syria, Turkey, Lebanon, Iraq and to a lesser extent Saudi Arabia as my units of analysis.

This research will consist of three case studies addressing the water crisis in the following interstate conflict zones:

- The Tigris and Euphrates Rivers (Turkey, Iraq, Syria)
- Dead Sea/The Jordan River/Sea of Galilee (Israel, Palestine, Jordan)
- The Disi Aquifer (Jordan and Saudi Arabia)

The Jordan River Basin will comprise the most salient case study. In all except for the Disi Aquifer, water conflict characterizes relations between riparians. The Israeli-Palestinian conflict has produced voluminous literature on the conditions within Palestine and the water shortage in the Jordan River Basin is particularly hard felt. The Golan Heights dispute between Syria and Israel originates from the annexation of that territory by Israel during the Six Day War in 1967. Golan Heights is known for its fertile land and provides a third of Israel's water supply.[2] The Tigris and Euphrates Rivers are shared by Turkey, Syria, and Iraq. Efforts by Turkey to construct dams have lessened the water flow available to Syria and Iraq.

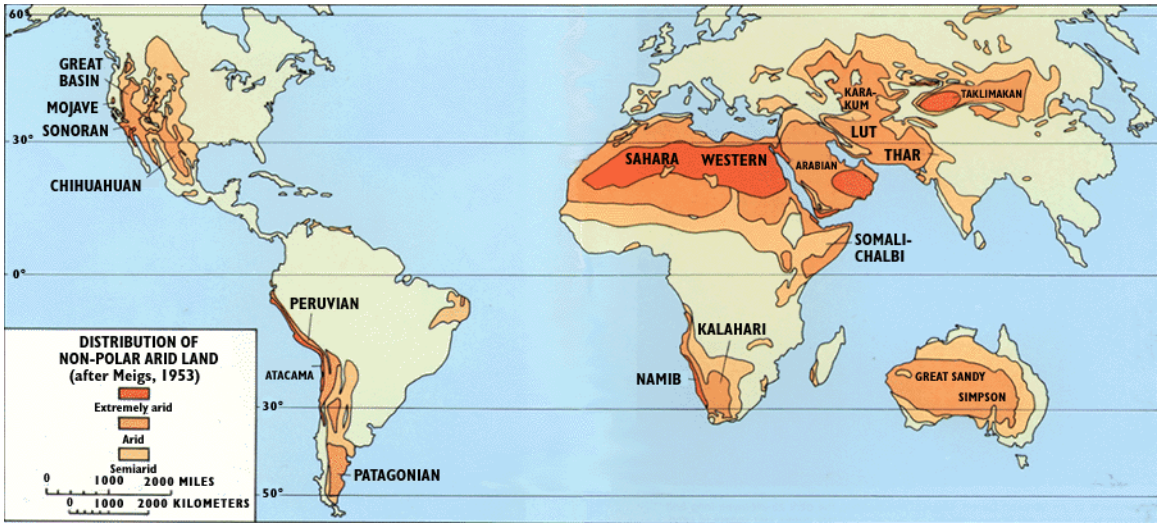
Physical Attributes

Water covers three quarters of the earth and yet only one percent of it is potable drinking water.[3] Although water shortage is a worldwide phenomenon, arid and semiarid regions experience the greatest water shortages. The human body is comprised of approximately sixty five percent water and those dwelling in an arid environment may perspire as much as 10 liters of water per day. Hence, water is especially crucial for survival to those living in arid and semi-arid climates.

2 "Regions and territories: The Golan Heights." BBC News. July 11, 2009. Retrieved from http://news.bbc.co.uk/2/hi/middle_east/country_profiles/3393813.stm

3 (Hillel, 1994)

The Middle East is a region that borders the continents of Asia, Europe, and Africa and ranges from extremely arid to semi-arid climate zones. From the fertile river valleys of the Tigris-Euphrates to the oppressive heat of the Sahara desert, the Middle East is a region which reflects great environmental variation. From Figure 1 it is clear that the majority of the world's arid zones are concentrated in the Middle East and North Africa.

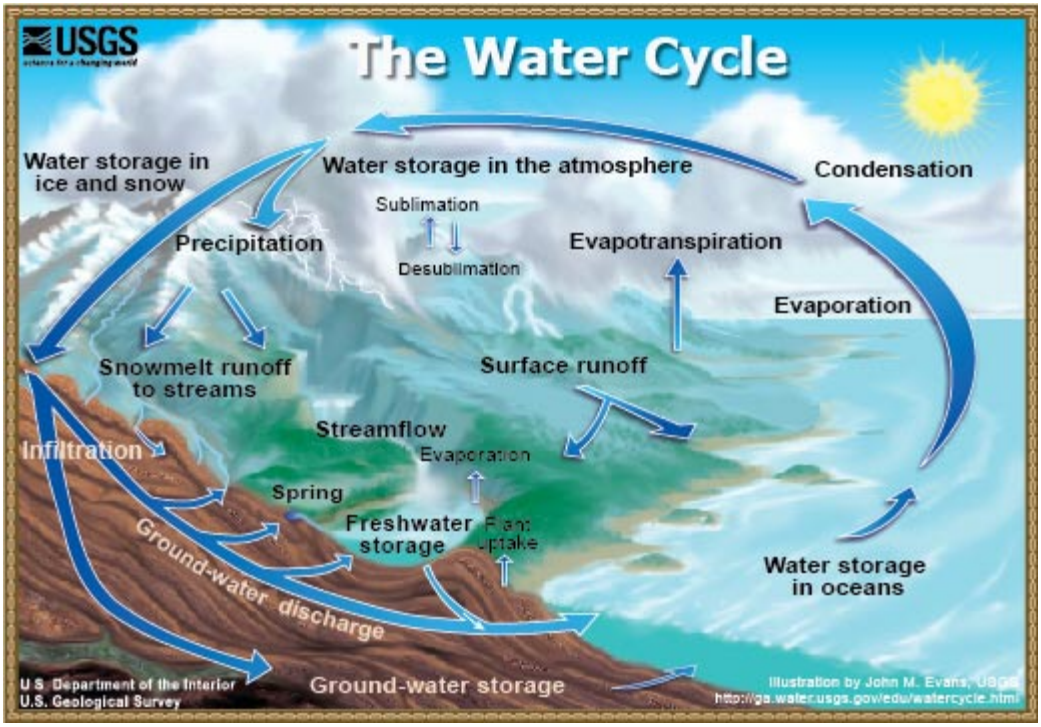


Source: U.S. Geological Survey http://pubs.usgs.gov/gip/deserts/what/world.html
Figure 1 Arid Regions of the World

The Water Cycle

The water cycle, also known as the hydrological cycle, is the natural process by which water moves from the atmosphere to the earth in an endless cycle.[4] During this cycle, water can exist in many forms: liquid, vapor, or ice. Yet, the amount of water within the system remains constant.

[4] (The water cycle, 2009)



Source: U.S. Geological Survey http://ga.water.usgs.gov/edu/watercyclesummary.html
Figure 2 The Hydrological Cycle

Beginning with the sun, the heat emanating from the sun causes the water in the ocean to evaporate into the air as vapor. This water vapor rises into the atmosphere and cools and condenses into clouds. Clouds move through the atmosphere by air currents. When the particles of water vapor within these clouds collide, they fall to the earth in some form of precipitation such as rain or snow. With time, an accumulation of snow can form polar ice caps and glaciers. However, most precipitation returns to the oceans or is absorbed on land. When water accumulates on land it may flow over the ground which is known as surface runoff.

Surface runoff feeds into lakes and rivers which ultimately feed into oceans. Some water is absorbed into the ground, a process called infiltration. Infiltration of water may reach deep underground and restore water to saturated subsurface rock known as aquifers. Infiltration may

also find its way back into the ocean and other bodies of water as ground water discharge. Sometimes ground water may resurface on land in the form of freshwater springs.

Evaporation is the process which drives the water cycle. The amount of water evaporating off the surface of the earth is roughly equivalent to the amount of precipitation. Only 10 percent of water evaporation from the ocean falls on land; most returns to the ocean.

Transpiration occurs when plants return moisture in the form of water vapor to the atmosphere through small pores on the underside of leaves. Approximately 10 percent of the atmosphere is comprised of water droplets from evapotranspiration. Transpiration depends on several factors: temperature, humidity, air movement, soil moisture, and the species of plant.

Overpopulation

Overpopulation has placed increasing burdens on the land and its natural resources. Historically, populations were kept to low numbers, a combination of factors such as high mortality rate and low life expectancy. Population growth and the near cessation of tribal migration in modern times have placed great pressure on natural resources.

Growing concern for the increasing population is directed towards the rate of population growth. The growth rate of the world population is increasingly at an unsustainable rate. The greatest increases are found within the poorest segments of society. The Middle East is predicted to experience a doubling of the population every generation. This rate of growth should draw concern because natural resources are already stretched to capacity.

Desertification

Overuse of land already affected by water shortage has contributed to the desertification of once productive agrarian land.[5] However, if irrigation is feasible, some arid regions can produce a surprising amount of crops if conditions are right. Desertification occurs in several stages. Initially, land capable of sustaining plant and animal life is exploited by humans. People living in arid conditions who cannot relocate typically overuse the land during times of drought. The degradation of plant life is further exacerbated by wind and rain erosion. Further overuse and erosion causes the once fertile land to become a desert.

[5] (Hillel, 1994)

CHAPTER 2: TIGRIS AND EUPHRATES RIVER SYSTEM

Figure 3 Water Conflict Map of Turkey

Almost all Middle Eastern states suffer from some degree of water shortage. An equitable allocation arrangement and new technology have been offered as solutions to the increasing water shortage. Water is being treated as a national resource instead of a universal resource that must be shared. (Amery & Wolf, 2000, p. 229) Independent actions taken by states can deteriorate interstate relations. (Altinbilek, 2004, p. 28)

Legal issues are forefront to the Tigris and Euphrates water disputes. According to Chalabi and Majzoub, resolving these legal problems would rectify the political and economic problems associated with the water dispute. In order to reach a settlement, it is necessary to identify the rights and obligations of each riparian. (Allan & Mallat, Water in the Middle East: Legal, Political, and Commercial Implications, 1995, p. 189) However, “non-agreed water

sharing is an unavoidable reality in present Middle Eastern international relations." (Allan T. , 2000, p. 217)

Scholars such as Daniel Hillel and George Joffe claim that competing claims for water in the Middle East have or will erupt in conflict. Postel is more ambivalent and proposes that the water crisis may lead to either conflict or cooperation. Gleick and Kolars and Mitchell offer more optimistic analyses. Since the water basin is a shared resource, the need to manage it jointly may encourage cooperation. (Dolatyar & Gray, 2000)

Dolatyar and Gray argue that the degree of strategic significance attributed to water is overstated in the literature. Furthermore, water shortages "arise primarily from the mode of water allocation within states rather than the water allocation between states." (Dolatyar & Gray, 2000, p. 117) Lastly, the riparians of the Tigris and Euphrates basin have been engaged in political negotiations and technical consultations since the early 1960s. Conflict is inconsistent with these states' long record of concerted efforts to resolve water complaints peacefully:

> *"Joint regional research institutes and training programs which exchange engineers, technicians, and farmers...Monitoring of water system using remote sensing and geographical information systems (GIS)...Technical cooperation through water transfers. Water augmenting techniques such as water harvesting, conjunctive use of surface and groundwater sources, and cloud seeding...Following the Turkish model of water user associations...Developing management plans for municipal and irrigation water supplies, especially for possible drought periods...International funding for joint water projects would be easier and more attractive..." (Altinbilek, 2004, pp. 31-32)*

Climate and Hydropolitical features

The source of the Tigris-Euphrates basin is found on the snow covered mountaintops of northeastern Turkey. Two mountain ranges, the Pontus and the Taurus, envelope the Anatolian Plateau and stretch from Turkey to Iran. The Euphrates and the Tigris rivers are fed by the precipitation from these mountain ranges: "Murat River is the major source of the Euphrates. The river originates near Mount Ararat north of Lake Van."[6] The Euphrates begins near Mount Ararat and descends for 400 miles southeast into Syria. Past Iraqi borders, the Euphrates joins with a delta at ar-Ramadi. Further downstream it loses water through natural and manmade channels.

The Tigris River originates in the eastern part of Turkey near Lake Hazar where it joins with several tributaries. It forms the border between Turkey and Syria and then enters Iraq. It eventually joins with the Euphrates River and drains through the Shatt-Al-Arab on the shore of the Persian Gulf near the town of al-Qurnah in the Basra Governorate of southern Iraq and southern Iran. (Altinbilek, 2004, p. 18) (Soffer, 1999) Several tributaries from the Tigris drain into the Zagros mountains of Iran. (Dolatyar & Gray, 2000, p. 119)

Turkey is especially fortunate amongst the nations of the Middle East because it has over 1000 mm of rain a year. (Allan T. , 2000, p. 53) The mountains of Turkey provide it with the advantage of having the largest catchment for water resources in the Middle East. A surplus of water flow drains into the Mediterranean and the Black Sea. A canal has been proposed to transfer this excess flow to the Tigris and Euphrates. Of the 95 bcm/yr of water which inundates

[6] http://www.absoluteastronomy.com/topics/Euphrates

Turkey annually, only 30 bcm have found its way into Turkey's water distribution system. (Dolatyar & Gray, 2000, p. 119)

Conversely, half of Syria and nearly two-thirds of Iraq is desert. They receive the minimum amount of rainfall per year for agriculture to be possible. Consequently, agriculture is totally reliant on irrigation. Although Syria has other sources of water such as Golan Heights and the coastal border between Turkey and Lebanon, the Euphrates still accounts for 86 percent of its water resources. Iraq experiences extremes in weather from hot dry summers to cold winters. (Dolatyar & Gray, 2000, p. 120) Evaporation is also a problem and continues to increase due to project delays. In Turkey the evaporation rate is 3-4 billion m^3, Syria is 1 billion m^3, and Iraq is 4- 5 billion m^3. (Soffer, 1999, p. 88)

From beginning to end, the Tigris and Euphrates span a length of 1900 km and 2700 km, respectively. Although the surface area of the Euphrates is larger than the Tigris River, 121,787 km^2 versus 53,052 km^2, 98% of the water which flows in the Euphrates originates from the mountains of Turkey. 53% of the Tigris is sourced from Turkey; several tributaries from Iran and Iraq contribute the rest of the catchment. (Altinbilek, 2004, p. 18)

There is disagreement in the literature on the approximate flow and dimensions of the Tigris and Euphrates river system. Not only governments but scientists have disagreed on the annual flow of the Tigris and Euphrates because it varies year to year. (Allan T. , 2000, p. 71) This is significant because determining the area contained within each state is vital to establishing a legal claim to a portion of the basin's resources. The Tigris covers a catchment area of 444,000 km^2 and the Euphrates catchment is estimated to be between 217,843 and 373,000 km^2. (Dolatyar & Gray, 2000, p. 121)

The total size of the catchment within each state is also debated amongst scholars. For Turkey, the Euphrates catchment is estimated to range from 28 to 40 percent; 17 to 25 for Syria; and 35 to 40 for Iraq. The Euphrates' annual flow is also debated. Some scholars estimate that 88-90 percent originates in Turkey and 10 percent in Syria while others claim that nearly 98 percent originates in Turkey. The apportionment of the Tigris basin is similarly debated amongst scholars: 12 to 20 percent in Turkey, less than one percent to two percent in Syria, 54 to 78 percent in Iraq, and the rest in Iran. The average annual combined flow of the Tigris and Euphrates is estimated to be approximately 70-74 bcm/yr, with 32 bcm for the Tigris and 42 bcm for the Euphrates. (Dolatyar & Gray, 2000, p. 122)

The flow of the Tigris and Euphrates rivers fluctuates throughout the year. Twenty percent of the annual flow occurs between November and March. The largest flow increase occurs in the summer from April to June when the rivers swell with 70 percent of the annual flow. From July to October, the rivers fluctuate down to only half of the flow experienced during the summer. This extreme variability has been stabilized by the introduction of dams to the river basin. The flow of the Euphrates ranges from 100 to 180 cubic meters to a maximum flow of 5200 to 7000 cm/s. In May 1969, Turkey and Syria simultaneously filled their reservoirs in Keban and Tabqa, respectively, which reduced the flow to a record 50 cm/s during that period. (Dolatyar & Gray, 2000, p. 122)

The natural flow of the Tigris and Euphrates river system is not conducive to the growing season. The quantity of water is insufficient during the winter and too early for the summer crops. Irrigation requires human engineering to make adequate water resources available year round. While dam building reduces the amount of water available to downstream riparians, it

does offer the benefit of controlling extreme water flow fluctuations. A constant uniform flow of water is very favorable to year round agriculture. (Dolatyar & Gray, 2000, p. 123)

Fears that upstream riparians can effectively intercept all the water for their own use overlook the consequences of costly sediment buildup in dams. A significant amount of sediment is carried by both the Tigris and Euphrates. The majority of this sediment stops short of reaching the Persian Gulf. It accumulates in river beds and dam reservoirs. Unless the dams are regularly maintained, the silt deposits will compromise the dam's structural integrity. (Dolatyar & Gray, 2000, p. 123)

Historical Background

Turkey is the point of origin of the Tigris and Euphrates Rivers. The area between these two rivers was known as Mesopotamia in ancient times. This water system gave rise to many ancient civilizations. The oldest of these civilizations dates back to 10,000 BC and included the Sumerians, Acadians, Babylonians, and the ancient Assyrians (Altinbilek, 2004, p. 15). These ancient peoples relied on the water from the Tigris-Euphrates River Basin to irrigate their crops and engineered an efficient flood control system to tame the floodwaters. In ancient times, this water system served the needs of approximately 20 million people. The historical record of water conflicts in this area dates back 6,000 years. Even then, disputes over access to water and attacks on water supplies existed.

Water management in the Middle East is as ancient as farming itself. Since 6000 BCE, civilization after civilization have engineered ways of changing the natural course of the Tigris and Euphrates rivers to irrigate their crops. Early agriculture consisted of primitive irrigation canals and ditches. The advent of city states brought with it more advanced irrigation and flood

control networks. The more sophisticated forms of government which came later were able to legally "define and enforce land claims and water rights and protect access to such facilities." (Dolatyar & Gray, 2000, p. 125)

The ancient peoples of the Tigris and Euphrates region developed sophisticated methods of controlling their water resources as far back as 4000 BC. The Sumerians and Babylonians directed the waters of the Tigris and Euphrates through canal systems to irrigate their crops and protect against floods. During the Mongol invasion, many of these water systems were destroyed. During the Ottoman era, these ancient water systems were then rebuilt. In the latter half of the twentieth century, more modern water treatment facilities were added. Turkey and Syria developed water storage and hydroelectric plants on the Euphrates and Iraq and Iran have built water facilities along the Tigris.

The decline of civilizations often meant that water management systems were often neglected. Without regular maintenance, drainage canals become filled with silt and water wheels fell into disrepair. Irrigation systems along with the rest of a state's infrastructure, require funding. The Middle East has been subject to invasions from antiquity to modern times. This has meant that societies in the Tigris Euphrates basin have been forced to fortify their water distribution systems with moats and other defensive measures. Water has been used as a target, weapon, and an object to conquer. (Dolatyar & Gray, 2000, p. 126)

Obviously water disputes in the Tigris-Euphrates Basin far predate the modern era. When the states of Syria, Iraq, and Turkey were created out of the remnants of the Ottoman Empire, several water agreements were in place. However, the end of the world wars brought with it a surge in development which reopened hydro-political problems. Water became scarce as new

dam constructions diverted water to irrigate more and more farmland. Hence, the present water conflict in the Tigris-Euphrates system "goes back no more than 50 years." (Altinbilek, 2004, p. 15)

The turbulent history of the region has led some scholars to use historical precedents as evidence that states have used water alone as justification enough for engaging in conflict. They claim that "no region has seen more water-related conflicts than the Middle East." (Dolatyar & Gray, 2000, p. 126) According to their analysis, the water conflicts of today are no different than the disputes over water throughout history. Hatami and Gleick (1993) conducted a study of ancient history, myths and legends of the Tigris and Euphrates area and chronicled what they believed to be water conflicts. However, Dolatyar and Gray find their analysis flawed and argue that water was not primary impetus for conflict. According to their definition, a water conflict is not merely the use of water as a military target, it should be the main impetus for engaging in conflict.

Dolatyar and Gray cite that greater efforts were made to preserve water systems and shared access to it. Water enabled agriculture to prosper which in turn led to the creation of larger civilizations. Hence, civilization depended on a sophisticated water delivery system. The Code of Hammurabi, circa 1790 BC, enumerated laws for maintaining their water system. This denotes a higher level of hydroengineering capability. Mesopotamian civilization prospered well under this organized system, the population had risen to 20 million inhabitants. (Dolatyar & Gray, 2000, p. 127)

With time, these water management systems were inherited by successive generations of rulers. Under the Abbasid caliphate, agriculture prospered. By the twelfth century, however, this sophisticated water system was destroyed by Mongol invaders who destroyed the dams to flood the camps of the Abbasid army. Under the Ottoman Empire, parts of this water system were restored but as the Ottoman Empire fell into decay, the canals also fell into disrepair.

Dolatyar and Gray describe the water history of the Middle East in the twentieth century as consisting of two phases. From the end of the Ottoman Empire to the 1960s, the aim of water management was flood control. In this period, there is no mention of water scarcity or water conflict in the historical record. Negotiations emphasized shared use of the Tigris and Euphrates. From the 1960s onward, the introduction of hydrological projects initiated a new era of competition for water. No longer was water just for drinking or irrigating small plots of land, water had become an industry.

The First Phase

In the first phase from 1918 to 1960, water management was intended for flood control and irrigation. The Tready of Sevres (1920) divided the former Ottoman provinces into what is known as Syria and Iraq. The headwaters of the Tigris and Euphrates remained in Turkish hands. With the collapse of their empire, the Turks were preoccupied with domestic issues and therefore water projects were not given top priority. Until the 1970s, the water supply was adequate enough for the population. In fact, there was a surplus of water and this encouraged states to find ways of exploiting the surplus to create hydroenergy and increase farming. (Dolatyar & Gray, 2000, p. 131) The riparians used a relatively small portion of the Tigris and Euphrates: 1.5 bcm

out of 42 bcm for Turkey and approximately 3 bcm for Syria. Neither Turkey nor Syria was concerned about water issues on the Euphrates before then.

Iraq was much more concerned because it relied on an agrarian economy and the Euphrates had always been unpredictable. (Allan T. , 2000, p. 227) Shortly before this period, the British hydrological engineer, William Wilcox, prepared the first hydrological survey of the Euphrates under the auspices of the British colonial government. The Hindiya Barrage was constructed at his suggestion. Several other water projects were initiated but construction on major waterworks would not begin until the mid twentieth century. Interstate relations at that time reflected cooperation as in the Franco-British Convention of 1920 which established a committee to help coordinate usage of the Tigris and Euphrates. This convention established the precedent that mutual consent was needed before a water project was initiated, guidelines which Syria and Iraq still follow. (Dolatyar & Gray, 2000, p. 133)

The Franco-Turkish agreement of 1921 concerned water agreements on the Koveik River which traverses through Turkey and northwest Syria. This agreement suggested that in the event Turkey developed the Koveik River, Turkey should compensate Syrian downstream users by tapping water from the Euphrates. The Treaty of Lausanne (1923) required Turkey to confer with Iraq before it proceeded with water developments that might affect Iraq's water supply from the Euphrates. The Friendship and Neighbourly Relations Convention of 1926 elaborated on the Franco-Turkish agreement of 1921 and similarly required Turkey to consider Syria's water needs before attempting any water projects. These cases help affirm a history of cooperation among the Tigris and Euphrates riparians in the early part of the twentieth century. (Dolatyar & Gray, 2000, p. 134)

Iraq and Turkey established a water dialogue after World War II. Their main concerns were flood control and water storage. They signed the Treaty of Friendship and Good Neighbourly Relations in 1946 which required Turkey "to monitor the two rivers and share relevant data with Iraq." (Dolatyar & Gray, 2000, p. 134) Unless both parties were open to cooperation and did not view water as a strategic issue, this treaty would not have been possible. Turkey was required to consult Iraq before constructing dams but Iraq reserved the right to build dams on Turkish territory to regulate the water flow downstream in Iraq. Also, Iraq was responsible for the cost of building such installations but the maintenance costs would have been borne by both Turkey and Iraq.

Iraq established several advisory boards in the 1950s: the Board of Development, the Ministry of Development, and the Ministry of Agrarian Reform in Iraq. These government agencies oversaw a national planning scheme to develop along the Euphrates River. Partially financed by foreign aid, a second barrage was built near the city of Ramadi. However, a leftist pan-Arab army coup which united Iraq and Jordan under a single coalition government forestalled future projects. (Dolatyar & Gray, 2000, p. 134)

Despite the aforementioned bilateral agreements, cooperation was still limited in the mid-twentieth century. Chalabi and Majzoub (1995: 195) argue that these bilateral agreements "worked well and could serve as a basis for a more extensive cooperation between the riparian countries." (Dolatyar & Gray, 2000, p. 135) Until the 1970s, the three riparians' usage had remained stable: Turkey used 3 percent, Syria 10 percent, and Iraq 50 percent. When water demands increased following the construction of water projects, the working agreements that were already in place were not adequate to address competing water claims.

The Second Phase

By the 1960s, Syria and Turkey simultaneously generated plans to construct water facilities along the Tigris and primarily the Euphrates rivers. This was cause for alarm for Iraq, since Iraq consumed the largest share of the Euphrates. Iraq viewed Syria and Turkey's actions as an opportunistic move to seize a larger share of the Euphrates. Trilateral and bilateral discussions revealed that the planned projects demanded more water than was supplied by the annual flow. If the water projects proposed by Syria and Turkey were fully implemented, Iraq would not receive enough water to meet its needs. These negotiations were unable to negotiate terms to all parties' satisfaction.

From 1980 to 1992, Joint Economic Commission (JEC) and Joint Technical Committee (JTC) meetings were held to address water disputes. No consensus was reached during these negotiations. The negotiations revolved around Iraq's contention that access to Tigris and Euphrates waters was an 'acquired right' or 'historical right.' Turkey attempted to compensate the "scarcity in the Euphrates by the surplus in the Tigris." (Altinbilek, 2004, p. 16) Iraq refused to negotiate use of the Tigris because the Iraqis considered use of the Tigris as its sovereign right. Syria argued that the Tigris and Euphrates were 'international watercourses' and proposed that the water flow should be apportioned according to each state's needs. As a result, Syria and Iraq agreed that Iraq would receive 58% of the water from the Euphrates River starting from the Turkish-Syrian border and Syria would receive the remaining 42%.

In 1984, Turkey proposed the 'Three-Stage Plan for Optimum, Equitable and Reasonable Utilization of Trans-boundary Watercourses of the Euphrates-Tigris Basin.' (Altinbilek, 2004, p. 16) This agreement sought to identify all sources of water, all sources of land resources, and determine the municipal, industrial, and agricultural demands for Turkey, Syria, and Iraq. Turkey

was accused of trying to appropriate a disproportionate claim of the Euphrates River. Syria and Iraq argued that the Tigris-Euphrates was collective property that should be shared equitably. Controversy over the filling of the Ataturk and Karkamis dams, leadership change in Syria, and the ousting of Saddam in Iraq suspended further JTC negotiations.

Unresolved water disputes could lead to "escalating disputes and armed confrontation." (Dolatyar & Gray, 2000, p. 136) Hillel (1994) and Kliot (1994) warn that increasing demand by upstream riparians could cause Iraq to lose 80 percent of its water resources. Although current needs are being met, observes Postel (1992), the water agreements currently in place won't be able to dissolve the "atmosphere of competition and mistrust that could breed future conflict." (Dolatyar & Gray, 2000)

The failure to negotiate these competing water claims suggests that other political issues have been detrimental to the riparians' ability to cooperate as they had in the earlier part of the twentieth century. Gleick points to the several political rivalries shared by all riparians: "For instance, Syria and Iraq opposed Iraqi military actions in the 1970s. In the 1980s, Turkey and Iraq tended to band together against Syrian military aggression, and Turkey and Syria sided with the allied forces against Iraq during the Persian Gulf War." (Dolatyar & Gray, 2000, p. 136)

Lowi (1995) also agrees that territorial disputes and personal rivalry amongst heads of state spoil attempts to create a trilateral water accord. For instance, Syria and Turkey have competing claims for Hatay province and tensions escalated when Syria allowed Kurdish insurgents hostile to the Turkish government to operate within Syria. Baath rulers in Syria and Iraq have been at odds with one another since 1968. Chalabi and Majzoub (1995) believe that the construction of the Aswan High Dam in Egypt was a catalyst for Tigris and Euphrates riparians

to launch hydraulic projects of their own in order to raise public opinion and exude an appearance of modernity to the international stage. On a regional level, the peaked interest in hydraulic projects in the 1960s mirrored the rivalry of the Cold War being fought between the U.S. and the Soviet Union. (Dolatyar & Gray, 2000, p. 138)

Several scholars have argued that the water conflict in the Tigris Euphrates basin is fueled in fact by several political issues unrelated to water demands, i.e. territorial disputes or international power struggles in a multipolar world. Dolatyar and Gray argue that the only water conflict by definition was the Syrian-Iraqi crisis of spring 1975 when Syria and Turkey simultaneously filled their dam reservoirs at Keban and Tabqa. However, even this episode was quickly resolved with the aid of diplomatic intervention. (Dolatyar & Gray, 2000, p. 138)

Joffe (1993) claims that legal claims to the Tigris and Euphrates water resources have no legal precedents with which to lay groundwork for negotiations. Dolatyar and Gray argue that *the Convention on the Protection and Use of Transboundary Watercourses and International Lakes* and "more than two decades of endeavor and deliberation by the International Law Commission for the development and codification of the non-navigational uses of international watercourses (ILC 1991)" (Dolatyar & Gray, 2000, p. 139) can be applied to equitably determine allocation of the Tigris and Euphrates river basin. Hillel (1994: 103) concedes, however, that the Tigris and Euphrates competing claims are complex and settling the matter would entail the consideration of several factors: compromising between historical rights and "proportionate contributions to the rivers' flows"; the actual quantity of water needed by each state to serve municipal, agricultural, and industrial needs; population size; the availability of alternative water

sources; the efficiency of water use; and the effects of one riparian's water activities on another state. (Dolatyar & Gray, 2000, p. 139)

In order to negotiate legal claims to the waters of the Tigris and Euphrates, data is needed to determine how much water is available and how much water riparians currently use. Kolars (1994: 88) admits that the data on the Tigris and Euphrates basin is at best sketchy: "Data regarding stream flow, precipitation, evapotranspiration, water removals, return flow, salinity, and a host of other variables are notoriously scarce, incomplete, and open to question everywhere in the Middle East." (Dolatyar & Gray, 2000, p. 142) An atmosphere of mistrust and secrecy between governments often prevents thorough analyses from being conducted. Despite the undercurrent of hostility, the riparian governments seek hydrological data from one another. The Geographical Information System (GIS) and the Earth Observation Satellite Company (EOSAT) are capable of providing satellite imagery of the region showing hydrological change over time. This wealth of information is technically possible but convincing rival governments to freely share satellite imagery of their country with their riparian neighbors, even for their mutual benefit, is no easy task.

Riparian States

Turkey

As an upstream riparian, Turkey has the ability to control the water flow of its downstream neighbors. "Turkey believes downstream states have no right to interfere in Turkish internal water policy." (Amery & Wolf, 2000, p. 228) This encourages tension and mistrust

between upstream and downstream riparians. Dolatyar and Gray advise that "appropriate institutions" could diffuse this tension and persuade each party that cooperation is in their best interest. They reiterate the mistrust that has grown between the Arab states and Turkey since Turkey joined NATO, allowed U.S. military bases to be built in Turkey, and the non-aggression pact signed with Israel. These actions have served to alienate Turkey from its Arab neighbors. Concurrently, the Arab nations adopted policies of Arab nationalism and socialism which further distanced itself from Turkey. Syria and Iraq increased their water storage capacity in order "enhance their sense of water security." (Dolatyar & Gray, 2000, p. 146)

Syria and Iraq also challenged Turkey's dam construction projects by discouraging foreign investors to continue their funding and using every legal, economic, and security leverage at their disposal. Turkey claimed absolute territorial sovereignty of the Tigris and Euphrates headwaters and Syria and Iraq referred to 'limited territorial sovereignty,' 'acquired right' and 'prior use' as their counter claim. In other words, Turkey claimed it had no obligation to share water originating from their land, while the Arab nations argued for a proportionate share of the water flow.

Keban dam, Turkey's second largest dam, is located on the Euphrates. Construction began in 1963 and it has provided hydroelectric power since 1975. Two years later, in 1977, the Southeastern Anatolia Project, or GAP was initiated to promote economic development in southeastern Turkey. The project encompasses 41.5% of the Tigris and Euphrates watershed. Once the project is completed it will provide 1.7 million ha of land which comprises 20% of Turkey's irrigated farmland.

The Gap Project

The Gap Project consists of 22 dams and 19 hydroelectric power plants. This irrigation system will consume 27% of the annual runoff from the Tigris and Euphrates water system. Dams have been built in the southern provinces of Keban, Karakaya, Ataturk, Birecik, Karkamis, Kralkizi, Batman and Dicle. Dam construction at Cizre and Ilisu is projected to be completed within the next five years.

The GAP Projects integrates multiple sectors of development such as "agriculture, industry, transportation, urban and rural infrastructure, health care and education." (Altinbilek, 2004, p. 25) In total, the GAP project requires $32 billion USD and half of this amount has been spent. The project has been engineered to take advantage of water-saving technology and promote sustainable water practices.

Kurdish Dissidents

The Euphrates and Tigris basin is also home to Kurdish nationalists. Turkey systematically tried to eliminate Kurdish language and culture in favor of promoting a unified Turkish nation. Syria decided to increase its support of the PKK (The Kurdistan Workers' Party) a guerrilla group set on attaining Kurdish autonomy from the Turkish government. However, Iraq was enmeshed with a war with Iran and was also in conflict with its Kurdish population to the north. Turkey's economy suffered and refugees began to crowd Turkish cities to escape the fighting in south eastern Turkey. Turkey refused to negotiate water rights in exchange for Syria relinquishing support for the Kurds. (Dolatyar & Gray, 2000, p. 155)

Syria hoped to use its support for the PKK as leverage in water negotiations. Turkey demanded that Syria sign a security pact, thereby ending their support for the PKK. Syria agreed

to sign only under the condition that Turkey maintain the flow of the Euphrates at 500 cm/s and assured Syria that it would receive 42% of the water flow and 58% to Iraq. Turkey also proposed a 'peace pipeline' as a gesture of cooperation to relieve the water stressed nations in the Levant with more drinking water. (Amery & Wolf, 2000, p. 252)

Syria

Agriculture is the most significant sector in Syria's economy but its reliance on rivers, springs, and groundwater is becoming unsustainable. Syria has the most pressure of population growth on its water supply. The southern part of Syria is water secure and it is successfully distributing water to the drier parts of Syria. (Allan T. , 2000, p. 162) Iraq and Turkey are the main riparians of the Tigris River; the Tigris barely enters Syria. The cost of harnessing the Tigris has been calculated to be too costly. (Allan T. , 2000, p. 256)

Ground water provides Syria with 44% of its irrigation. Syria has approximately 4.8 million ha of cultivated land. 85% of this land is rain fed and the part which requires irrigation is increasing. Dams currently in operation are the Tabqa Dam (1975), Al Baath Dam (1988) and Tishrine Dam (1999). (Altinbilek, 2004, p. 24) These dams irrigate 375, 000 ha and create 28 MW power. Altogether, 530,000 to 620,000 ha of land are irrigated. Tabqa High Dam was renamed Al Thawrah or "the Revolution" and was complete in 1973. The Great Khabur Project is one of Syria's current projects. (Allan T. , 2000, p. 72)

Syria has altered its water development plans as well. Tabqa Dam was originally planned to fertilize 600,000-650,000 ha but inaccurate hydrological surveys done in conjunction with the Soviets in the 1960's has caused Syria to rescale the project back to only 240,000 ha. (Dolatyar

& Gray, 2000, p. 157)The cost of land reclamation was untenable so the Syrian government has shifted its policies toward rain-fed agriculture concentrated on the coastal land.

Water from Turkey is polluted with agricultural runoff. A desalination plant has been suggested. (Amery & Wolf, 2000, p. 10) What remains to be seen is whether Turkey will finance the building of a water treatment plant to purify the water it uses before allowing it to flow to Syria. As in the case of the Colorado River, the U.S. pays to treat the polluted water it sends to Mexico. (Allan T. , 2000, p. 257)

Iraq

Iraq was the first to build a dam on the Euphrates called the Hindiyya barrage in 1914. Construction on irrigation and flood control systems were undertaken by the Kingdom of Iraq's Board of Development during the 1950s. This consisted of the Ramadi flood control reservoir, Habbaniye dam, a regulator, canals, the Lake Tharthar project and the Samarra dam. (Altinbilek, 2004, p. 20) Tharthar was significant because it connected the Euphrates and Tigris through an 1100-m^3/s capacity canal. Qadissiyah and Fallujah dams were constructed between 1972 and 1990. The total irrigable area is estimated to be approximately 4 million ha, 1-1.3 million ha from the Euphrates and 2 million ha from the Tigris.

In 1975, when the flow of the Euphrates fell from 28 billion cubic meters per annum to 21 billion, Iraq sent troops to the Syrian border. (Allan & Mallat, Water in the Middle East: Legal, Political, and Commercial Implications, 1995, p. 196) Iraq threatened to bomb Tabqa Dam if more water wasn't released. The Soviets and Saudi Arabia intervened and helped mediate the dispute. Despite this mobilization of forces, diplomacy prevailed and Syria agreed to release more water to Iraq. (Allan T. , 2000, p. 73)

However, Iraq was able to offset the water cost of agriculture by importing food. Prior to invading Kuwait, Iraq was suffering economic hardship and as a result they had been importing 90% of their food. They lacked skilled Iraqi farmers; many farm laborers were Egyptian foreign workers. (Allan T. , 2000, p. 256)

A report by the United Nations Environment Program (UNEP) published in 2001 highlighted the disappearing marshlands of southern Iraq. According to this study, between 1970 and 2000, 90% of the marshland had disappeared. An interstate solution was called for to replenish the marshlands by releasing water from dams. Blame was cast with Turkey's dam projects, the planned construction of the Ilisu Dam in particular. Turkey argued that the main cause of the disappearance of the marshes was the construction of levees and canals engineered by Iraq. Ilisu Dam lost much of its international funding.

Iraq's water development scheme is geared towards efficiency. Better technology and water conservation methods include Tharthar Canal "a major reservoir which links the Tigris and Euphrates Rivers." (Dolatyar & Gray, 2000, p. 157)Nicknamed the 'third river' this project was controversial because it dried the marshlands to the south of Iraq. This was seen as a deliberate move by the Iraqi government to flush out dissidents who used the marshes as a defense blockade against the Saddam dictatorship. The Iraqi government's decision to drain the wetlands left 150,000 refugees to flee to neighboring Iran. (Allan T. , 2000, p. 205) The UN criticized the project as an environmental crime but the Iraqi government denied those charges.

Iran

Iran's largest dam, the Dez Dam, was finished in 1962. Located on the River Karun, it is the first of such projects to harness the hydroenergy potential of the Karun River system. In the

past decade, Iran has invested billions of dollars to further develop the Karun River. This has also had detrimental effects further downstream on the marshlands of the Shatt-al-Arab delta. A water reservoir which feeds off the River Karkheh has been constructed to irrigate 320,000 ha of land. A 540 km pipeline delivering 250 million m^3 freshwater from Karkeh Dam to Kuwait is also scheduled for construction. (Altinbilek, 2004, p. 25)

Present and Future Water Development

As of 2004, there were 32 major dams on the Euphrates and Tigris river system. Collectively, these dams can store five times the rivers annual flow. The hydroelectric plants altogether produce 11350 MW of power. (Altinbilek, 2004, p. 25)

All of this development has produced significant changes in the environment. From 1974 to 1998, the flow of water in central Iraq had dropped two thirds from 2,594 m^3/s to 831 m^3/s after the construction of a new dam. However, what also changed was the flow pattern. Instead of flooding during the summer months, the river's flow became more uniform. This is turn caused more water to become available during the winter months; the flow of water increased from 272 to 575 m^3/s post-dam construction and more hydroelectricity was produced as a result. (Altinbilek, 2004, p. 25)

In anticipation of future irrigation projects, experts have projected a water shortage sometime within the coming decade. This is based on projections which depict a deficiency of 2-12 km^3/y in the Euphrates and a surplus of 8-9.7 km^3/y for the Tigris River. Turkey, Syria, and Iraq have 202,000 ha, 350,000 ha, and 2.8 million ha, respectively, of land which may lend itself to irrigation. However, the possibility that these lands may reach their full irrigation potential is not uniform. (Altinbilek, 2004, p. 26)

Water conservation could prevent 10 to 20% of water from being wasted. Turkey has already undertaken such conservation measures by replacing open canals with low pressure pipelines. Educating farmers on water-saving techniques would require more funding. Water pricing would encourage consumers to adopt more economical behaviors when using water.

Turkey claimed it reserved the right to use all of the Tigris and Euphrates water without consent of other riparians. However, according to Article 2(b) of the UN Convention the Tigris and Euphrates are considered international rivers because they are a watercourse "parts of which are situated in different States." (Dolatyar & Gray, 2000, p. 149) "Turkey insists that the Tigris and Euphrates form a single transboundary water basin" because their sources are very close to one another and they combine at their end point known as the Shatt al Arab. Iraq counterclaimed that the rivers are separate. Turkey refuses to negotiate sharing the water basin unless the Orontes River is included. If the Syrians and the Iraqis want shared use of the Tigris and Euphrates Basin, they must be willing to negotiate water rights for Turkey to use the Orontes River which is located in Hatay Province, a disputed land between Turkey and Syria. Syria claims the Orontes is not an international river because the land it flows on is disputed between Syria and Turkey. (Allan T. , 2000, p. 279)

Turkey criticizes its downstream neighbors of wasting water on unproductive agriculture. Turkey also argues that Syria and Iraq should compensate Turkey for the water facilities which control the water flow, which prevent floods and provide a constant flow of water all year round even during droughts. As a result, Syria and Iraq were successful in blocking most of the international funding for the GAP Project. This forced Turkey to bear the entire cost of the dam project single-handedly.

Since the World Bank requires consent of all riparians before financing is approved, the Bank denied loaning to Turkey. Most other lending sources refused to help fund the GAP project as a result of Syrian and Iraqi efforts. The legal and financial barriers have led to time delays and scaling back of the GAP project. The International Court of Justice concluded "the obligation of every state not to allow its territory to be used for acts contrary to the rights of other states." The UK Dept of Trade and Industry was convinced by Greenpeace to withdraw support for the Ilusu Dam. (Allan T. , 2000, p. 296)These fallbacks coincided at a time that Turkey was experiencing high inflation and unemployment, according to Bulloch and Darwish (1993: 65). (Dolatyar & Gray, 2000, p. 154)Turkish economists blamed the country's financial troubles on the GAP but politicians were motivated to continue the project as a matter of national pride.

Scholars who advance the notion of a zero-sum game because Turkey controls the headwaters ignore the might of Syria and Iraq's influence in the international community. Without financing from the World Bank and other lending institutions, Turkey has struggled to bring the GAP to completion. The financial blockade created by Syria and Iraq has not only weakened Turkey's economy but it have even destabilized Turkish security. Despite competing claims, cooperation and diplomacy have prevented conflicts from erupting in the basin. Until negotiations have settled the legal rights and obligations of the riparians of the Tigris and Euphrates, water disputes will continue to threaten the security and economy of the region.

CHAPTER 3: THE JORDAN RIVER BASIN

Introduction

The Jordan River is sacred according to the Judeo-Christian tradition and has been continuously inhabited since ancient times. Urbanization and deforestation have exhausted the natural resources. Overgrazing and tree harvesting have laid the land bare and soil runoff has inundated the river system causing the formation of swamps. (Hillel, 1994, p. 147) American writers Herman Melville and Mark Twain remarked on their travels to the Holy Land in the mid-nineteenth century that the natural landscape had become a wasteland.

When referring to the Jordan River itself, Twain remarked that he found it "crooked, shallow, and puny." (Hillel, 1994, p. 147) Compared to other water basins in the Middle East, the Jordan River, despite its fame, is the smallest. It provides only 2 percent of the water flow of the Nile River, and 5 and 3 percent of the Euphrates and Tigris Rivers. In Arabic it is called Nahr al-Urdunn, indicating its status as more of a stream than a river. (Dolatyar & Gray, 2000, p. 85)

Geography

The topography of the Jordan River basin is unique and has created an environment of extremes. Located on the east coast of the Mediterranean, rainfall is concentrated in the western part of Israel. The western side of Israel is at sea level and then rises further eastward until it dips dramatically into what is called the Jordan River Valley. The Jordan River Valley and the West Bank are desert and it is in this area that irrigation is thought to have began nearly eight

millennia ago. This rift which separates Israel from the West Bank extends all the way from southern Anatolia to the Red Sea. (Hillel, 1994, p. 152)

The Jordan River begins at Mount Hermon which is located in the occupied territory of Golan Heights. The land located above the Sea of Galilee is referred to as the upper Jordan and everything below as lower Jordan. The three principal sources of the Jordan River are the Dan River of Israel, the Hasbani in Lebanon, and the Banias River located in Syria. These rivers converge on the Huleh Basin. The Jordan River encounters several tributaries: the Yarmouk from Syria and Jordan, Harod and Yabis, and lastly the Fariah, Zarqa, and Nusayrat tributaries. Past these tributaries it a small stream that meanders until it drains into the Dead Sea. (Hillel, 1994, p. 155)

The Dan, Hasbani, and Banias Rivers constitute the upper Jordan. The Dan River, located in Israel, is the largest tributary and contributes 50 percent of the upper Jordan. The Hasbani has unpredictable flows. It generates between 52 and 236 mcm per year. Like the Hasbani, the Banias River, which has its origins in Syria, is also irregular. Its flow is 121 mcm per year on average. (Dolatyar & Gray, 2000, p. 89)

The Jordan River Valley is a land of extremes. It transitions from a fertile landscape to a dry and desolate one. Temperatures of over 100 degrees Fahrenheit are common near the Dead Sea. Although the religious significance of the Jordan River is of great measure to the Judeo-Christian tradition, the river itself is meager in proportion to other well known river systems. The Jordan River is only 1.5 percent the discharge of the Nile River. It is only 30 meters wide and 1 to 3 meters deep. Although it is small by comparison, the demand for its water is uncompromisingly great. (Hillel, 1994, p. 156)

The Yarmouk River

The Yarmouk River is the main tributary of the Jordan River and can technically be considered an independent river in itself. Although it is less than half the size of the Jordan River, it is the source of 70 percent of the upper Jordan's flow. However, the Yarmouk's flow fluctuates annually as well as seasonally from 300 to 800 MCM/Y. The most efficient use of the Yarmouk is to store the excess water during the rainy winter season to supplement the dry summers. However, the failure of negotiations to decide allocation has prevented development on the Yarmouk, development which would make more effective and efficient use of this valuable water resource.

Jordan River Riparians

Four states share the Jordan River basin: Syria, Lebanon, Israel, and Jordan. Palestine is the fifth consumer of the Jordan River's limited water resources. Among these riparians, only Lebanon has escaped the misfortune of having an arid environment. Syria is 70 percent desert, Israel 60 percent, and 85 percent of the Kingdom of Jordan is desert. (Dolatyar & Gray, 2000, p. 89) The catchment of the Jordan River Basin is distributed as follows: 54 percent in Jordan, 30 percent in Syria, 14 percent in Israel, and less than 2 percent in Lebanon. The percentage sourced from each country via smaller rivers and tributaries: 27 percent from Jordan, 32 percent from Israel, 10 percent from Lebanon, and 31 percent from Syria. However, the Banias River, located in Golan Heights is also an abundant source of water, and consequently, is disputed between Israel and Syria. (Hillel, 1994, p. 157)

Although the Jordan River Basin partially satisfies the water demand of Syria and Lebanon, these states are not as reliant on the Jordan River as its principal water source. Their agricultural base is fed by other sources of water within their borders. Lebanon's climate and mountainous terrain have created a fertile landscape. Lebanon is endowed with several minor rivers which comprise its water base. Syria has sufficient surface and groundwater as well as alternative water resources to the Jordan River. (Dolatyar & Gray, 2000, p. 90) Syria has a total of 36 bcm of water which is adequate for its needs. In the northeast of the country, Syria relies on the Euphrates for much of its domestic and agricultural needs. In fact, the Yarmouk River only provides 7 percent of Syria's water supply. (Hillel, 1994, p. 158)

Conversely, Israel, Jordan, and Palestine suffer an acute water deficit. Their demand on the Jordan River Basin is greatest because they have limited ground and surface water. By comparison, the Jordan River Basin supplies only 5 percent of the water used in Lebanon and Syria. Jordan has traditionally collected its water from the Jordan River, principally the Yarmouk River, which is the largest tributary. Even after Jordan lost territory to Israel during the 1967 Six Day War, Jordanians get 50 percent of their water supply from the Jordan River.

Water shortage in the Jordan Basin is a matter of inequitable allocation and natural scarcity. Historically, although water was scarce, sustainable water practices prevented water deficits from occurring. Dolatyar and Gray argue that scarcity began with the onset of the Arab Israeli conflict as the two opposing sides sought to sequester water resources for their own use. Scholars such as Homer-Dixon theorize that a 'population race,' an effort to control the 'other' from increasing in population size through "deportation, exclusion, or extermination" played a

role in the Arab Israeli conflict. According to Homer-Dixon, this population race contributed to the water shortage in the Jordan Basin. (Dolatyar & Gray, 2000, p. 93)

The West Bank

Israel has severely limited the Arab population from accessing new water sources. Palestinian resentment continues to grow as Israelis overdraw local aquifers. Palestinian's consume 130 mcm per year which "represents only 20 percent of the rechargeable groundwater reserves of the West Bank, estimated as ranging from 560 to 710 mcm." (Dolatyar & Gray, 2000, p. 92) For those living in the West Bank, illegal water drilling has become necessary in order to meet demand. Overpumping has lowered the water table and has caused once freshwater wells to turn saline. These unsustainable methods have continued for 30 years in Gaza. A growing water deficit will mean that those living in Gaza will either have to import water or somehow manage the expense of building desalination facilities. (Dolatyar & Gray, 2000, p. 93)

Israel

Between World War I and the establishment of the State of Israel, the Jewish population grew from 80,000 to 600,000. Immigration made the population swell yet again and by 1951, the population doubled to 1,300,000. Ten years after it was founded, Israelis numbered over 2 million. Today, Israel's population is 7,353,985 (CIA, 2010).

Conversely, the Kingdom of Jordan experienced a flood of Palestinian refugees. As Jewish immigrants arrived by the tens of thousands in Israel, 450,000 Palestinians sought refuge in Jordan. Prior to this expulsion, Jordan's native population was 200,000. These refugees were mostly peasant farmers. In an effort to restore their livelihood, the Jordanian government took

measures to divert the water from the Jordan River in order to increase the arable land. (Dolatyar & Gray, 2000, p. 98)

Deforestation, industrialization, and converting wetlands into farmlands were methods by which the new Israeli government sought to change the arid landscape into the lush paradise described in the Hebrew Bible. These developments served to provide employment to the rapidly growing Israeli population. It also served to keep the Israeli people and government entrenched in its newly acquired territory. By developing the land, the Israeli government was convinced their claim to the land could not be violated. (Dolatyar & Gray, 2000, p. 100)

Israel boasts an efficient water infrastructure which was put in place in the early 1950s. Israel's National Water Carrier serves both urban and rural residents through an interconnected system of "canals, tunnels, pipes, reservoirs, and pumping stations." (Hillel, 1994, p. 165) The water main begins on the shore of the Sea of Galilee and transfers water over a distance of 100 km to Tel-Aviv. From Tel-Aviv two pipelines transfer water "southward over a distance of 95 km to the arid Negev region." Local demand for water is greatest during the summer months, however, depending on its availability, local aquifers may reintroduce water back into the main water system during the winter months.

In addition to domestic consumption, the creation of Israel's water system in the 1950s allowed the country to increase agricultural output from 30,000 ha in 1948 to 200,000 ha in the 1980s. The amount of water extracted by the National Water Carrier increased from 380 million cubic meters in the 1970s to 420 MCM per annum in the 1980s. However, this growing demand is unsustainable. Increased demand for water coupled with decreasing inflows is draining the Sea of Galilee and Israeli aquifers at an alarming rate. (Hillel, 1994, p. 165) 80 percent of Israel's

water resources are located in the north of Israel, but 65 percent of its agriculture and urban centers are in the southern half of the country. This maldistribution of water has contributed to a growing deficit of 200 to 300 mcm per year. (Dolatyar & Gray, 2000, p. 92) In order to combat this growing water deficit, Israel has ventured into new ways of reintroducing water into its water system. Waste water reclamation, cloud seeding, and desalination are some methods which Israel has undertaken to alleviate the water shortage. (Dolatyar & Gray, 2000, p. 92)

One quarter of Israel's water supplies comes from the Sea of Galilee. It is approximately 166 km sq and provides 750 to 850 MCM/Y depending on the amount of rainfall that year. The lake also serves as an artificial reservoir. Engineers can control the storage capacity of the Sea of Galilee via dam at the south end to control the outflow. Although the dam can store nearly twice the amount of annual water flow, this would not be enough to sustain Israel over multiple dry seasons. Increasing the water level would endanger the many farms, roads, and religious and ancient sites in the area. (Hillel, 1994, p. 166) Lowering the water level and increasing the flow of water would increase the salinity of the Sea of Galilee and lessen the quantity available during the winter months.

Prior to agricultural development, evaporation, water diversion, and the conversion of the Galilee as a reservoir, the Sea of Galilee fed 650 MCM/Y into the Dead Sea. That number has dropped by more than half to 200 to 300 MCM per year. Due to evaporation, the Dead Sea has shrunk by more than 30 percent. (Hillel, 1994, p. 168)

The Kingdom of Jordan

The Kingdom of Jordan suffers from both a growing population and a meager share of the Jordan Basin. With a population of 6,407,085 (CIA, 2010) Jordan comparatively has half the

water available per capita than Israel. Israel and Syria have the advantage over Jordan because they are upstream riparians. Syria controls 80 percent of the headwaters. (Hillel, 1994, p. 169) Jordan heavily relies on its surface water because only 15 percent of the precipitation it receives is reintroduced into the ground water.

Although Jordan spans 90,000 sq km, the majority of the land is infertile. It experiences short rainy winters and long dry summers. The distribution of rain is highly uneven in this arid nation. A mere 3 percent of the country receives a minimum of 300 mm of rain a year which is the minimum needed for rainbased agriculture. (CIA, 2010) Most farming is concentrated in the northwestern edge of the country at the joining of the Jordan and Yarmouk Rivers.

Jordan has invested $3 billion dollars in water system improvements. These include reservoirs, dams, treatment centers, distribution networks, and sewage treatment facilities. The King Talal Dam on the Zarqa River was completed in 1977 and has a capacity of 90 million cubic meters. (Hillel, 1994, p. 175)

Jordan's annual water requirements vary according to each sector. The consumer demand for water is 21 percent, industrial use is 4 percent, and agricultural use is 75 percent of the total freshwater demand. The combined total of consumer, industrial, and agricultural demands for water therefore equal 1.01 cu km per year. However, this is greater than the .9 cu km of renewable freshwater. A deficit of .11 cu km accrues annually. (CIA, 2010) Jordan was prevented from building storage capacity on the Yarmouk River out of Israel's security concerns. As a result, Jordan's water deficit is increasing as it draws on non-renewable water sources. (Dolatyar & Gray, 2000, p. 91) Hence, the annual water per capita available to Jordanians

compared to its neighbors is relatively low. In Jordan, the annual consumption of water per capita is 300 cubic meters versus 360 cm for Israeli citizens. The other Arab states consume 1,000 cm per capita. (Hillel, 1994, p. 175)

Jordan consists of three zones: the Jordan Valley, its associated tributaries, and other water basins. The Jordan River Valley mainly includes the Yarmouk River and its corresponding rivers and wells which contribute 300 MCM/Y. The Wadis, or valleys, and the groundwater sourced from the cities of Amman, Zarka, Dhuliel, and Qastal contribute another 380 MCM/Y. Other sources of water are found in the basins of Wadi Arabah, Jafir Basin, Disi, and Azraq which provide another 100 MCM/Y. Therefore, the total sum of water supplies in the country equal anywhere from 700 to 900 MCM/Y. The introduction of dams into the water system could provide an additional 100 to 200 MCM/Y. There are also nonrenewable groundwater resources on the border between Jordan and Saudi Arabia.

The East Ghor Canal has been Jordan's major water development undertaking thus far. Originally, part of a larger project which would have included dams on the Yarmouk and its tributaries, the East Ghor Canal consists of main canal which runs south from the village of Addasiye extending all the way to the Dead Sea. The canal has spurred "land reform, settlement, and infrastructure and community development." (Hillel, 1994, p. 171) The crops produced from such land reclamation are sold domestically and exported to the Persian Gulf states.

History

According to Dolatyar and Gray, the water crisis in the Jordan Basin is a relatively new phenomenon that began when colonial powers facilitated the Zionist establishment of Israel. The

indigenous people of the Jordan Basin lived lifestyles well adapted for the arid environment. Early in the twentieth century, the Zionists tried to secure as much water resources in the Jordan River Basin. They lobbied the Conference in Versailles in 1918 to include land in Syria and southern Lebanon as part of the Jewish national homeland. However, Syria was a French mandate. France prevented the Zionist settlers from achieving these goals. France prevented hydrological surveys from being conducted. (Dolatyar & Gray, 2000, p. 95)

First Zionist Settlers

Towards the end of the 1800s, Jewish settlers began arriving in Palestine to escape the persecution in Europe but also to reclaim what they considered their ancestral homeland. These original pioneers were part of the Jewish Zionist movement which sought to establish a Jewish national homeland. Many of these settlers took to farming and some established collective farms known as kibbutz where all work and profits were shared equally and decisions were made democratically. (Hillel, 1994, p. 148)

Arab resentment grew as the number of Jewish settlers in Jerusalem increased. By the end of WWII, Holocaust survivors began arriving in the British Mandate of Palestine. Following WWII, the UN recommended that Palestine be divided into a Jewish and Arab state. This two state solution was rejected by the Arabs and war began between the Israelis and Arabs and as a result the Israelis managed to gain even more territory. Jews were banished from Arab nations and Arabs were displaced from their homes by the Israeli government.

The 1967 Six Day War

Palestinians did not represent a cohesive group and were unable to fend off maneuvers from other Arab states annexing parts of Palestine. Egypt annexed Gaza strip and Jordan ruled

the central highlands and renamed it the "West Bank" of Jordan. In 1967, war erupted again between Israel and its Arab neighbors. The Israelis gain control of Gaza from Egypt, the West Bank from Jordan, and Golan Heights from Syria. Egypt's initial success during the 1967 war allowed for a treaty with Israel which returned control of Sinai to the Egyptians. (Hillel, 1994, p. 151)

Palestinian resentment culminated in a popular rebellion known as the Intifada or "uprising". Following the Persian Gulf War, the U.S. took the initiative to begin negotiations between the Israelis and Palestinians. This peace process was brokered by U.S. President Bill Clinton in 1993 and resulted in mutual recognition of Israel and the Palestine Liberation Organization. (Hillel, 1994, p. 151)

Arab-Israeli Conflict

Dolatyar and Gray argue that the water conflict in the Jordan River Basin is fueled more by politics than the actual water shortage. According to them, "water has been more a pretext than a cause of interstate strife." They advance that the water allocation within states is the most pressing problem rather than interstate water allocation. They point to the national and regional efforts that have been made to dissuade states from going to war over water. A bitter yet tacit agreement over water has been in place between Jordan and Israel, and for the most part, water shortage has resulted in cooperation more than conflict. (Dolatyar & Gray, 2000, p. 87)

Water Development

Development projects on the Jordan River have been underway since the British Mandate of Palestine. In 1939, Dr. Walter Clay Lowdermilk under the auspices of the U.S. Soil

Conservation Service, suggested that a Jordan Valley Authority be established, similar to the Tennessee Valley Authority in the United States. Such an institution would have directed the construction of hydroelectric plants, irrigation systems, drainage, reforestation, and the extraction of minerals from the Dead Sea. (Hillel, 1994, p. 159)

The Zionists embraced Lowdermilk's plan and the Tennessee Valley Water Authority approach. This plan would have used the water resources of the Hasbani, Banias, Yarmouk, Dan, and Zarqa rivers to irrigate farmland in Northern Galilee and Northern Palestine. Lowdermilk also envisioned that the Litani River could be diverted to form an artificial lake in order to irrigate the Negev Desert and that a canal would carry water from the Mediterranean to the Dead Sea. (Dolatyar & Gray, 2000, p. 95)

The development of Israeli sovereignty changed the Zionist's water agenda. Sovereignty meant that Israel could appropriate the water sources it needed without having to participate in a regional water sharing scheme. UN recognition of Israel and the Arab-Israeli War of 1948 caused the Arab nation states to reject the regional water sharing scheme that Lowdermilk's plan encouraged. (Dolatyar & Gray, 2000, p. 95)

Zionist leaders encouraged Jewish settlers to tame the land. Zionists romanticized the immigrants' ties to the land. They encouraged new Jewish settlers to take up farming as a way of both empowering settlers to feel connected to their new homeland and help build the foundation for its economy. Settlement building was both instrumental in expanding Jewish territory and securing access to water resources. It was also a way in which Zionist leaders could instill a sense of collective identity and purpose to Jewish settlers who came from diverse backgrounds. (Dolatyar & Gray, 2000, p. 95)

Between 1953 and 1954, Eric Johnston was appointed by President Eisenhower to negotiate shared use of the Jordan Basin using the Tennessee Valley Authority as a model. Combing several plans from the Arabs and Israelis, the final draft was called the Unified Plan. The Unified plan would have allocated water in the following ways: (1) to Lebanon: 35 MCM/Y from the Hasbani; (2) Syria: 20, 22, and 90 MCM/Y from the Banias, upper Jordan, and Yarmouk; (3) Jordan: 100, 377, and 243 MCM/Y from the lower Jordan, Yarmouk, and tributary wadis, respectively; and (4) Israel: 375 and 25 MCM/Y from the upper Jordan and the downstream Yarmouk. (Hillel, 1994, p. 161) A proviso of the plan would have allowed Israel free access to surplus flows of other riparians.

Johnston's plan was not successful because Arab leaders rejected a plan that benefited Israel. The meetings were restricted to technical personnel and were guided by a non-political agreement to make as much water available to each riparian divided equitably. The functional nature of the deliberations allowed for much progress to be made away from the media glare. Although the Johnston plan was rejected by Arab leaders it has been the de facto plan and has been followed by Jordan and Israel thereafter. "Interestingly, the Arab states later contended that Israel was violating the same agreement that their political leaders had once rejected." (Hillel, 1994, p. 161) New trends, such as population growth, environmental changes, and changing political boundaries have since rendered the Johnston Plan somewhat obsolete.

However, the Johnston Plan allowed for the Israelis and Jordanians to begin their own separate water agendas. Originally, the Israelis wanted to divert water from the upper Jordan through Golan Heights. However, this area was and is counterclaimed by Syria. In order to avoid further hostilities, the Israelis sourced their water from the Sea of Galilee. Continued use of the

Sea of Galilee is raising its salinity levels and may eventually render the water too saline for domestic, agricultural, and industrial uses. (Hillel, 1994, p. 162)

The Headwater Diversion Project

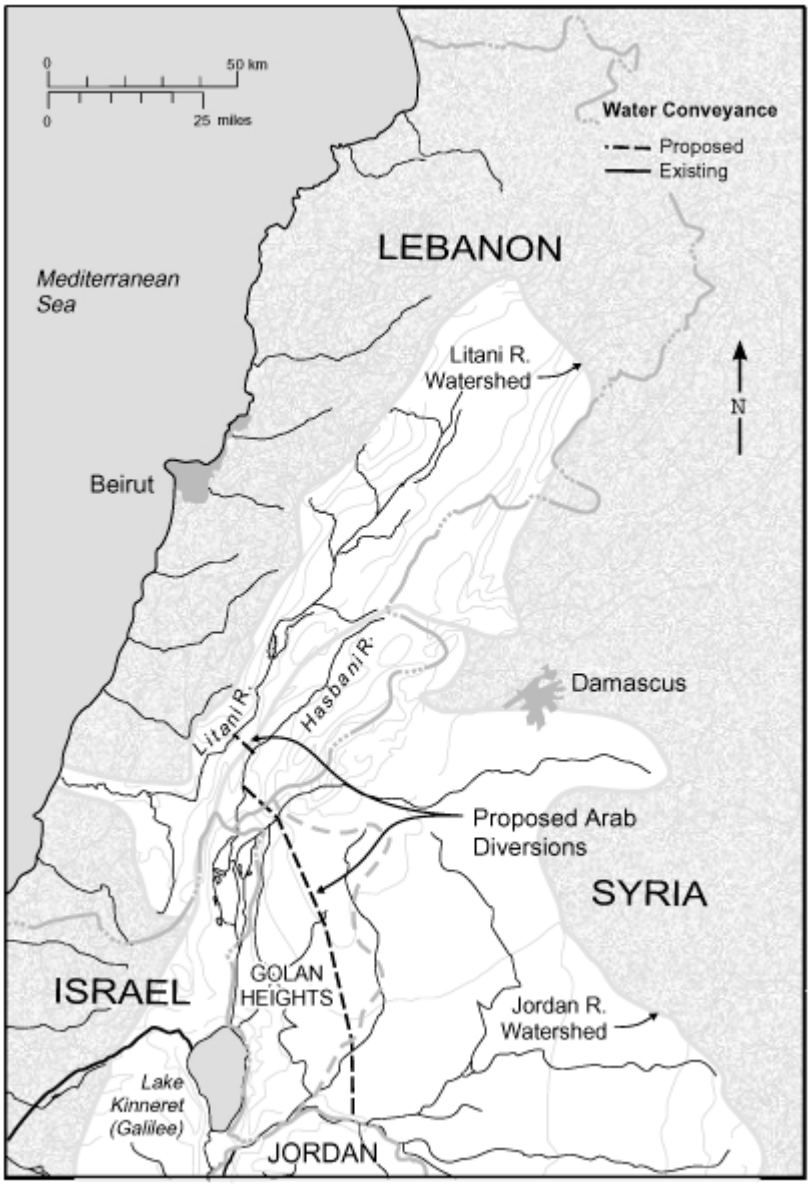


Figure 4 1959 Arab Water Diversion Plan
source: http://www.idrc.ca/openebooks/719-1/img/watershed_141_la_0.jpg

Unsatisfied with the prospect of continued use of the Jordan River by the Israelis, the Arab states' began construction on their water diversion project. This project would have diverted the water from the Litani River of Lebanon to the Hasbani River and then "to the Banias in Syria via a tunnel." (Hillel, 1994, p. 162) The water would be transferred through a tunnel over the Golan Heights to Wadi Raqqad, a tributary of the Yarmouk River. A dam was to be constructed at Muheiba, Jordan and "used by the Jordanians of the lower Jordan Valley." After a summit meeting in 1964, the Arab states' agreed to go forward with the plan.

The Headwater Diversion Plan quickly elicited an armed response from Israel. Israel bombed Syrian construction on the diversion project in 1967. Water conflict scholars argue that these confrontations eventually led to the 1967 Six Day War. The Soviet Union accused Israel of plotting to invade its client state, Syria, which Israel denied the charges. The Soviets urged Egypt to launch a preemptive strike against Israel. Egypt blockaded Israeli shipping and moved its army into Sinai. Hence, Egypt's blockade of the Tiran Straits was a catalyst for the beginning of the Six Day War. (Hillel, 1994, p. 163)

Israel was the decisive victor of the Six Day War. The Golan Heights and the Banias headwaters were among its spoils. With the Banias under their control, the Israelis were assured access to upper Jordan River waters. Now that the headwaters belonged to Israel, Israel controlled the Jordanian dam on the Yarmouk River. In addition to the Banias River, Israel also annexed a strip of Lebanese land thereby preventing diversion of the Hasbani to the Litani River. However, Lebanon had long suspected Israel of coveting the Litani River. In 1970 the Lebanese countered Israeli hopes of tapping the Litani River by diverting the headwaters of the Litani to the Awali River.

Unity Dam

Maqarin Dam, also known as Unity Dam, was proposed in 1953 to be built on the Yarmouk River. It was to be joint project between Syria and Jordan. Initially, it was planned to be a 100 meter high dam, able to store 250 MCM. Israel objected to the plans for the Maqarin Dam out of fears that it would disrupt the flow of water to Israel. According to Jordan, based on the de facto allocation stipulated under the Johnston plan, only 3 percent of the natural water flow from the Yarmouk River is allocated to Israel. (Hillel, 1994, p. 173)

By the 1970s the United States became involved in finding a solution to the Middle East water problem as a means of fostering cooperation towards peace in the region. The Carter administration began negotiations with the Syrians and Israelis, the upstream and downstream riparians, respectively, to negotiate allocations of the Jordan River. The Syrians wanted to dam the upper waters while Israel wanted to secure their share of the river. The negotiations failed and Jordan was forced to reduce their agriculture enterprises to conserve water.

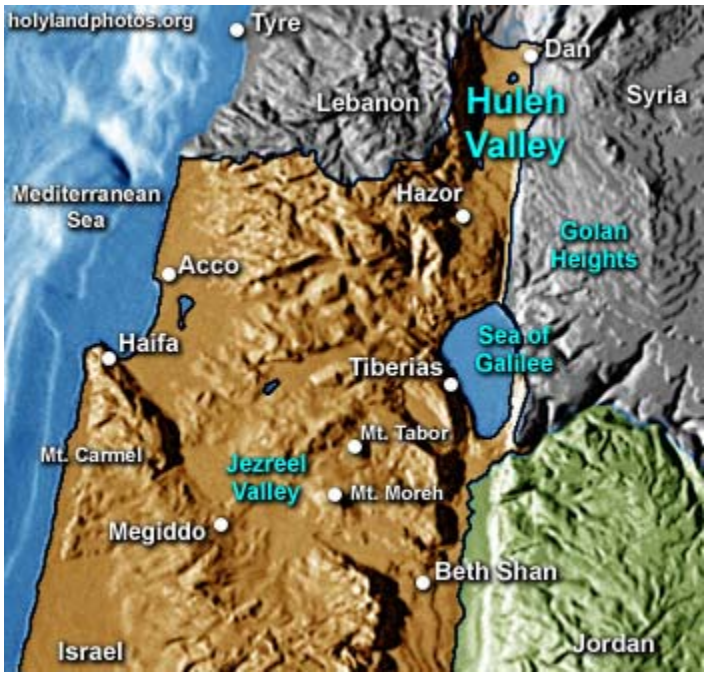


Figure 5 Hullah Valley
Source: http://www.holylandphotos.org/browse.asp?s=1,2,5,29

The Hullah Valley

One of Israel's water development shortcomings was the draining of the Hullah Valley in the 1950s. The draining of the Hullah swamp was meant to defeat malaria and to convert swamp land into usable land for housing development and agriculture. The project did not play a role in ousting Malaria because the disease had previously been under control. The land proved worthless for agricultural ventures. The agriculture that was undertaken caused agricultural runoff of pesticides which polluted the Sea of Galilee. The process of draining what had formerly been swamp land released nutrients from the soil. This soil runoff found its way into the Sea of Galilee which also affected the water quality, a phenomenon known as eutrophication. (Hillel, 1994, p. 164) In the 1980s, after years of denying the ecological disaster that the Hullah project had created, the Jewish National Fund spent $30 million dollars in an effort to restore the Hullah

marshes to its original state. However, where the project was successful was in creating more Israeli settlements. (Dolatyar & Gray, 2000, p. 101)

Water as a strategic issue

Settlements were used to lay claim to land and provide security to the border. The rapid expansion of settlements created a sudden increase for the demand of water. Water had become a zero sum game among the Arabs and Israelis. Israelis needed more water in order to build its infrastructure and become a modern state. Lebanon and Syria were upstream of Israel; they could control Israeli expansion by limiting the amount of water available to Israel. Hence, water had become a security issue. (Dolatyar & Gray, 2000, p. 104)

Institutionalisation of water policies

Once Israel became a sovereign state, it seized all the water sources within its territory. The Israeli government abolished ownership by landowners and villagers over local wells. "Israel's National Water Carrier became a symbol of aggressive expansionism." (Dolatyar & Gray, 2000, p. 105) The Palestinian National Liberation Movement attacked Israel's National Water Carrier and the Arab League agreed to water developments to help Lebanon, Syria, and Jordan. As a result of Israel's victory in the Six Day War, the land Israel captured allowed for "an unparalleled integration of its water resources into one national system." (Dolatyar & Gray, 2000, p. 105)

Israel strictly curtailed Arab farmers' access to water in the West Bank. Permission to drill new wells was rarely granted. Less than five percent of water resources in the West Bank were allocated to the Arab population while Israel consumed 95 percent. Meanwhile, irrigated

agriculture expanded from 15 percent in 1950 to 65 percent in the late 1980s. (Dolatyar & Gray, 2000, p. 107) Dolatyar and Gray contend that Israel's planned occupation of the water rich region of southern Lebanon was a means to avoid the expense of building costly desalination plants. However, Israeli generals at the time asserted that the construction of desalination plants would have been less costly than military invasion.

The New Paradigm

Dolatyar and Gray identified three events which have steered Israel away from a nationalistic water agenda and towards regional cooperation. In the 1980s, a prolonged drought forced Israel to reprioritize its water management practices. Water for agricultural uses was decreased and this reflected Israel's paradigm shift away from water as a strategic issue to water as a commodity or economic issue. This paradigm shift was encouraged by the decreasing importance of agriculture to Israel's economy. By 1993, agriculture was barely 3 percent of the country's GNP. (Dolatyar & Gray, 2000, p. 109) Fewer than 4 percent of Israel's labor force was employed in the agricultural sector. The water in dispute between Arabs and Israelis is worth in monetary terms as less than half percent of Israel's GNP. All these factors have served to recharacterize water as a economic issue rather than a strategic issue.

The second factor in Israel's paradigm shift was the growing environmental awareness especially among the younger generation. Older generations of Israelis were taught a romanticized ideal of farming, but this line of thinking has been replaced by a growing concern for the environment. Younger Israelis have reconciled with the fact that their country in its natural state is a desert. Water pollution is a problem which affects both Israelis and Arabs. In order to address this problem, "joint management of water resources is warranted: when viewed

from an environmental perspective, water negotiations are no longer a zero-sum game." (Dolatyar & Gray, 2000, p. 111)

The third factor was the end of Cold War alliances and a new era of political alliances in the Middle East. Peace talks between Israeli and Arab leaders included discussions on water and environmental issues. The Madrid negotiations of 1991 helped initiate a dialogue on water scarcity in the region; "seminars, conferences, and papers concerning the scarcity of water resources in the Middle East and the impact of the scarcity on the region's politics." (Dolatyar & Gray, 2000, p. 111) There is a growing awareness that a multilateral approach to water scarcity in the Middle East is needed.

Conclusion

While allocation continues to be a source of tensions, Israel and Jordan have found ways of cooperating with one another. The dispute between Israel and Jordan over the planned construction of the Maqarin dam is based on water rights and allocation. The Johnston plan, despite having been rejected, is still used somewhat as a guideline to determine allocation. For instance, the Johnston plan allocated 25 MCM/Y to Israel via the Yarmouk River. In actuality, Israel has utilized 70 to 100 MCM per annum. The Israelis have assisted the Jordanians with clearing sediment and debris from the opening of the East Ghor Canal. (Hillel, 1994, p. 173)

For lack of nonrenewable water resources, Jordan has turned to exploiting its aquifers. The process of tapping underground water is an expensive undertaking. As the water table continues to diminish, it will become prohibitively more and more expensive. Although the

water is often brackish, the costs of processing and transporting it high, nonrenewable groundwater supplies approximately 125 MCM/Y. (Hillel, 1994, p. 174)

In order to combat its water problem, Jordan needs a more efficient and well maintained water system. Its current method of water delivery suffers from leakages. The cost of water should also be carefully metered. Water utilities are underpriced in Jordan. If consumers were charged a more realistic sum, more funds would be available to properly maintain and improve the water infrastructure in Jordan. The cost of transporting the water is expensive because water sources are far from the population centers. (Hillel, 1994, p. 175)

There are several ways in which Jordan must address the water problem. Water supplies must be increased, whether from conventional or alternative means. To increase the efficiency of the water system, Jordan must target the most important sectors of its water consumption and give priority to those specific water demands. Waste water reclamation needs to be incorporated into the water infrastructure. Finally, and most importantly, Jordan and its fellow riparians must reach an agreement on water allocation of the Jordan River Basin. (Hillel, 1994, p. 175)

Dolatyar and Gray argue that the early Zionists' romanticized vision to tame nature and alter the natural landscape was detrimental to the environment and hence the water supply. They also advance that the water shortage was a factor in the Arab-Israeli conflict but that the reasons for that struggle centered on Israel's right to exist, its national identity, and the struggle for territory and power. Inevitably, the solution lies in resolving allocation issues through the application of international law. (Dolatyar & Gray, 2000, p. 114) "Israeli experts and policy-makers invoke [the distinction between technical and political considerations] to argue that talks should centre on technical matters such as data gathering, supply enhancement and water

management, while Palestinian officials do likewise in arguing that negotiations should centre on political questions of distribution, ownership and rights." (Selby, 2003, p. 44)

CHAPTER 4: THE DISI AQUIFER

Introduction

Competition over the Disi Aquifer is a relatively new development mentioned in water resource literature. Although there is little written about this topic it may soon come to prominence as water becomes more scarce in the Persian Gulf. Ferragina and Greco describe the relationship between Jordan and Saudi Arabia as an asymmetrical distribution of power. (Ferragina & Greco, The Disi project: an internal/external analysis, 2008) According to the CIA World Factbook, Jordan's economy is among the smallest in the Middle East with a GDP of $33 billion while Saudi Arabia has a GDP of $585 billion. Clearly, Saudi Arabia has greater financial leverage to exploit the Disi Aquifer.

Although the Disi Aquifer is a shared resource, Jordan and Saudi Arabia have pursued unilateral exploitation of the aquifer known as "precautionary use." (Ferragina & Greco, The Disi project: an internal/external analysis, 2008, p. 451) Precautionary use entails non cooperation over a shared resource in the hopes of securing water rights to that shared resource. Jordan and Saudi Arabia hope to exploit the Disi Aquifer so that in legal terms, they will create a precedent for using this resource. Essentially, if a state has evidence of use over a long period, this de facto situation, it is hoped by the state, will award that state the acquired right to the water resource.

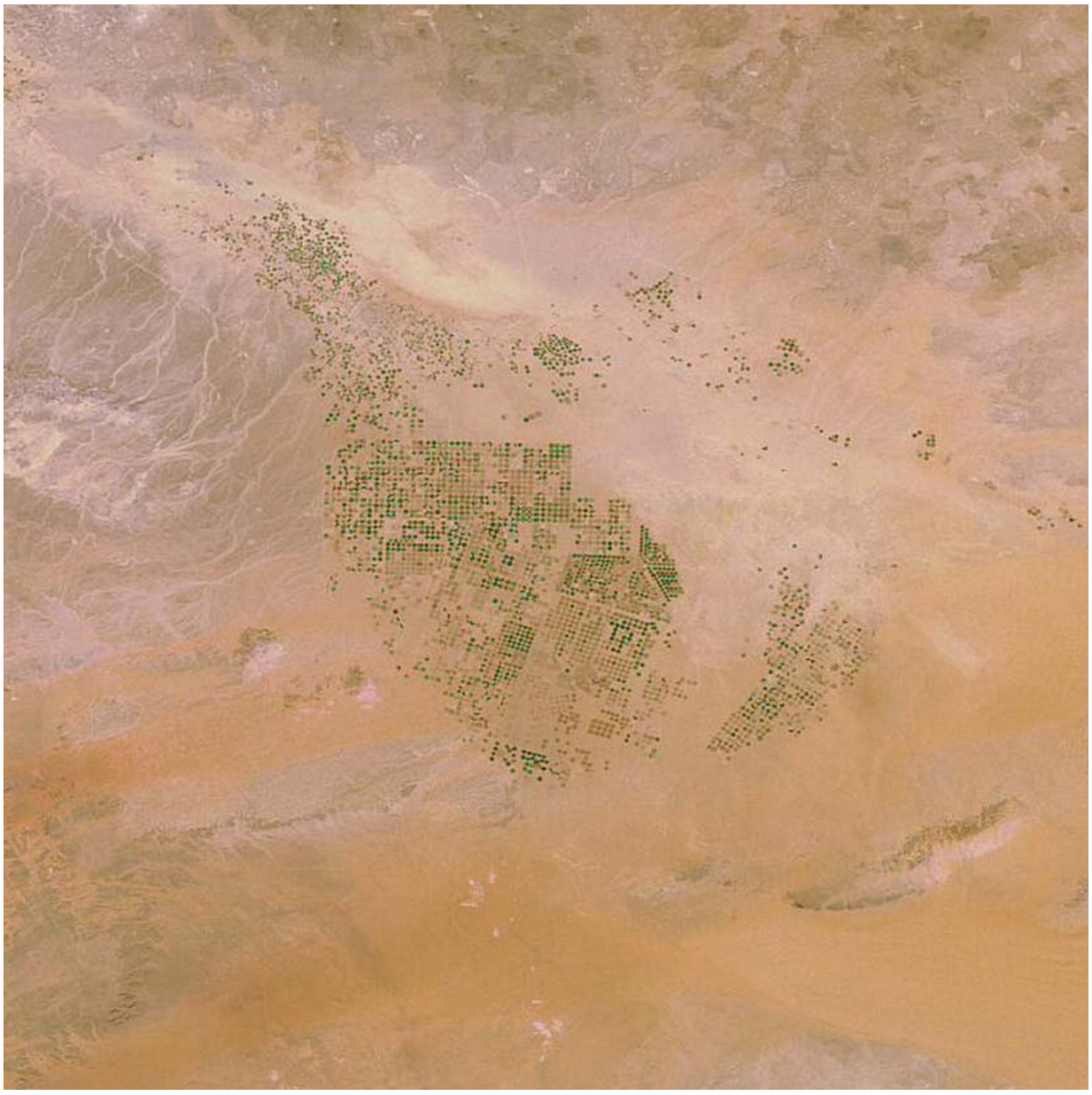
Technical Specifications

The Disi Aquifer was discovered in 1969 by the United Nations Development Program. "It is 250 km long, 50 km wide, and over 1000 m deep." (Ferragina & Greco, The Disi project: an internal/external analysis, 2008, p. 451) This water source is approximately 30,000 years old and is basically a non renewable resource. It is part of the Rum-Saq-Tabuk water subsystem and lies beneath the border of Jordan and Saudi Arabia.

Source: http://eosnap.chelys.it/image-of-the-day/agriculture-in-saudi-arabia-november-7th-2008/
Figure 6 An Example of Center Pivot Irrigation in Saudi Arabia

Saudi Arabia's consumption levels of the Disi Aquifer have actually altered the reservoir's flow patterns. Remarkably, Saudi Arabia, despite its arid climate was able to exploit this water for agricultural uses to export cereals worldwide. However, an economic downturn in the 1990s forced Saudi Arabia to curtail its agriculture. Jordanian sources say that Saudi Arabia's

consumption decreased from 1.4 billion cubic meters per year in 1995 to 800 million cubic meters per year in 2004.



Source: http://eosnap.chelys.it/image-of-the-day/agriculture-in-saudi-arabia-november-7th-2008/
Figure 7 Aerial View of Desert Irrigation in Saudi Arabia

In Jordan, the Disi Aquifer was used to supplement the decreasing domestic water supply. Large scale farming contracts were awarded to companies such as a Ram, Wafa, Arabco,

and Grameco in order to supply the city of Aqaba. According to the Water Authority of Jordan and the Ministry of Water and Irrigation, Jordan has extracted between 70 and 80 million cubic meters per year since the late 1980s. However, procuring a more accurate estimate of the water used by these agri-businesses is difficult because the Jordanian government has set no limits on the amount of water used by these companies. The Jordanian government does not monitor how much water is extracted. In addition, water used for irrigation is often lost to the atmosphere because the area is so dry.

The Water Shortage in Amman

The water shortage in Amman is particularly acute compared to other cities. Since 1987, a system of rationing water has been in place providing households with a new supply of water once a week. The huge gap between rich and poor is also reflected in the varying degrees of storing and using quantities of water.

Amman's water shortage is a result of increasing population and growth and the natural aridity of the region. The city's consumption rate was 105 million m3 and local sources of water "are insufficient to meet this demand." (Potter, Darmame, & Nortcliff, 2010) 98 percent of households in Amman are connected to the water supply network, characteristically high for a third world nation, but not surprising due to the lack of alternative sources of water.

Amman's water system is considerably inefficient. 54% of water was lost through leakages. This waste is a result of lack of planning whereby extensions to the water system were hastily put together with small-diameter pipes. In order to make sure the water reaches through these smaller pipes, developers increased the pump size thereby increasing the overall pressure in

the water system. This added pressure then in turn causes the pipes to leak. While "The remaining 'unaccounted for water' has been due to inadequate billing, lax payment collection and illegal use of water, which in 2004 amounted to over 30□000 instances. The Water Authority of Jordan (WAJ) calculates that, on average, an illegal user of water consumes two to three times more water than a legal subscriber." (Potter, Darmame, & Nortcliff, 2010)

Private water suppliers transport water during the dry summer months to compensate for unmet demand. Socioeconomic status plays a role in a household's ability to procure more water, "the costs of purchased water, storage tanks, pipework and filters are prohibitive for poor households in the eastern and southern areas of Amman. This is one of the reasons for the low average domestic water consumption of 94 litres per head per day recorded for the city." (Potter, Darmame, & Nortcliff, 2010)

In 1999, Amman's water system was privatized. ONDEO, the commercial arm of Suez Environmental, of which Lyonnaise des Eaux, France, was a leading subsidiary created a local company in Jordan called LEMA to operate Amman's water system. LEMA managed 350,000 accounts and greatly improved billing and debt collection. From 2005 to 2006, LEMA was replaced by a public company known as Meyahona ("Our Water"). Although Amman's water system is no longer privatized the Jordanian government insists it shall remain commercialized.

Higher income households were found to consume more water. On average, higher income households consumed 70.24 m3 of water per quarter whereas lower income families consumed 32.68 m3. Higher income households also pay 3.76 times more for their water. "Thus, the average water bill of the high-income households was 55.80□JD per quarter, against 14.84□JD for the low-income households. However, it is important to note that the low-income

households are devoting a higher proportion of their income to the purchase of water: an eightfold disparity in income versus under four times disparity for water." (Potter, Darmame, & Nortcliff, 2010)

Water rationing has influenced Jordanian household's ability to do chores. 74 percent of households refer to their weekly water ration as the 'day of water.' Household chores such as laundry, cleaning, gardening, as well as bathing, are strategically saved for the 'day of water.' Jordanian women lamented on the physical labor involved on the 'day of water':

> Women suffer from the rationing and it is physically hard for women. They should rush in order to finish all the weekly tasks in a few hours and to fill up the tanks. The day of water means for me as a housewife an emergency day to do the whole housework alone, in addition to looking after my six children. We try to deal with it. It's a challenge for women, because we must do as many tasks as possible during the day that water comes. It's like an International Day of dirty laundry and cleaning from the morning to the evening! It's very exhausting and if you miss those hours of water, you are forced to wait another week! (Potter, Darmame, & Nortcliff, 2010)

However, rationing also serves to emphasize the difference between rich and poor:

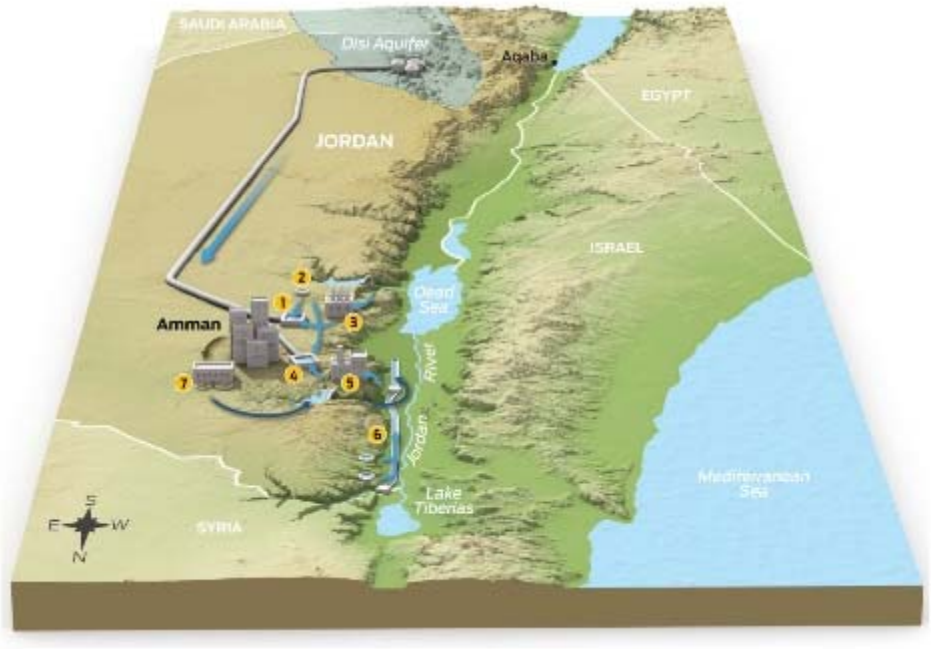
> Some areas have water every day due to social connections. So, how come all these hotels and some people have water that they use with ease, while we don't even have enough water to take a shower? The distribution is not equal at all, between the rich and the poor areas. How can you imagine that those ministers

and businessmen in Amman West could fill up the huge capacity of storage and swimming pools in just 15 or 24 hours? (Potter, Darmame, & Nortcliff, 2010)

Residents also complain that the water is of very poor quality:

> Ten years ago, the water from the network became like wastewater in its taste and smell. We had several children get sick due to this contaminated water. Water comes once a week from Thursday morning until Friday mid-day and it is contaminated and full of chlorine. Water is not suitable. So, I boil water for cooking, tea and coffee, while I drink rainwater which my father collects on his farm. (Potter, Darmame, & Nortcliff, 2010)

The Disi-Amman pipeline



Source: http://spectrum.ieee.org/energy/environment/jordans-radioactive-water-problem/2

Figure 8 Proposed Disi Pipeline

In the 1990s, the water crisis in Jordan compelled the government to seek alternative resources for the increasing water demand in its capital city Amman. A 325 km pipeline from Disi to Amman was drafted with a budget of $625 million dollars. The construction projected 65 wells and water plants to achieve the necessary water pressure to carry the water the 250 m difference in altitude. Initially, the project was estimated to be completed within 5 years.

For several reasons, the Disi Aquifer is an ideal water source for Jordan. It is an abundant pure freshwater source, an exceeding rare phenomenon in the region. However, it is a fossil aquifer which means that it is a nonrenewable water source. Like petroleum deposits, once the water is depleted, it cannot be naturally replenished.

What makes the aquifer even more readily available is the relatively easy political negotiations with its neighbor Saudi Arabia compared to other shared water resources in the Middle East region. Thus, the likelihood that Jordan would have to encounter vetoes by other countries also wanting to exploit the same resource was marginal. In 1996, the Jordanian government sanctioned an environmental feasibility study through the U.S. company *Harza* to develop a strategy to exploit the Disi Aquifer.

However, Saudi Arabia still reserved the right to file a complaint against Jordan with the World Bank. In 2004, the World Bank issued a statement that Saudi Arabia would need to have no objection to Jordan using World Bank funds to exploit the Disi groundwater resource. Subsequently, Jordan was denied World Bank funds and other forms of international funding. This left the Kingdom of Jordan with little choice than to use a build-operate-transfer (BOT) model to begin construction on the pipeline. Using this model, a private company would finance

the planning, implementation, and management of the pipeline for a period of 40 years. After the contractual terms expired, Jordan would assume control of the pipeline's facilities.

Despite the pressing need for the water the proposed pipeline would deliver, there are several environmental considerations that have been taken into account. Since the Disi Aquifer is non-sustainable, many argue that it should be carefully rationed because Jordan suffers from a burgeoning population and an unstable climate. Drilling for water would destabilize the natural environment through soil erosion and threaten local desert wildlife. The feasibility study carried out by the *Harza* company revealed that drilling would also risk the introduction of salt water from the aquifer positioned above the Disi.

The economic considerations involve the final costs to Jordanian consumers. Former Jordanian Minister of Water and Irrigation, Dr. Munther Haddadin, pointed to the escalated cost to Jordanian households by tapping into the Disi aquifer. The current affordable price for Jordanian consumers is approximately $40 per person a year, or 2 percent of annual per capita income. However, the introduction of the Disi Aquifer to the water supply would cause this sum to increase to nearly $200 per year, five times what would be considered affordable to the average Jordanian.

Since the consumer costs of the project are so high, the Jordanian government sought to offset the cost to Jordanian households. A $200 million non-refundable grant was issued by the Jordanian government to help fund the BOT solution. $100 million was offered to the company chosen to start the BOT. Rising energy costs threatened construction. The War in Iraq caused oil prices to increase. In 2004, the Jordanian government increased the price of oil in response to the decreased supply from Iraq.

Finding a contractor to build the pipeline was especially difficult for the Jordanian government. Initially, an American company, Saudi Oger, Black & Veatch International won the contract bid in 2004. However, their asking price was too much for the Kingdom to afford. A Turkish company GAMA Energy AS won the second round of contract bidding in 2007. The contact terms required GAMA to invest $1 billion dollars in the project and maintain the water pipe facilities for 25 years. After 25 years, the project would be returned to the Kingdom of Jordan.

Why Open Conflict is Unlikely

Greco utilizes a four step securitization continuum to describe how shared use of the Disi Aquifer between Jordan and Saudi Arabia may turn into a security issue. The first phase is described as non-politicised: states pursue their interests undeterred by other states; and no political discourse has yet to be formed to advance the state's agenda over another state. The second phase is described as politicized, wherein a political discourse begins to form to advance the states's agenda, in the case of Disi, the Jordanian government began promoting the benefits of extracting water from Disi. The third phase, securitizing, entails reforming the politicized issue into a security concern. In the case of Jordan and Saudi Arabia, competition for this shared resource can quickly transform from a political issue to an issue of national security. The final stage, violization, is the violation of one's state's national security by another state.

The securitization continuum proposed by Greco implies several security concepts. An official "sanctioned" discourse is used by authorities to popularize the state's agenda and minimize opposition. Between the politicized and securitized phases, the concept of "non violent conflict" manifests itself in Disi in the form of official protests by the Jordanian government

against Saudi overexploitation of the aquifer. Silence is also a method of control and power. The Saudis' lack of response to Jordanian claims of overexploitation serves to prevent Saudi Arabia from acknowledging that a security dilemma exists.

Internal and external actors in the Disi project

Government

Since water is considered a strategic resource in the region, large-scale projects such as the Disi-Amman pipeline involve intrastate and interstate water relation. The main internal force within Jordan with regard to the Disi issue is the Ministry of Water and Irrigation. Former Minister of Water and Irrigation Hasim El-Nasser argued that in addition to controlling consumption, addressing government waste on subsidies to less profitable agriculture products and cropping strategies, and on the whole, weaknesses in the country's water management was necessary.

The Private Sector

The consulting company *Consolidated Consultant* is another prominent internal actor in the Disi water project. This company was enlisted by the Jordanian government to produce a new environmental feasibility study for submission to the World Bank. Several participants from different sectors of Jordanian society collaborated on the study:

> "academic scholars, public institutions (ministries, municipal governments, the Water Authority and the Jordan Valley Authority), stakeholders and local associations, government environmental institutions (the Royal Scientific Society, the Royal Society for the Conservation of Nature and the Jordan Environment Society), some NGOs

(Friends of the Earth, etc.), and representatives of civil society, mainly Bedouin traditional authorities." (Ferragina & Greco, The Disi project: an internal/external analysis, 2008, p. 456)

The Academic Community's Consensus

A consensus is forming within the academic community in Jordan in support of drilling the aquifer. However, scholars such as Professor Elias Salameh have produced withdrawal estimates far more conservative than the national government. Initially, Salameh estimated that the aquifer could provide 100 MCM over 40 years or 70 MCM over 100 years. However, the Ministry of Water and Irrigation planned to exploit 100 MCM over 100 years. Since the Disi Aquifer is a nonsustainable resource Salameh precautions against overexploitation; he advocates that the water from the Disi should be used to supplement the drinking water supply and not for irrigation. If farms were connected to the water supply the overall pressure of the aquifer would eventually be compromised.

Environmental Organizations

Environmental organizations such as the Royal Scientific Society and the Royal Society for the Conservation of the Nature support drilling the Disi Aquifer. Although Friends of the Earth Middle East criticize the project they have not formally rejected it. They point to waste in Jordan's mismanaged water system and the fact that Disi's proximity to the tourist area of Aqaba will likely mean it will be 'misguidedly' used for industrial uses and to cater to tourists instead of solving the water crisis in Amman.

Local Farmers

The possibility that the Disi would be used for irrigation purposes has raised so much concern that all farming contracts will be phased out by 2011. This move by the Jordanian government is meant to appease critics of the Disi project. Irrigation of small plots of land by the local population would be allowed to continue into the foreseeable future. It is uncertain how long Jordan can afford to not renew farming contacts for larger agricultural enterprises. Many agribusinesses are owned by Jordan's wealthy and powerful. The government's ban on large scale farming using Disi water is being challenged by companies seeking to renew their farming licenses.

Source: http://spectrum.ieee.org/energy/environment/jordans-radioactive-water-problem/0
Figure 9 A Well in the Disi Aquifer Near Aqaba

Local communities lacked information about the Disi Project and were for a large part not involved in the decision making. They were not involved in the planning stage of the project but were later involved in its implementation. Amman residents also weren't involved in the decision making although they are expected to incur steep rises in their water utilities and energy costs. In order to raise support for the endeavor, the Jordanian government emphasized the benefits of the project such as "job opportunities, improved infrastructures, and more water for the villages along the pipeline." (Ferragina & Greco, The Disi project: an internal/external

analysis, 2008, p. 457) The government has largely withheld technical data. Therefore, residents were not provided a full cost-benefit analysis of pursuing construction on the Disi.

The Media

The media's reaction to drilling in the aquifer was generally supportive. Reports mirrored the government's enthusiasm for the project. However, reports never provided clear and consistent information. Early reports describe a return of 125 MCM over 50 years. However, these statistics fluctuated considerably over the years. The most optimistic report made assurances of 200 MCM per year for 200 years.

The International Community

Support from the international community was not as cohesive. The World Bank did not approve funding for the Disi project nor did it condemn the project either. The ambiguity in their response may lie in the fact that Jordan's neighbors had already embarked on their own water exploitation projects. Israel's used the water of the West Bank to grow citrus in the Negev Desert while Saudi Arabia had already begun exploiting the Disi Aquifer for their agricultural exports. "Basically, Jordan was doing the same as its neighboring countries." (Ferragina & Greco, The Disi project: an internal/external analysis, 2008, p. 458)

Jordan has accused Saudi Arabia of overexploiting the Disi Aquifer twice. The first complaint was in 1992 and elicited no response from the Saudis. The second complaint was in 1999 and again, the Saudis did not respond to Jordan's grievances. However, the Saudi government informally notified Jordan's Minister that the Saudis had no objection to Jordan's plans to extract from the Disi Aquifer. Ferragina and Greco claim this is "a clear case of

'voluntarily silencing' the issue for the media and the public." (Ferragina & Greco, The Disi project: an internal/external analysis, 2008, p. 458)

It has also been suggested that Saudi Arabia's passive responses to Jordan is a sign that the aquifer is nearing its threshold. If the Saudis had begun water negotiations, they would have to disclose their extraction rates. According to Barry Buzan, "Jordan has been adopting a 'securitization' strategy in recent years. An issue can be securitized in order to keep it within the sphere of national security and out of the public debate. This can be followed by violence or, as in this case, by a non-action strategy, simply by silencing the issue." (Ferragina & Greco, The Disi project: an internal/external analysis, 2008, p. 458) Ferragina and Greco speculate that Saudi Arabia and Jordan have been securitizing information regarding the Disi Aquifer in order to repress any public debate over the issue.

Jordan and Saudi Arabia's behavior suggest that a silent pumping race is occurring. Jordan has increased its use of groundwater to irrigate crops and while it is not sustainable, it is Jordan's effort to establish a de facto situation in order to lay claim to the Disi Aquifer on the grounds of "prior use." Ferragina and Greco claim this sort of state behavior has created a "pumping race," essentially a zero-sum game. Furthermore, the Jordanian Ministry of Water and Irrigation classified the extraction rates, the threshold of the aquifer, and its environmental implications. The Minister of Water Irrigation declined to answer questions regarding Disi "as prevention for possible information escape, which could damage the success of the project." (Ferragina & Greco, The Disi project: an internal/external analysis, 2008, p. 459)

Recent Developments

According to The Jordanian Times, in August 2010, groundwork on three of the 61 wells was underway. The Disi Water Conveyance Project will supply Jordan's capital city Amman with 107 million cubic meters of water by 2013. The remaining wells are projected to be completed by 2012. According to project officials, construction on the pipeline was on schedule. The project is on its second year of construction. At this time, most of the pipes and other construction materials have been procured. (Namrouqa, Disi project construction in full force, 2010)

Fourteen subcontractors have been recruited to help finish construction at the main sites. The Disi Water Company (Diwaco) is preparing to build pumping stations at the well field, a total of over 400 sq km in the Mudawara region of southern Jordan. Construction on pipelines from Hassa and Mudawara and from Madaba and Abu Alanda will start in September according to GAMA, the Turkish company overseeing the water project.

The well field site is located in Dbeidb, an area 17 kilometers south of Mudawara. Most of the wells will be used for water extraction while a handful will be "on standby" and only used for emergencies. Water generation wells are dug at a deeper depth of 600 to 700 meters while piezometer wells are dug at a shallower depth of 400 meters. A piezometer well is used to measure water pressure in soil.

The project began in June 2009 when the financial closure was signed. The Jordanian government has invested $400 million in the Disi Pipeline Project. $100 million is reserved for potential price increases in materials such as steel. Currently, the European Investment Bank and

the French Development Agency have tendered $100 million in soft loans to help fund the project. The price of one cubic meter of water has been calculated to be .74 Jordanian dollars.

However, by the end of September 2010, the Jordanian Minister of Water and Irrigation Mohammad Najjar reported that the project had encountered a "huge delay." A meeting called between GAMA and its subcontractors urged that more manpower was needed to complete the project on schedule. Although the necessary supplies and designs are in place, construction has been delayed because "GAMA 'is depending on subcontractors whose contracts were signed recently with the company.'" (Namrouqa, Major delay in Disi project - Najjar, 2010)

Conclusion

Ferragina and Greco doubt that the pumping race between Saudi Arabia and Jordan will escalate into open conflict. For the most part the two states have made no outward moves to cooperate or publicize information. Since the aquifer will eventually be exhausted there is very little incentive to cooperate. The Disi Aquifer is likely an example of the "tragedy of commons" where all parties seek to maximize their use of public resources thereby inevitably depleting it entirely.

Jordan must take stock of its water policies. Water from the Disi aquifer used for agriculture could be replaced by treated sewage water by 2020. Stopping illegal drilling, importing water-intensive crops, and refocusing water priorities to the impoverished southern region instead of Amman would improve Jordan's water situation.

Fixing instead of Drilling

Although the water situation in Jordan is dire, there are still reports that as much as 50% of water transported to Amman and 64% in Mafraq are lost to leakage. This total would suggest 140 MCM of wasted water, which is greater than what is expected to be pumped from the Disi aquifer. (see Appendix A) Even with the addition of the Disi Aquifer to Jordan's water supply, unless the distribution system is properly repaired and maintained, this nonrenewable resource will also be needlessly wasted.

A study in 2005 found that "the health and environmental benefits of investing in water efficiency are almost twice as valuable as the costs." The Jordanian ministries of health, water and irrigation, and environment seek to decrease water leakage from 50 to 60% to 18% by 2015. The study also encouraged increasing water supplies "to the 40 percent of people who use less than 51 liters of water a day, while discouraging wasteful consumption by the 20 percent who use more than 117 liters." (Benefits of water efficiency worth twice the costs - report , 2005)

The most recent expected extraction rate for the aquifer is 100 MCM for 50 years. However, the lack of transparency by the Jordanian and Saudi governments makes it difficult for experts to decide if this is realistically feasible. An engineer from Jordan's Ministry of Water and Irrigation, Ali Subah disclosed that a "memorandum of understanding" was signed in 2007. However, the contents of that document have not been released. Officially, groundwork on the Disi Amman Pipeline commenced on August 3, 2008. According to Dr. Mahsaneh, former co-chairman of the Jordan-Israel Water Coordination Committee, by the time the Disi Pipeline is finished it will not be able to meet the increasing demand.

CHAPTER 5: CONCLUSION

Upon review of the preceding case studies a mixed pattern of interstate relations begins to reveal itself. While the realist argument is heavily touted within water resource literature, conciliatory efforts made by Middle Eastern states are often overlooked. What abounds is the mismanagement of an already scarce resource. The use of unilateral force to achieve control over water resources is also a dominate pattern repeated throughout the region.

Figure 10 shows a case by case comparison of water conflict zones. In the first column, titled "Cause of Water Scarcity" the severity and nature of the water scarcity is described. In the second column, titled "National Interests" the water development goals for each riparian involved in the water dispute is described. In the third column, titled "Bilateral Relations" the international relations between each respective riparian is described. The comparison made between the three cases can be found in the bottom cell of each column.

Case: The Tigris and Euphrates River Basin

Tigris and Euphrates Basin: Cause of the Water Scarcity

According to figure 10, shortage arose from water development and not natural scarcity. Conflict began in mid 20th century with the creation of Turkish and Syrian water development. As the upstream riparian, Turkey has more power than Syria and Iraq.

As mentioned in Chapter 2, the Tigris and Euphrates Basin involves three main riparians: Turkey, Syria, and Iraq. "Twenty-eight percent of the basin lies in Turkey, the uppermost riparian, 17 percent in Syria, the middle riparian, and 40 percent in Iraq, the downstream riparian." (Lowi, 1995, p. 55) As the upstream riparian, Turkey has considerable power and

discretion over this water resource. Since 88 percent of the basin originates in Turkey and only 12 percent in Syria, Iraq has no control over its main source of water.

Figure 10 Case Comparison Chart

Case	Cause of Water Scarcity	National Interests	Bilateral Relations
Tigris and Euphrates	Shortage arose from water development and not natural scarcity. Conflict began in mid 20th century with the creation of Turkish and Syrian water development. As the upstream riparian, Turkey has more power than Syria and Iraq.	Turkey seeks to use the Tigris and Euphrates to generate hydropower, economically develop southeastern Turkey, and increase agricultural production. Syria and Iraq are trying to preserve their agricultural production against increasing use of the T/E by Turkey.	Turkey and Syria relations are strained because Turkey's GAP Water Program has caused crop failures in north Syria. In retaliation to Turkey's water policies, Syria supported Kurdish separatists. The filling of Syria's Tabqa Dam significantly decreased water flow to Iraq and nearly resulted in open conflict
Jordan River Basin	Basin has historically experienced natural scarcity due to arid environment. Population growth has increased the demand for water. Israel and Jordan heavily rely on the Jordan R. for most of their water supply.	Israel uses the Jordan for domestic consumption as well as industrial and agricultural uses. The severe water shortage in Jordan means that using water for the drinking supply is first priority. For Israel, water has economic value, but is a matter of survival for Jordan.	Syria refuses to negotiate water rights with Israel because that would acknowledge Israeli sovereignty. Severe water shortage in Jordan leaves little choice but to negotiate with Israel. Israel fears compromising water rights because it might encourage Arab states to claim more territory.
Disi Aquifer	Disi wasn't discovered until mid twentieth century by geological survey. Population growth and a desert environment places high demand on water. The aquifer is a non-sustainable resource: once it is gone it will not come back.	Jordan uses Disi to supplement drinking water supply. Jordan plans to build water pipe from Disi to Amman. Saudi Arabia uses the water for agriculture meant for export. Both seek to establish a precedent for water use in order claim rights to the aquifer.	Neither state has moved to cooperate or publicize disputes. Since the aquifer will eventually be exhausted there is very little incentive to cooperate. The Disi Aquifer is likely a "tragedy of commons" where both seek to maximize their use of public resources inevitably depleting it
Conclusion	In all cases, scarcity was intensified by population growth that occurred in the mid twentieth century. In the Tigris and Euphrates case, the water supply was adequate before development projects began.	In all cases, upstream riparians seek to use the water supply for hydropower and industrial uses in order to modernize their economies. For downstream riparians, water is primarily for domestic use and a matter of survival. Upstream riparians have the distinct advantage	Politics has influenced state behavior on whether to cooperate with other states. In all cases, absence of formal water agreements has left water disputes unresolved. Disi is a unique case where pre-existing political rivalries are largely absent hence it does not affect the water dispute.

Although the Tigris and Euphrates produce a considerable amount of water, 31.8 billion cubic meters, it is susceptible to irregular flooding on a seasonal basis. The technical solution to this irregularity is collecting the excess floodwater during the spring season to counter shortages during the winter months. Precipitation also varies across the region. In Turkey and Syria, precipitation levels drop from 1,000 to 500 mm per year. Turkey receives the greatest amount of rainfall per year with an average of 670 mm, which is sufficient for agriculture.

Syria receives even less rainfall at 250 mm per year. Syria can not only rely on rain based agriculture at such low precipitation levels and therefore must rely on irrigation based methods of agriculture. Syria relies on the Euphrates River for over 86 percent of its water resources." In the case of Iraq, almost two thirds of its total land area is desert and much of the county gets less than 125 mm of rainfall per year." (Lowi, 1995, p. 56) Iraq is highly dependent on the Tigris and Euphrates River to irrigate its crops.

Tigris and Euphrates Basin: State and National Interests

According to figure 10, Turkey seeks to use the Tigris and Euphrates to generate hydropower, economically develop southeastern Turkey, and increase agricultural production. Syria and Iraq are trying to preserve their agricultural production against increasing use of the T/E by Turkey.

Historically, Iraq had made the greatest use of the basin. As the downstream riparian, Iraq's demand for water had no effect on its upstream neighbors. However, increasing population during the mid twentieth century caused Turkey and Syria to increase their water consumption.

This increased demand for water led to several water development projects by Turkey and Syria. In Syria, the Tabqa dam was constructed from 1968 to 1973. Turkey's monumental

dam development program led to the construction of several dams: most notably Keban (1965-1973), Karakaya (1976-87) and Ataturky (1983-1992). (Lowi, 1995, p. 57)

Tigris and Euphrates Basin: Bilateral Relations: Syria and Turkey

These hosts of development projects had a deleterious effect on the ecosystem and water supply for the downstream riparians. Syrian and Turkish usage of the water basin reduced both the quantity and quality of water available to Iraq. Therefore, a water agreement is necessary in order to enforce limits and boundaries on upstream riparian usage.

The absence of a formal water agreement allowed interstate relations in "high politics" unrelated to water issues to deteriorate. "The issue of sharing water brought to the fore other sources of tension simmering between Turkey and Syria on the one hand, and Syria and Iraq on the other." (Lowi, 1995, p. 57) The first series of negotiations began in 1965. However, these talks failed because Turkey wanted Syria to accept Turkey's claim to Hatay province, through which the Orontes River flows. Since ownership of Hatay is a source of conflict between Syria and Turkey, Syria refused to sign a water agreement because by doing so it would have ceded this territory to Turkey.

Tigris and Euphrates: Bilateral Relations: Syria and Iraq

The following year, Syria and Iraq began bilateral talks. These negotiations sought to reconcile appropriate distribution of the Euphrates. Historically, Iraq had made use of the Euphrates River on a greater scale than Syria. Iraq also wanted to secure more water for increased demand in the future. "As the classic downstream state, Iraq insisted on its claim to acquired rights to a fixed share of the rivers discharge." (Lowi, 1995, p. 57) Syria argued in favor

of potential needs rather than acquired rights. After three years of negotiations, Iraq was apportioned 59 percent, but this agreement was never formalized.

When the Keban and Tabqa dams became operational in 1973, it significantly decreased the flow of water to Syria and especially Iraq. An additional 200 mcm was granted. During this time, Syria also acquiesced to filling the reservoir with less water in order to preserve Iraq's agricultural needs. By 1975, however, "Iraq charged Syria with violating the agreement by reducing the flow, thus placing a rural population of three million at risk." (Lowi, 1995, p. 58) This decreased flow was the result of the Syrians filling the newly constructed reservoir at Tabqa Dam. Iraq filed complaint with the Arab League because it had received less than half the volume of water it had received in years prior.

The filling of Tabqa Dam futher strained relations between Syria and Iraq. "Against the background of acute political and ideological tensions that had been festering since the inception of a Bath regime in Baghdad in July, 1968, the charges and countercharges quickly reached a crescendo." (Lowi, 1995, p. 58) The overarching political rivalries prevented the technical issues from being addressed.

By 1975, third parties had intervened to ease tensions between Iraq and Syria. The Arab League, Saudi Arabia, and Egypt served as mediators to prevent the escalation of conflict. Syrian troops had amassed on the border between Iraq and Syria. In an effort to defuse the crisis, Saudi Arabia helped negotiate a water agreement whereby water would be apportioned on a "proportional basis." This agreement was never signed and the dispute remained unresolved.

The political rivalries between Syria and Iraq can be traced back to the Bath Party takeover of Iraq in 1968. The Bath Party had been a power in Syria since 1963, but in 1966, the

government of the "old guard"—the founding fathers of the party were ousted by dissenting younger members. Two years later, the "old guard" took power in Iraq. This posed a real threat to the Syrian regime, which was struggling with a pro "old guard" (and hence, pro-Iraqi) contingent at home." (Lowi, 1995, p. 58) Hence, this rivalry within the Bath Party characterized relations between Syria and Iraq. This climate of hostility and suspicion not only prevented progress on political issues but technical ones as well.

The water issue became intricately tied to regional politics. For example, Iraq criticized Syria's efforts to reconcile with Israel when Syria decreased the water flow. Iraq accused Syria of retaliating against Iraq's criticisms of Syria's friendlier relations with Israel. Hence, water politics began to fuel inter-Arab tensions.

Turkey's major water development project will mean much less water will reach Syria and Iraq in the future. Negotiation has not been forthcoming because Syria and Iraqi representatives refuse to sit at the same bargaining table. This has hindered them from allying against Turkish policies. The lack of third party involvement also means encouragement to cooperate is missing.

Tigris and Euphrates: Bilateral Relations: Iraq and Turkey

In 1984, Iraq and Turkey negotiated that Iraq would receive a total of 500 cubic meters per second. Syria refused to sign the water agreement. Then, negotiations between Turkey and Syria purportedly led to an agreement of also 500 cubic meters. However, the two agreements make no reference to each other. This demonstrates how negotiations between riparians often lack coordination and collective bargaining.

Tigris and Euphrates: Conclusions

Regardless, not only is Turkey an upstream riparian but it is economically and militarily superior to its downstream neighbors. Turkey's water usage is to generate hydropower for its growing economy, encourage development in its southeastern provinces, and to appease the Kurdish population which predominate southern Turkey. Although Syria is situated at a geographic advantage in comparison to Iraq it is still economically behind Turkey and Iraq. Both Syria and Iraq stand to benefit from a water agreement with Turkey.

The issues of recognition, legitimacy, and hegemony have characterized interstate relations in the region. Competing claims by Syria and Turkey over Alexandretta province introduced the question of sovereignty. Bathist rivalries between Syria and Iraq introduced the question of legitimacy. Turkish economic and military superiority introduced the issue of regional hegemony to the water dialogue.

Although the height of open conflict occurred in the 1970s, the water scarcity continues to become more pronounced. When Turkey's East Anatolia project reaches completion it will remove 14-17 bcm from the water system. This will compromise Syria's hydropower capabilities and agriculture. Rural communities in Syria have already started to abandon their once fertile farmlands. Iraq is being forced to do without one third of previous water levels. Not only does this affect the drinking water supply but is causing the collapse of agriculture further downstream.

Case: The Jordan River Basin

Jordan River Basin: Cause of the Water Scarcity

According to figure 10, the Jordan Basin has historically experienced natural scarcity due to the arid environment. Population growth has increased the demand for water. Israel and Jordan heavily rely on the Jordan R. for most of their water supply.

Jordan River Basin: State and National Interests

Israel uses the Jordan for domestic consumption as well as industrial and agricultural uses. The severe water shortage in Jordan means that using water for the drinking supply is first priority. For Israel, water has economic value, but is a matter of survival for Jordan.

Especially in the case of the Jordan River Basin, the larger political conflict has greatly influenced the outcome of the water dispute. The possibility of relative and even absolute gains has been the major concern for Israel and its Arab neighbors. Each side has been reluctant to sign a water accord in fear that such a compromise would strengthen the other. Since access to water is closely linked to development all parties fear that relinquishing control of the water supply will compromise their chances of developing in the future.

The Arab states were also concerned about Israel's intention to transport water to the Negeve Desert to the south. Aside from the fact that this "contravened international legal principles." (Lowi, 1995, p. 193) The Arab states knew this water would be used to supply the economic development of Israel which would encourage more immigration to Israel. In order to safeguard against their enemy's growing numbers, the Arab nations rejected the principle of extra basin usage.

Israel also fought to prevent its neighbors from becoming stronger as a result of water compromises. The Johnston Plan would have had a proviso to split the Jordan River system into an upper and lower Jordan with Lake Tiberias used as a reservoir. Israel rejected this plan in fear that it would make it easier for the Arab states to make future claims to more of the Jordan River.

Controversy erupted over the construction of the Maqarin Dam in the 1970s and 1980s by Jordan on the Yarmouk River. "Israel's initial reaction to the project was that it wanted to revive the terms of the earlier Johnston Plan" (Lowi, 1995, p. 193) which allocated water to territory now claimed by Israel. Israel wanted this water allocated to its own water supply and Jordan did not want the water to be sent to Israel because it would encourage more Israeli settlement in Palestinian territories.

Jordan River Basin: Bilateral Relations: Israel and Jordan

Returning to the question of whether technical issues can be resolved before the larger political issues, Lowi provides two examples from the history of the Jordan River dispute. In the case of the United Development Plan and the Maqarin Dam, the US served as a third party to negotiations. The US expected that cooperation on smaller issues such as water development would carry on or "spill over" into cooperation in the political arena. According to Lowi, for the most part, functionalist solutions to the Jordan River dispute have failed due to the difficulty in persuading all parties to sit at the bargaining table.

Only modest gains have been made in negotiations between Israel and Jordan. Borrowing from game theory, Lowi argues that functionalism fails because the strongest state will most likely decide that cooperation offers little to gain. Syria refused to cooperate in the 1950s

because its water need from the Jordan River was not as great as Jordan's. As the strongest state in the dispute, Syria's refusal to negotiate sabotaged the possibility of cooperation.

During the era of the Johnston Plan negotiations, there existed "conflicting views of rights, needs, and international legal precedents." (Lowi, 1995, p. 195) Israel and Jordan were the most dependent on the Jordan River because they sourced their water from multiple sources, and as upstream riparians, they had more control over their access to the Jordan River. Lebanon and Syria viewed this water dispute in more geopolitical terms. Their antagonism towards Israel transferred from the political arena to technical areas. Ultimately, the practical need to cooperate meant their reluctant involvement in the Johnston Plan. However, the Arab League rejected the Johnston Plan because it provided for the relative gains of Israel. Despite its great need for water, as the least powerful state, its interests were overshadowed by more powerful states.

The Palestinian Question dominated politics during the period of water negotiations in the 1960s. Hence, the water dispute was subject to this hotbed of politics. It was inconceivable at the time to view water sharing separate from the larger issues of Israeli legitimacy and the Palestinian refugee problem.

Jordan River Basin: Conclusions

Syria's refusal to cooperate with Israel's plan to build the Maqarin Dam was motivated by the relative gains Syria perceived Israel would make. The strained political relations between Syria and Jordan at this time also prevented cooperation on water issues. Syria as the upstream riparian, was in the most powerful position, "There could be no cooperation in the basin without its acquiescence, unless it was coerced by a downstream riparian with a stronger military or a third party. This is true of international river basins in general." (Lowi, 1995, p. 196) According

to Lowi, the Maqarin Dam dispute illustrates the point that political dischord often impedes the "optimal" resolution of riparian disputes.

Case: The Disi Aquifer

Disi Aquifer: Cause of Water Scarcity

Disi wasn't discovered until the mid twentieth century by a geological survey. Population growth and a desert environment places high demand on water in the region. The aquifer is a non-sustainable resource: once it is gone it will not come back.

Disi Aquifer: State and National Interests

Jordan uses Disi to supplement drinking water supply. Jordan plans to build water pipe from Disi to Amman. Saudi Arabia uses the water for agriculture meant for export. Both seek to establish a precedent for water use in order claim rights to the aquifer.

Disi Aquifer: Bilateral Relations

Neither state has moved to cooperate or publicize disputes. Since the aquifer will eventually be exhausted there is very little incentive to cooperate. The Disi Aquifer is likely a "tragedy of commons" where both seek to maximize their use of public resources inevitably depleting it.

Disi Aquifer: Conclusions

Jordan must take stock of its water policies. Water from the Disi aquifer used for agriculture could be replaced by treated sewage water by 2020. Stopping illegal drilling, importing water-intensive crops, and refocusing water priorities to the impoverished southern region instead of Amman would improve Jordan's water situation.

Findings

Revisiting the original research question: Will the water shortage in the Middle East ultimately lead to conflict? As mentioned in the introductory chapter, realists argue that self interest and the lack of international law will make conflict very likely. Liberal functionalists, on the other hand are optimistic that cooperation is mutually beneficial and as a result, states can be motivated to cooperate. In this study, the dependent variable was the presence of conflict over water and the independent variables consisted of: 1) nature or severity of water scarcity 2) state's national interests in regards to water usage; and 3) bilateral relations amongst riparians.

The first hypothesis: as water scarcity increases, conflict is more likely to occur. For 2 out of 3 cases, preexisting scarcity was caused by population growth that occurred in the mid twentieth century. This population growth led to attempts by states to modernize their economies and at the same time create water development to address the increased demand for water. In the case of the Tigris and Euphrates basin, water scarcity was not issue until Turkey and Syria began building dams and reservoir thereby reducing the water flow downstream. Historically, the Tigris and Euphrates basin is a fertile land area, unlike the arid environments found in the Jordan Basin and Disi Aquifer.

The second hypothesis: state's national interests in regards to water usage will influence states' decision to cooperate with other states on water issues. In all cases, upstream riparians seek to use the water supply for hydropower and industrial uses in order to modernize their economies. For downstream riparians, water is primarily for domestic use and a matter of survival. Upstream riparians have the distinct advantage of deciding whether to alter the situation

The third hypothesis: preexisting bilateral relations amongst riparians will influence states' decision to cooperate with other states on water issues. For 2 out of 3 cases, politics has influenced state behavior on whether to cooperate with other states. In all cases, absence of formal water agreements has left water disputes unresolved. Disi is an interesting case because pre-existing political rivalries are largely absent hence it does not affect the water dispute.

Comparing Cases

In all three cases, the need for water resources is significant. With the exception of the Tigris and Euphrates Basin, the natural aridity of the region serves to increase the water shortage. Upstream riparians are in a position of power compared to downstream riparians. Turkey and Israel share the distinct advantage of being upstream riparians. In each of the three cases, the water source in question has become geopolitically significant. Certainly, in the case of the Jordan River Basin, the water conflict is an extension of the larger political conflict between Israel and its Arab neighbors. The Tigris and Euphrates Basin has also become politically charged. Syria has used Turkey's struggle against Kurdish separatists as leverage to gain control over that water resource.

Even when a larger political conflict is absent, division over a shared water resource is possible as in the case of the Disi Aquifer. In the absence of a formal water sharing agreement unilateral actions can be made by dominate riparians. In each case, favor rests on the upstream state. Turkey in the Tigris and Euphrates Basin, Israel in the Jordan Basin, and Saudi Arabia in the Disi Aquifer. (Lowi, 1995, p. 73) These dominant riparians have the relative power advantage to act with little to no fear from less powerful nations.

According to Lowi, interstate relations are "characterized by varying degrees of distrust, the perception of threat and power struggle. For two of the cases, on external conflict separate from the low politics issue of water spoils state relations. "This is so, whether the external dynamic is a struggle from ideological and political hegemony as in the Euphrates case, a power struggle in the Disi Aquifer, or a combination of these added to a conflict over land and fight for political recognition as in the Jordan. These external conflicts serve to intensify the overlapping water conflict. Realists would argue that high politics trumps cooperation in low politics.

The conflict in the Euphrates and Jordan basins has yet to be resolved because the dominant riparian has little incentive to negotiate releasing more water to its downstream neighbors. Hence, "the middle and downstream states are locked into a power struggle that prevents them from lobbying together to assert their water demands and pressure the upstream riparian to compromise." (Lowi, 1995, p. 74) International pressure is conspicuously absent thereby lessening any chance of fostering negotiations to resolve the water conflict. According to Lowi, "if Turkey could be brought to the bargaining table and would promise substantial concessions, Syria and Iraq would agree to negotiate a water sharing agreement, despite their adversarial relations. This, however, was not the case in the mid 1970s, when the ideological conflict between Syria and Iraq was at its peak and the consumption needs of the riparians were not as great as they are today." (Lowi, 1995, p. 75)

The Jordan Basin conflict can be described as having gone through two stages. The power dynamic and nature of interstate relations between Israel and Jordan account for the failure to create a formal water sharing agreement. In the first phase, the surrounding Arab states refused to acknowledge the legitimacy of Israel's sovereignty. This is the reason why in 1955,

the Arab states refused to finalize negotiations on the Johnston Plan sponsored by the United States. Syria refused to cooperate because it did no want to acknowledge Israel's right to exist. Furthermore, Syria's own use of the Jordan Basin was very little in comparison to Jordan and Lebanon. Since Syria was the most powerful state, the functionalist plan for cooperation failed to gain support.

The Johnston Plan failed for several reasons. Eric Johnton, the US special envoy, "believed the Arabs would cast aside their determination to regain Palestine for the economic good of two basin states, Israel and Jordan." (Lowi, 1995, p. 75) Lowi pinpoints Johnston's failure to recognize that the overarching political conflict decided the identities and core values of each riparian thereby undermining any chance for a functional agreement. The Israelis were eager to reach an agreement because such an agreement would validate Israeli sovereignty.

Conversely, the Arab nations had no intention of legitimizing Israeli's right to exist. Hence, the overarching political environment prevented both a comprehensive peace settlement as well as a formal water agreement. Syria, was not as dependent on the Jordanian Basin therefore it could afford to refuse to negotiate with Israel. Jordan, on the other hand, sources most of its drinking water from the Jordan Basin. Had Syria not been included in negotiations, a water agreement between Jordan and Israel might have been reached.

Concern over the potential gains made by rival states is another cause for the inability to reach a water agreement. For realists, riparian states view the water conflict in terms of a zero sum game. According to Lowi, "it was not so much that the Arab states could not cooperate in sharing water resources because they denied the legitimacy of "the other" but rather if they would share water and not try to exploit the maximum unilaterally, irrespective of the other's

rights and claims, they would be contributing to improving the capabilities of the other." (Lowi, 1995, p. 76)

International law regarding these shared water sources often fails to protect states' water rights. Upstream states will often employ the doctrine of absolute national sovereignty in order to secure more water for their own interests. It is not surprising that conflicts over water inevitably arise especially in a region where water is naturally scarce.

APPENDIX: THE GREATER AMMAN WATER SUPPLY PROJECT

The Greater Amman Water Supply Project

From http://www.water-technology.net/projects/greater_amman/specs.html

Key Data

National Sustainable Supply Capacity:

750 million cubic metres a year

Current Water Demand (all uses):

>1 billion cubic metres a year

Annual Deficit:

222 million cubic metres a year (1995); 251 million cubic metres a year (2011 predicted)

Current Annual Allowance Per Capita:

180m³ to 200m³

Amman Water Supply Allocation (2003):

96 million cubic metres a year

Total Programme Investment Required to 2012:

$5bn

King Abdullah Canal / Zai WTP Project

Increased Supply to Amman:

45 million cubic metres a year

Project Elements:

Rehabilitate the four pumping stations between Deir Allah and the Zai WTP; increase pumping capacity by 20%

Project Cost:

$70m

Zara-Maain Water Project

Increased Supply to Amman:

38 million cubic metres a year

Project Elements:

Pre-treatment system; desalination plant; 40km transmission pipeline; SCADA, telemetry and monitoring / control systems

Project Cost:

$125m

Disi-Mudawwara Project

Increased Supply to Amman:

100 million cubic metres a year

Project Elements:

325km transmission pipeline; 65 new boreholes; well field collectors; 12,000m³ collector reservoir; main pumping station and associated balancing tanks; 16,600m³ regulating tank; flow control

Project Cost:

$1,000m (estimated)

Red Sea-Dead Sea canal project (The Peace Conduit)

Increased Supply:

850 million cubic metres a year fresh water for Jordan, Israel and Palestine

Project Elements:

180km combination conduit (tunnel and canal sections) conveying 1.8 billion cubic metres a year of seawater; associated power / RO desalination projects

Project Cost:

$800m (estimated)

Project Timeline:

Disi-Mudawwara Project Feasibility Study:

Mid-1996

Disi-Mudawwara Preliminary Design Studies:

Mid-1997

Petra Conference for Donor Nations:

November 1997

King Abdullah Canal / Zai WTP Phase 1 Completed:

18 May 1998

First Contract Awarded for Restructuring Greater Amman Water Supply System:

December 1998

Second Contract Awarded for restructuring Greater Amman water supply system:

13 April 1999

Management Contract Awarded for Water Services in Greater Amman:

August 1999 (originally for four years, later extended until 2005)

Initial Bids Taken on Disi-Mudawwara Project:

Late 2001

Contract Awarded for Greater Amman Water System Rehabilitation and Improvement:

14 January 2002

EU-Jordan Association Agreement Start Date:

1 May 2002 (formally signed in 1997)

Disi-Mudawwara Project Final Bids Opened:

20 August 2003

Zara-Maain Project Awarded / USAID Funding Agreed:

29 September 2003

EU Further Funding Agreement Signed:

9 March 2004

Zara-Maain Project Completion:

August 2006

Disi-Mudawwara Project Ordered:

August 2008

Key Players:

Jordanian Agencies:

Ministry of Water and Irrigation (MWI); Jordan Valley Authority; Water Authority of Jordan (WAJ); Irrigation Advisory Service

Funding:

World Bank; United States Agency for International Development (USAID); European Investment Bank; Arab Fund for Economic and Social Development; the EU; Kreditanstalt fuer Wiederaufbau; Germany, Italy

Infrastructure Upgrade Supervision:

Lahmeyer International and Sigma Consulting Engineers JVC; CEC / Sajdi & Partners

Network Redesign Contractors:

Dorsch Consult; Hazen & Sayer ; The Morganti Group; Montgomery Watson

Network Management:

Suez-Lyonnaise des Eaux

DISI Consultants:

DHV / Stewart Scott International (SSI); Brown and Root North Africa; Consolidated Consultants (CC)

Zara-Maain Project Main Contractor:

Morganti Group / Ondeo Degremeont

Disi-Mudawwara Project Contractor:

Gama Power Systems

Other Contractors:

Tokyo Sekkei Jimusho (Engineering); Gibb; Camp; Dresser & McKee; Metcalf & Eddy; Harza; CH2MHill; ABT & Associates; Chemonics; Rural Development Associates; Development Alternatives, Inc.

REFERENCES

Allan, J. (1996). *Water, Peace and the Middle East: Negotiating Resources in the Jordan Basin.* New York: St. Martin's Press.

Allan, J., & Mallat, C. (1995). *Water in the Middle East: Legal, Political, and Commercial Implications.* New York: St. Martin's Press.

Allan, T. (2000). *The Middle East Water Question: Hydropolitics and the Global Economy.* New York: I.B. Tauris Publishers.

Altinbilek, D. (2004). Development and Management of the Euphrates-Tigris Basin. *Water Resources Development* , 15-33.

Amery, H., & Wolf, A. (2000). *Water in the Middle East: A Geography of Peace.* Austin: The University of Texas Press.

Benefits of water efficiency worth twice the costs - report . (2005, April 21). Retrieved October 22, 2010, from IRC International Water and Sanitation Centre : http://www.irc.nl/page/17843

CIA. (2010). *Jordan*. Retrieved May 23, 2010, from The World Factbook: https://www.cia.gov/library/publications/the-world-factbook/geos/jo.html

Dolatyar, M., & Gray, T. S. (2000). *Water Politics in the Middle East.* New York: St. Martin's Press.

Ferragina, E., & Greco, F. (2009, May 4). Controversial Aspects in the Management of Transboundary Fossil Groundwater: the Disi Aquifer. Istabul, Turkey.

Ferragina, E., & Greco, F. (2008). The Disi project: an internal/external analysis. *Water International* , 451 - 463.

Ghazal, M. (2007, January 18). Bring the people to Disi aquifer, not water to the city. *Jordan Times* , p. 2.

Griffiths, M. (1999). *Fifty Key Thinkers in International Relations.* London, New York: Taylor & Francis Routledge.

Hillel, D. (1994). *Rivers of Eden: The Struggle for Water and the Quest for Peace in the Middle East.* New Work: Oxford University Press.

Libiszewski, S. (1994). Water, Water, Everywhere. *The Ecologist* , 196-197.

Long, B. R. (2003, December 11). *The Battle over the Al-Disi Aquifer*. Retrieved October 3, 2010, from Inventory of Conflict and Environment Case Studies: http://www1.american.edu/TED/ice/aquifer.htm

Lowi, M. R. (1995). *Water and Power: The Politics of a Scarce Resource in the Jordan River Basin.* New York: Cambridge University Press.

Morris, M. E. (1996). Review of Miriam Lowi's Water and Power: The Politics of a Scarce Resource in the Jordan River Basin. *International Journal of Middle East Studies* , 123-125.

Namrouqa, H. (2010, August 10). Disi project construction in full force. *The Jordan Times* .

Namrouqa, H. (2010, March 5). *Jordan does not owe Israel a drop of water*. Retrieved October 3, 2010, from The Jordan Times: http://www.jordantimes.com/?news=24581

Namrouqa, H. (2010, September 29). Major delay in Disi project - Najjar. *The Jordan Times* .

Potter, R. B., Darmame, K., & Nortcliff, S. (2010). Issues of water supply and contemporary urban society: the case of Greater Amman, Jordan. *Philosophical Transactions of the Royal Society A* , 5299-5313.

Selby, J. (2003). *Water, Power, and Politics in the Middle East.* London: I.B. Tauris.

Smith, J. B. (2005). *The Globalization of World Politics, Third Edition.* New York: Oxford University Press.

Soffer, A. (1999). *Rivers of Fire: The Conflict over Water in the Middle East.* New York: Rowman & Littlefield Publishers Inc.

The water cycle. (2009, October 6). Retrieved January 19, 2010, from U.S. Geological Survey Web site: http://ga.water.usgs.gov/edu/watercyclesummary.html

Upson, S. (2009, August). *Jordan's Radioactive Water Problem*. Retrieved October 3, 2010, from IEEE Spectrum: http://spectrum.ieee.org/energy/environment/jordans-radioactive-water-problem/2