



Sustainable Water Strategies for Jordan



International Economic Development Program
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University of Michigan, Ann Arbor
April 2008



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Executive Summary

Jordan is the fourth water poorest country in the world in a regional system defined by uncertainty and instability. This analysis (1) outlines the main challenges and opportunities of increasing national water supply and reducing economic and demographic sectors' demand burden, (2) details the institutional interests of the stakeholders in the water debate, (3) analyzes the costs and benefits of a range of water policy options, and (4) recommends an integrated, multi-sectoral series of steps to reform the water sector.

Water supply in Jordan comes primarily from the Jordan River Valley, groundwater sources, rainwater collection, and limited desalination plants. The agricultural sector accounts for the majority of national water demand, despite making only a minor contribution to GDP and national workforce aggregates. Other major users include the industrial, municipal, and tourism sectors. The stakeholders in the debate over current allocation and future investments include the Jordanian Water and other Ministries, donor countries, Inter-Governmental Organizations (IGOs), Jordan-based water advocacy groups, water consumers across sectors, and private investors.

In preparation for the writing of this document, preliminary research was conducted using publicly available data and reports authored by both government and non-government sources. Subsequent field research in February 2008 facilitated interviews with Jordanian and international organizations directly involved in Jordanian water policy. The list of these interviews is included in Appendix A.

Following an assessment of major supply and demand issues, institutional realities, and stakeholder interests, this paper recommends that the Jordanian government should:

- Adopt a comprehensive, long-term water strategy that incorporates more open access to information and heightened coordination and cooperation between sectors.
- Continue updating the water network while assessing whether mega projects offer the most efficient and sustainable use of limited funds.
- Combine increased education and technical support with financial incentives to shift production away from water-intensive, low-yield crops.
- Step up enforcement of existing laws regarding weekly water quotas and illegally tapping groundwater sources, possibly to include the transfer of authority from Water Ministry officials to law enforcement officials.
- Increase Jordan's bargaining leverage during water negotiations with other riparian states (Syria, Israel) by more closely tying water-specific objectives to Syrian and Palestinian track negotiations, regional peace efforts, and bilateral talks with the U.S.

A multi-pronged approach that harnesses and coordinates the strengths of diverse stakeholders will help secure the long-term availability of the water resources crucial to Jordan's success in the 21st century.

1. Section I: Analysis of Supply and Demand

Deserts comprise 92 percent of Jordan's territory.¹ Droughts are a natural part of the region's climate, but recent prolonged droughts suggest that the arid climate has been exacerbated by human factors.² In arid countries like Jordan, even slight changes in water levels have significant impacts on agriculture, industry, nutrition, and health.³ Furthermore, rainfall in the region is seasonal, localized, and unpredictable. High evapotranspiration rates diminish the value of water that is available.⁴

Jordan currently is the fourth most water-deprived countries in the world ($140\text{m}^3/\text{person}/\text{year}$)⁵ and has the 9th highest population growth rate (2.4 percent).⁶ Jordan has a negative water balance of 20 percent⁷, meaning the country requires 1.15 billion cubic meters annually but only has 850 million cubic meters (MCM) of renewable supply available.⁸ Shortfalls have been made up by over-pumping non-renewable groundwater,⁹ and water tables are dropping rapidly.¹⁰ Of Jordan's twelve major groundwater basins, six are over extracted, four are at capacity, and two are under-exploited.¹¹

Because of steep population growth and the sudden influx of refugees due to political instability in the Middle East,¹² the available renewable water resources per person have dropped drastically from $3,600\text{ m}^3/\text{capita}/\text{year}$ in 1946 to $140\text{ m}^3/\text{cap}/\text{yr}$ in recent years.^{13,14} This is more than 45 times less than the amount available in the U.S. ($9,000\text{ m}^3/\text{cap}/\text{yr}$). Population strain on water availability is exacerbated by problems of climate changes, pollution, general mismanagement, and water conflicts.¹⁵

1(a) Supply

Jordan gets its water from a diversity of sources. The Jordan and Yarmuk Rivers are the major sources of surface water, but they have become unpredictable in recent years due to upstream damming and diverting by Israel and Syria, respectively.¹⁶ Underground water from non-renewable aquifers and treated wastewater also contribute to Jordan's water supply.¹⁷ There are approximately 2,000 groundwater wells in Jordan, of which half are illegally constructed, further exacerbating the problem of water over-exploitation.¹⁸

The Water Authority of Jordan privatized its water and wastewater services in Amman in 1999 with the help of LEMA. LEMA is a Jordanian company with shares that are owned by Suez Environment, a French water service company, and MWHAJ, a regional engineering consultant company specializing in water.^{19, 20, 21} In 2007, LEMA transferred control of Amman's water and sewage systems to the commercial government-owned Jordanian water company, Our Water.²² There has been some criticism of the privatization efforts, with critics claiming that the private companies have not reduced the amount of unaccounted for water or improved water quality, as was promised in the contracts.²³ The privatization scheme does, however, have the possibility to supply water efficiently if it is based on effective strategic planning and accompanied by efforts to clearly define its public objectives.^{24 25}

As noted by the United Nations Development Programme (UNDP), one of the most significant issues related to water supply is storage. One organization, Mercy Corps, has donated significant amounts of money and time towards increasing the supply of freshwater to rural areas. This effort has been focused on community-based organizations intent on both improving the water networks and building water catchments for rain storage.

Transferring water from one region to another is also a significant challenge, since water is not equally distributed in Jordan. The transfer between surplus and deficit areas is managed by large-scale engineering systems such as huge pipelines.²⁶ These water conveyance systems are not very efficient and tend to deteriorate water quality as well as increase water losses from evaporation and leakages.²⁷

Another issue with water treatment and supply going into the future is the problem of energy. The rising cost of oil has affected every sector of society, including food and other basic goods.²⁸ Shortages have caused the government to remove almost all fuel subsidies in the Kingdom. Energy is a necessity for both treating and accessing water. Without a constant and affordable supply of fossil fuels, the Jordanians will have to find some other means to treat and move their water supplies.

The government is exploring a number of projects to increase Jordan's water supply either temporarily or permanently. The largest projects, or "mega projects," include tapping the Disi aquifer and building a canal between the Red and Dead Seas. Other projects include desalination plants, network updates and Public-Private Partnerships (PPPs). The advantages and disadvantages of these projects will be discussed in depth in Section III.

I(b) Demand

Compared to other countries, Jordan's per capita domestic consumption of water is low;²⁹ the average Jordanian is supplied with 90 liters per day compared to the "normal" consumption rate of 170 liters cited by the World Health Organization (WHO).³⁰ The government has implemented a strict water rationing program, pumping water to households only one or two times per week.³¹

Water is just one facet of a larger web of economic and environmental stressors – rapidly growing populations, economic development, increasing standards of living, and weak international enforcement mechanisms all put strains on scarce resources.³² Water scarcity has led to significant competition between different sectors of society (specifically agriculture, industry, and domestic use).³³ Experts predict that resource constraints will precipitate a change in Jordanian water allocation in the near future.³⁴ With Jordan's current population of 5.6 million expected to almost double by the year 2050, the proportion of water used for domestic may increase by 50-60 percent in the same time period.³⁵

Earlier influxes of Palestinian refugees, as well as the rapidly growing Iraqi population (now over 700,000), have added additional strains to Jordan's limited water supply.³⁶ According to the "National Water Master Plan," written by the Ministry of Water and Irrigation of Jordan (MWI) and the German Technical Cooperation (GTZ), future demands are exceeding the current supply by more than 30 percent. This trend is projected to worsen into the future (Table 1).³⁷

Table 1: Development of Resources and Demands in MCM/a

Year	2005	2010	2015	2020
Renewable Groundwater	259	259	259	259
Surface Water (baseflows and reservoir safe yields)	382	404	419	433
Treated wastewater, not flowing into reservoirs	34	69	89	101
Additional Resources	344	511	454	456
Total Resources	1019	1244	1220	1250
Municipal, Industrial, Tourist demands	433	493	561	634
Agriculture incl. reuse schemes	1114	1120	1101	1052
Total Demands	1546	1612	1661	1686
Groundwater return flows from losses	66	63	62	63
Deficit in MCM/a	-461	-306	-379	-373
Deficit in %	-45%	-25%	-31%	-30%

(Source: National Water Master Plan, <http://www.mwi.gov.jo/NWMP/>)

In Jordan, even though only 5 percent of land receives enough rainfall to support cultivation, agriculture is currently the largest user of water. While farmers irrigate less than ten percent of the total agricultural land, agricultural demand of water represented 72 percent of total water demand in 2005,³⁸ and the agricultural sector contributed only 2.7 percent of Jordanian GDP in 2004.³⁹ Despite water shortages, Jordan's system of subsidies encourages the overuse of irrigation water, which necessitates strict rationing to allocate the remaining water resources.⁴⁰ Nevertheless, studies suggest that appropriate price setting can be used for optimizing cropping patterns and water distribution, which can also substantially increase agricultural production.⁴¹

Although the agricultural demand of water is predicted to drop to 62 percent by 2020,⁴² it will still be the largest user going into the future. At the same time, the demands for municipal, industrial and tourism use are predicted to increase, leading to the increase of the total water demand in the future.⁴³ Consequently, it is important to analyze why the demand for water keeps increasing despite attempts to control demand.

1(c) Municipal and Tourism Sectors

Water demand is increasing in the municipal sector due to the increasing population in Jordan because of both a high birth rate and the recent influx of Iraqi refugees. The groups that have suffered the most, however, are the rural areas. A member of the UNDP in Jordan stated that the Jordanian government focuses on water distribution in highly populated areas, and, as a result, rural area residents have water access just every twelve days, whereas those in cities like Amman will receive water every seven days. Demand is also impacted by the tourism industry, which is projected to increase into the future. Big investment projects designed to attract tourists are under construction at the Dead Sea coastal area and elsewhere. Tourists do not generally have knowledge of the severe water issue in the Kingdom.

1(d) Industrial Sector

The industrial sector is gaining more importance in Jordan. Its contribution to the GDP was approximately 17 percent in 2002.⁴⁴ The nation-wide economic development plan, including a free trade zone in Aqaba, makes it possible to achieve nationwide high economic growth rate of 4.5 percent, which keeps increasing the industrial use of water.⁴⁵

1(e) Agricultural Sector

Although the Jordanian government has tried to shift water away from the agricultural sector, there have been difficulties with this approach. Representatives from the UNDP and Mercy Corps cited farmers' limited education as a barrier to change – they do not know how to grow crops that require little water. They continue to grow water-intensive crops like citrus fruits simply because it is what they have grown historically. In addition, farmers also lack the marketing skills and capital necessary to switch to different crops.⁴⁶ A member of Mercy Corps in Jordan also cited political difficulties with agricultural reform such as a strong tribe system and the existence of powerful farmers resistant to change.⁴⁷ Finally, the separate interests of various Jordanian ministries (MWI, Ministry of Agriculture, Ministry of Planning), UN agencies, and major donors (USAID, JICA, etc.) make it difficult to coordinate changes to water policies.

2. Section II: Analysis of Institutions

2(a) Power Centers

Before proposing any recommendations to address Jordan's water crisis through policy change, it is important to understand the power dynamics of the country. Knowledge of where power is centered and who influences decision-making will help craft policy recommendations that are both feasible and sustainable given political, cultural, and bureaucratic realities. Yes, excellent

Jordan is a monarchy, and decision-making processes usually begin, end, or at least pass through the palace. This is true despite the appearance of democracy that Jordan's three branches of government

present. The fact that all three branches possess members either directly or indirectly appointed by a highly influential king, means that policies not in line with the king's priorities seldom originate within the government.

Parliament consists of the Senate and the House of Deputies. Senators are appointed by the king, while deputies are elected by the citizens through direct elections. The king has constitutional power to dissolve Parliament at any time. Generally, the legislative branch's actual power is limited because, in many respects, its main function is to approve or legitimize programs proposed by the king. More often, it exercises what power it has by vetoing the king's proposals rather than generating its own initiatives.

The administration of all internal and external Jordanian affairs is entrusted to the prime minister and the cabinet or the Council of Ministers,⁴⁸ the members of which are appointed by the king and approved by the House of Deputies. Of the twenty-four ministries, the three most crucial to water policy are the MWI, the Ministry of Planning (which oversees the funding and implementation of many projects), and the Ministry of Agriculture (a key player due to the large percentage of water used for agriculture). In addition to these formally appointed officials, both King Abdullah and Queen Rania have councilors who wield substantial power and are often directly involved in policy matters.

The question of who wields influence in terms of water policy is much more complex than simply analyzing governmental structure, however. Firstly, one must assess who the actual individuals are in government. The phenomena of *wasta* – a centuries-old custom of giving weight to tribal and familial connections when awarding professional positions – abounds in Jordan, which continues to possess a strong tribal system. Allocating state resources, hiring within ministries, and deciding promotions within the state bureaucracy are all aspects of Jordanian life that owe much to the practice of favoring *wasta* over strict considerations of competence, need, and efficiency. Unlike outright corruption such as appropriating state treasury funds, *wasta* does not suffer from an overly negative public perception and is seen merely as a way of doing business. *Wasta* negatively impacts efficiency in all ministries, and the MWI is no exception.

Powerful tribes are able to build and maintain links to the government through these connections and thereby actively lobby in the interests of their group. Interestingly, the influence of tribes is historical and cultural rather than economic. This power and its relevance to water policy have also been manifested in very concrete ways on the ground. Government and civil sectors alike cite the recent shooting of a MWI official who attempted to stop illegal tribal well drilling as an example of how tribes resist undesirable government policies. A common sentiment on the ground is that the only person the tribes will listen to is the king.⁴⁹

Ironically, this level of influence works in both directions. While the king has a privileged position of power over the tribes, the king is also dependent on the tribes for continued legitimacy and support. In general, the king must be careful to maintain positive public opinion of the monarchy in order to preserve his authority and power. This is particularly challenging in the area of water due to the resource's limited availability, which means that the public gains more influence when demanding shifts in water policy.

Recent water contamination scandals – including a case near Irbid where 1000 people experienced severe diarrhea and high fever due to *Cryptosporidium*⁵⁰ – have caused the king to make improving water networks and treatment facilities a priority. This new prioritization may be due, in part, to a desire to promote civilian health, but it is also a response motivated by a fear that more scandals could sow discontent with the monarchy's rule.

In the same way, non-governmental organizations (NGOs) play the important role of raising awareness and shaping national discourse on issues like water. While the MWI downplays the influence of NGOs,

they are the groups that brainstorm innovative programs, listen to community needs, and perform the important role of advocacy at national and international levels. Their programs may offer larger Jordanian and intergovernmental agencies prototypes that take new technical, economic, and/or geopolitical approaches to ongoing challenges.

When looking at power centers in Jordan, it is also essential to consider what forces may be placing external pressure on the country. Some IGOs like the UNDP are unable to propose policies and can only respond to programs proposed by the Jordanian government. However, major donors, including USAID, JICA, and GTZ, as well as lending organizations like the World Bank and influential countries like the United States, have the power to set terms and priorities on the projects they wish to fund. The extent to which they exercise that power rather than letting the Jordanian government make program decisions can vary. In many cases, it is difficult for the government to reject IGO or international pressure to adopt a specific water policy.

2(b) Bureaucracy

A number of Jordanian government entities deal with water in the domestic context and in relations with riparian states: the Royal Cabinet (the King's personal staff), the MWI, the Ministry of Agriculture, the Ministry of Planning, the Ministry of the Environment, and the Foreign Ministry. Unlike in the U.S. federal government, where strategic resource planning occurs within agencies in conjunction with the White House-based planning and budgetary staff, long-range strategic planning in Jordan occurs in the Ministry of Planning, relatively divorced from the day-to-day operations of the MWI itself. A number of interagency water committees meet bi-weekly at the Secretary-General (vice-ministerial) level to discuss mega projects, near term reallocation goals, and donor coordination.⁵¹

The MWI is responsible for all of Jordan's centralized water and wastewater systems, as well as for forming national water policy. In principle, all Ministries are currently operating under the MWI's 2007 five-year strategic National Water Master Plan, a comprehensive attempt to join demand- and supply-side strategies. According to the Secretary General of the MWI, this plan is currently being updated to outline planning activities that include the influx of Iraqis in its predictions; the updated plan will be extended to cover the next seven years.

In practice, water allocation across the country can be a haphazard affair, with MWI sub-directorates and municipalities across the country making personal pleas to senior Ministry officials to direct the tap to be turned on in their zone.⁵² MWI officials are also responsible for enforcement of water quotas, an often perilous task that pits the prerogatives of the central government against the power of local tribes, whose influence allows them to tap groundwater with impunity.

The Ministry of Agriculture is the lead agency dealing with the nation's farmers, whose aforementioned drain on national water demand remains a long-term challenge. Any future targeted subsidies or penalties aimed at reducing overall agricultural sector demand or encouraging the production of more water-efficient crops would fall under the MWI.

In order to address the more technical challenges related to water allocation and management, the Kingdom created a new institutional architecture in 1988 centered on the MWI and two major agencies: the Jordan Valley Authority (JVA), and the Water Authority of Jordan (WAJ).⁵³

The responsibility for all water and sewerage services is vested with the WAJ. This agency provides 98 percent of the population with water from the centralized system, and handles 65 percent of the country's wastewater net. The WAJ has experienced significant change over the years, from a centrally-controlled agency to one operating regionally and on a "commercial" basis.⁵⁴

The JVA is in charge of the operating system in the Jordan Valley, which receives a significant portion of the country's water allocation, but primarily for irrigation purposes. Wastewater reuse for irrigation is common, especially in water-scarce regions, and Jordan's reuse is one of the highest in the world.⁵⁵ Although this practice carries minimal health risks, it has a huge effect on soil quality. Even highly treated waters contain suspended particles, usually salts, which will remain in the soil after plants use the water or it evaporates. Soil salinization is a very serious and irreversible problem in arid regions.⁵⁶

Laws prohibiting the transfer or sale of water without express permission do exist but this piece of the legislation goes largely unnoticed, and the sale of water from private wells to citizens is common. Some farmers in the highlands also buy their water from private well owners to avoid the cost of the connection to the central water network, or the cost of tapping a new groundwater well.⁵⁷ In Amman, serious droughts had led the government to restrict water delivery to only one day per week, forcing individuals in need of water to purchase it from a truck.⁵⁸

Officials from all ministries interact directly with donor country embassies in Amman and with IGO representatives such as UNDP. All stakeholders in country describe these interactions as productive, mutually beneficial, and relations as cordial. Yet, the MWI faces long-term human resources challenges that threaten to dull the impact of strategic planning: *wasta*, as well as a formidable brain drain to the private sector.

A major human resource challenge in the Jordanian water public sector is the outward flow of talent from Jordan to (1) the Jordanian private sector and (2) private and public sectors abroad, both in the West and wealthy Gulf countries.⁵⁹ The MWI is not exempt from this trend, and suffers from a severe and increasing drain of talent from its ranks to the range of European firms that have won contracts in Jordan. This "brain drain" will only exacerbate current inefficiency trends if public sector salaries (or prestige) cannot match that of the private sector. Taking steps to curb this outflow could boost policy planning at the Ministry and ensure better water access and enable Jordan to harness new technologies.

2(c) Geopolitics of Water

Finally, Jordan's water policy and the related decision-making power are dictated by regional geopolitics. Most of Jordan's major water resources are transnational. In the case of the Jordan River, Jordan is downstream of Israel and Syria and therefore has little bargaining power with its neighbors in pure water terms. Although Jordan is considered a locus of stability in an unstable region, it is not sufficiently large or powerful to affect destabilizing factors that originate abroad. Therefore, the government is often forced to respond reactively to external shocks instead of responding proactively to longer-term crises such as water scarcity.

Jordan gets more than 36 percent of its water from sources shared by its neighbors⁶⁰ – the Jordan River specifically is shared by Syria, Israel, the West Bank, and Jordan. A long history of competition for scarce water resources exists between these countries, and at times disagreements over water have contributed to larger regional conflicts.⁶¹ Syria protested to the United Nations in the 1950s when Israel began constructing its National Water Carrier, diverting the Jordan River to the Negev Desert.⁶² When the Arab League decided to attempt to divert the Jordan River's headwaters in 1964, border skirmishes resulted, which later contributed to the outbreak of the 1967 Arab-Israeli war.⁶³ An Israeli victory enhanced Israel's water resources through control of the Golan Heights and the West Bank aquifer, which in past decades has led to charges that Israel is stealing water that rightly belongs to the Arab countries.⁶⁴

Over 90 percent of the Jordan River is diverted for human use.⁶⁵ Israel uses about 60 percent of the flow of the lower Jordan River for drinking water and irrigation. Jordan and Syria share 40 percent of the river's supply, damming and diverting water from its largest tributary, the Yarmuk River.⁶⁶ The

economies and societies in the Jordan-Yarmuk basin are extremely vulnerable to any restrictions in their supply, making the situation highly volatile.⁶⁷

Even when the larger political environment did not allow states in the region to sign official water treaties, Jordan and Israel continued meeting on an annual basis to discuss water issues at informal “picnic table” talks.⁶⁸ The 1994 peace treaty between Israel and Jordan agreed to establish a Joint Water Committee to develop additional water resources including two new dams. Current agreements, however, do not address the pressing issue of shrinking groundwater sources.⁶⁹

While recent events point to increased international cooperation on water issues, water diplomacy is still a challenge for Jordan. In 2004, Syria and Jordan began construction of the long-discussed Al Wahdah (“Unity”) Dam on the Yarmuk River. Jordan is funding most of the project, which had been stalled for years as a result of inadequate funds.⁷⁰ Syria will receive the majority of the electricity generated by the dam, with Jordan utilizing 73 percent of the water stored in Wahdah’s reservoir.⁷¹ MWI acknowledges that the dam will not solve the country’s water problems, but the dam is projected to help reduce Jordan’s water deficit by about 10 percent.⁷²

When water reserves run low, Jordan becomes dependent on Syria due to the high volume of water it receives from the Yarmuk River.⁷³ Although Syria has been privately accused of having built dams that violate agreements with Jordan, the MWI hesitates to criticize its neighbor openly, given Jordan’s need to use diplomacy to gain additional water in times of shortages.⁷⁴

The Jordan River is also suffering from a major environmental crisis. The Sea of Galilee, which is where diversion of most of Israel’s share of the Jordan’s water begins, is currently at the lowest level ever recorded, and its continued use as a water resource is now at risk.⁷⁵ The Dead Sea is also receding sharply, having lost a third of its surface area in the last fifty years.⁷⁶ A clause in the 1994 Israeli-Jordanian peace treaty obliges both countries to protect the Jordan River against pollution, but the river’s deterioration has continued in spite of this treaty.⁷⁷

3. Section III: Discussion of Policy Options

While a wide range of options are available to Jordan to address its water scarcity, many bear financial, political, and/or environmental costs that make such solutions less feasible. Options can be divided into two major areas – program options focus on physical projects for water provision, while institutional options focus on educational, political, and implementation processes tied to water.

3(a) Program Options: Supple-side

3(a)(1) Mega Projects

The MWI sees large projects as the ultimate solution to Jordan’s water issues; however, the completion of such projects takes time, money, and an integrated approach. The majority of projects designed to improve the quality and availability of clean drinking water suffer greatly from disintegration and time. For example, a member of the WHO in Jordan stated that while agencies are building new treatment plants, they are not reengineering the entire system, something that will be necessary if Jordan is going to have a sustainable supply of freshwater going into the future. While cost is certainly a factor here, the reliance on donor groups and the lack of coordination between different implementing agencies has a far greater effect on the success of these programs.

In order to increase the supply of water, Jordanian government is considering several mega projects such as tapping the Disi Aquifer and constructing the Red Sea-Dead Sea Canal. Although these projects may be able to increase water supply, they also have multiple disadvantages. It is important to consider the

costs and benefits of such projects and weigh them against the costs and benefits of other options to ascertain whether mega projects will provide the largest sustainable returns to investment.

3(a)(2) Disi Aquifer

This is a project to convey water from the Disi aquifer, located in the southern desert area on the Jordan-Saudi Arabia border, to the capital. The project will be designed to ensure the conveyance of about 100 million cubic meter of water per year by building a 320 km-long pipeline.⁷⁸ Gama, a Turkish company, is responsible for building pipelines and pumping stations to bring water to Amman and other cities.⁷⁹ This project will be executed on a BOT (Build, Operate, and Transfer) basis. The Turkish firm will sell water to Jordan for 40 years before Jordan government will take over ownership.⁸⁰

The Disi pipeline will serve residents in Amman.⁸¹ The 100 MCM of water supply per year is about 10 percent of total water available in 2005.⁸² According to the Secretary-General of the MWI, "Fifty years should be safe thanks to this project." However, it is difficult to verify the accuracy of such projections and many question this figure. Indeed, once the tap is turned on, it is difficult to control the consumption and to promote the sustainable use of this non-renewable reserve.

In addition, there are several other disadvantages to this project. The cost of the project is high; current estimates suggest the entire plan will require \$600 million.⁸³ Additionally, the Disi aquifer's location on the Saudi border makes further exploitation politically sensitive.⁸⁴ Water leakage is another problem, with the conveyance pipeline at risk from deterioration.⁸⁵ The aquifer is an unsustainable source, and so users risk increasing salinity as the source becomes depleted. The aquifer will not be able to supply water to Amman before 2015 and will only be able to meet 20 percent of projected municipal demand by 2020.⁸⁶ Before the Disi aquifer is emptied, the Jordanian government must find a permanent solution to its water scarcity problem.

3(a)(3) Red Sea-Dead Sea Canal

Another major project under consideration is the Red Sea-Dead Sea Canal, which would connect the Red Sea and Dead Sea as well as an associated hydroelectric power plant and desalination facilities. The length of the proposed Red Sea-Dead Sea Canal is about 180km, and it would provide 850 MCM/year of fresh water to Jordan, Israel and Palestine.⁸⁷ Theoretically, this canal would also restore the Dead Sea's water level to around 400 meters below sea level.⁸⁸

The main advantage of this project is the virtually unlimited supply of water, which would offer a long-term solution for water problems in Jordan. Additionally, the project may be able to save the Dead Sea by using sea water to compensate for current water loss.⁸⁹ Some have also argued that this canal could provide a platform for regional peace and cooperation with Israel.

However, the estimated cost of the Red Sea- Dead Sea Canal is about US\$5 billion and it may take up to 20 years to complete.⁹⁰ Although the feasibility study of this project began in 2006,⁹¹ it is expected to take about two years and cost \$15.5 million.⁹²

In addition to the financial obstacle, political hurdles such as the fluctuating peace process between Israel and Arab states may create unforeseen obstacles for the project.⁹³ Moreover, although this canal may be able to restore the Dead Sea to a more sustainable level, it may also make the current industries in the Dead Sea go into bankruptcy and change the ecosystem by altering the Dead Sea's composition.⁹⁴

3(a)(4) Desalination at Aqaba

The main principle of a desalination plant is to convert sea water into fresh water suitable for consumption or irrigation. Since the signature of the peace treaty with Israel in 1994, the construction of a desalination plant in the Aqaba region has been discussed. Indeed, the Aqaba Special Economic Zone

attracts investments from industries and is also a popular area in terms of tourism. Important growth in this region is therefore expected and a desalination plant would aim at meeting the water demand for the area's growing population as well as the industrial and the tourist sectors' needs.

Contrary to the mega projects described above, desalination does not require regional cooperation. Politically, this makes its implementation much easier. Desalination is also a technology that already is used in the Middle East, especially in Israel and Saudi Arabia. As the efficiency of desalination plants improves, this technology can help augment existing water supplies.

However, large-scale desalination requires significant amounts of energy and expensive infrastructure. Unlike Saudi Arabia and other rich Gulf states, Jordan is a relatively poor country which does not have any internal energy reserves. The cost of desalination is, consequently, very high for the Hashemite Kingdom, especially considering the recent increase in the price of oil. The cost per liter of water desalinated is also an issue as this technology is not yet used in Jordan. The projections range from \$0.50 to \$1.00 per cubic meter.⁹⁵

The Ministry of Planning and International Cooperation estimate that a desalination plant would cost \$50 million, with construction divided into two phases, with each phase producing a facility with a capacity of 5 million cubic meters per year.⁹⁶ However, this cost estimate provides an incomplete assessment of desalination's true costs. According to various studies, the total investment cost of a hydropowered seawater desalination plant would be around \$389 million including treatment and operation costs.⁹⁷ Even if the international community, notably the World Bank, and international partners such as USAID, were to help fund this project, the cost per cubic meter water provided would remain very high.

3(a)(5) Updating the Network

Water loss from the network is a major problem in Jordan. Data from the MWI indicate that at least 45 percent of water is lost during transfer.⁹⁸ Although major repairs and renovations – including pipeline upgrades, reservoirs, and pumping stations – have been undertaken in Amman and other areas,⁹⁹ more construction is still needed. The estimated cost for improving the entire network is \$1.2 billion.¹⁰⁰ The MWI, in conjunction with USAID aims to decrease water lost by 2-2.5 percent per year to a target reduction of 25 percent.¹⁰¹

The advantage of updating the network is that it can increase supply without the acquisition of new sources. Unlike the mega projects that require substantial initial investments, system updates can be improved piecemeal under a limited budget.

However, insufficient data are available about the network. For example, although the company LEMA was in charge of the water network in Amman for almost eight years, there are no hard numbers available on the degree to which LEMA improved water service in the capital. The Secretary General of the MWI stated that while improvements occurred, they were not as substantial as had been hoped.¹⁰²

3(a)(6) Public-Private Partnerships

The Water Authority of Jordan had privatized its water and wastewater services in Amman from 1999 to 2007 until the commercial government-owned company Our Water took over Amman's water and sewage systems.¹⁰³ The largest wastewater treatment plant in Jordan (Al-Samra) adopted a BOT system in 2000 and has tried to integrate PPPs into its management strategies.¹⁰⁴

The main advantage of PPPs is the ability to incorporate private knowledge and skills into public projects. For example, privatization has the possibility to supply water more efficiently if it is based on effective strategic planning, accompanied by efforts to clearly define its public objectives and methods for satisfying them.¹⁰⁵

However, as the LEMA case shows, PPPs are not always as successful as anticipated. In order to examine the benefits of private-public partnerships and improve them, it is essential to have data on the projects tied to this partnership – data which is currently difficult to obtain.¹⁰⁶

3(b) Program Options: Demand-Side

3(b)(1) Change in Agriculture Policy

Although agricultural activities consume 65 percent of the total water supply, the sector accounts for only 2.7 percent¹⁰⁷ of current GDP and employs 6 percent of the workforce.¹⁰⁸ Furthermore, for one cubic meter of water invested in agriculture, tourism, or industry, agriculture generates the lowest return on investment, with a return of 0.30 JD per cubic meter of water, compared to a return of 20 and 40 JD for tourism and industry, respectively.¹⁰⁹ These significant imbalances suggest that a change in agriculture policy could have a substantial effect on both water availability and national wealth.

Farmers generally choose to invest in high water crops such as bananas, watermelons, and citrus. This is not an efficient strategy in an arid area plagued by water scarcity. Furthermore, many of these crops are exported, meaning that Jordan is, in effect, exporting water that is needed for domestic consumption.

These facts suggest that Jordan should consider progressively transitioning away from agriculture. This would help to ease the tension over water supply and enable the country to reallocate water to satisfy needs of the growing population. However, this global strategy of transition is a long term solution – training the technicians, improving the irrigation network, developing needed support systems, and generating the political will needed to make a successful and sustainable transition will take time.

In transitioning away from agriculture, officials should make changing the dominant crop types a priority. A cost-benefit analysis of different crops' returns on irrigation would help direct this transition. Low-water high-return crops would be theoretically be the ideal alternative to current high-water low-return produce. However, few such crops exist; more realistic alternatives would either be low-water low-return crops or high-water high-return crops such as dates, papaya, and berries.¹¹⁰

This idea of transitioning to crops with a better return faces major obstacles on both political and economic fronts. Indeed, according to NGOs like Mercy Corps and Friends of the Earth-Middle East, there is a lack of political willingness to seriously rethink the agricultural strategy and to put pressure on farmers to implement such an agenda, notably because influential tribes would have to be confronted on the issue.^{111 112}

Any policy that promotes a shift in crops would bear both economic and political costs. In the short term, farmers would need to be guaranteed another source of livelihood while they receive the retraining necessary to shift production; otherwise, the change would create unemployment, discontent, and a cascade of other negative side effects. Possible solutions include the following options:

1. **Subsidies:** Subsidies could ease the economic transition that accompanies a crop change. These subsidies ideally would be used only during the length of the transition and would provide farmers with an incentive to implement this shift. This kind of policy has been implemented in many countries, notably in Japan and in the European Union.

The main problem with subsidies is that after implementing such a policy, it is difficult to discontinue subsidizing without negatively affecting the targeted sector. Furthermore, although the benefit of these subsidies would be high in terms of water savings, the financial costs of the program would be a major issue for the Jordanian government. Nonetheless, compared to the

mega projects involving the construction of large and expensive infrastructures, this policy offers an efficient ratio in terms of cost compared to the amount of water saved.

2. **Taxes:** The reciprocal solution would be to impose taxes on high-water crops. This would create a disincentive to cultivate these crops and create a natural move to more water-efficient alternatives. It is an inexpensive policy compared to the subsidies option; however, such a harsh policy, if implemented alone, would negatively impact farmers' profits. Furthermore, the socio-economic consequences must be considered if there is no simultaneous effort to educate and retrain farmers on how to cultivate crops that are more water efficient.
3. **Tariffs:** Similarly, import tariffs could be removed on imported goods such as Somali bananas. This would make foreign produce more competitive on the Jordanian domestic market, perpetuating a natural shift to products where Jordanian farmers retain a competitive advantage. The costs of this policy are similar to those outlined in the previous option.
4. **Debt Forgiveness:** A major obstacle to any crop transition is that farmers are often caught in a cycle of debt – they cannot afford the short-term decrease in profits that typically accompanies a change in production strategy because they must be certain of a harvest large enough to repay debts accrued at the beginning of the year. Although potentially expensive, offering to repay farmers' debt in exchange for increasing a farm's water efficiency has political and economic appeal. Farmers may view debt forgiveness more favorably than some of the other proposed policy tools, and forgiving debt could foster greater long term flexibility and innovation in the agriculture sector.

In addition to policy mechanisms to shift production priorities, alternatives also exist for overcoming the current political unwillingness to tackle the issue of agriculture reprioritization. According to a Mercy Corps representative, one significant issue is that the government, especially at the local level, is reluctant to oppose tribal influence. These tribes have no incentive to alter current practices because they have a political influence that guarantees them a form of impunity.¹¹³

To change the status quo, the best option is to promote an intervention by King Abdullah, as he wields a unique level of influence over the tribes.¹¹⁴ The King is already invested in the water issue – especially due to recent water scandals – and in February 2008 he ordered the creation of a new committee overseen by Prince Faysal to tackle the water crisis.¹¹⁵ In such a contentious issue, the influence of the royal family, especially the king and queen, may be the only way to convince farmers to switch to more water-efficient crops and production strategies.

The last, and perhaps most important, component of a proposed change in agricultural policy is to emphasize education and training. Indeed, in addition to any financial incentives or disincentives put in place, there must be a comprehensive policy of formation and awareness-raising at the local level. Many organizations, including the UNDP and Jordanian NGOs, underscore that the current crisis is due in part to a lack of technical training and awareness about effective conservation strategies.

Jordanian farms are generally small, family-owned enterprises. Farmers primarily cultivate high-water crops out of familiarity and custom. Promoting a change will take time and require training to facilitate any transition. This raises the concern of the availability of the required "training workforce." Questions such as where these technicians would come from and how long would it would take for them to educate Jordanian farmers have yet to be answered.

Recent programs can serve as a template for such training. Two years ago, UNDP created a \$4 million-program to encourage farmers to switch crops and reduce water use. This awareness campaign focused

mainly on water management, water and health consequences, and the rehabilitation of the water system. Such initiatives, if expanded, can serve as a complement to other agriculture policies implemented by the government.

3(b)(2) Community-Based Work

In addition to mega projects and nationwide reforms, it is essential to consider the potential for change at the local level through community-based initiatives. For example, Jordanian NGOs and international aid agencies are funding community-based organizations (CBOs) to promote household water-conservation projects. Projects include switching to more effective irrigation techniques, installing rainwater harvesting tanks for storing drinking water, and helping sheep and goat breeders use water efficiently.

An effective variation of such projects are micro loan programs that lend qualifying communities a small amount of money to implement water projects deemed important by the community itself. The fact that communities themselves have input in the kinds of projects that they would find most beneficial is a key element of making such initiatives sustainable long term.

These community-based works are cheaper than mega projects and are able to improve residential water networks and water harvesting systems. These projects also foster cooperation between NGOs, major donors (USAID, JICA, etc.), and local governments. By collaborating with NGOs on these projects, major donors can increase the efficiency of their funding through increased flexibility, decreased bureaucracy, and solutions tailored to the needs of individual communities.

However, community-based projects alone will not fix Jordan's water problems. The amount of water saved by these community-based works would most likely be fairly limited compared to the quantity that could be provided by mega projects.

In order to promote community initiatives, the Jordanian government can combine local projects with comprehensive institutional support and coordination, filling the gaps in communication and resource-sharing that traditionally exists between national government, donors, NGOs, and local communities.

3(c) Institutional Options

3(c)(1) A Comprehensive Plan

In developing a strategy for water sustainability, Jordan must design a comprehensive plan beyond what currently appears to be more of a scattershot approach. This is quite challenging, given that the country is frequently beset by more immediate, unanticipated crises often related to regional instability. These events are made a priority in terms of policy making, meaning that water policy becomes inherently reactionary. Furthermore, pressure from international donors or domestic interests may cause the government to focus on specific programs rather than objectively assessing the pros and cons of all options.

Instead, what is needed is a proactive, objective water policy that prioritizes water as its own issue and identifies the most efficient and effective use of funds to maximize the long term positive outcomes of any government water program.

3(c)(2) Free and Open Access to Data

Another recommendation for better water stewardship in Jordan is heightening access to water data. The unavailability of accurate and complete data acts as a barrier to the successful implementation of potentially useful water research and dampens the development of university, NGO, and IGO research.

Security is the main obstacle to institutionalizing a more open-access water data policy. Government officials are wary of freely granting access to all parties interested in such information as it could pose a threat to the safety of important water sources. A secondary impediment is the Jordanian bureaucracy itself – access to data varies based on the energy employees are willing to expend responding to information requests.¹¹⁶

Unfortunately, the government does not always possess all the resources necessary to make informed decisions. Academic institutions and non-governmental organizations can be valuable resources, as they can offer answers to important policy questions at no cost to the government. For this reason, increased access to water data can facilitate the identification of viable water initiatives.

3(c)(3) Public Awareness Campaigns

Another concern expressed by various sectors is an overall lack of public knowledge regarding good water management. Instituting a public awareness campaign about water use is a cheap and easy way for the government to reduce demand. In the urban areas where use is especially high, it can be beneficial for individuals to understand where the water comes from and learn different conservation strategies. Reducing demand in the cities will mean that more water is available during the times of greatest need, such as during the dry, summer months.

However, the urban population is already highly conscious of the problem of water availability as they typically only receive water once a week. This program could be unnecessary, as water use in cities is nowhere near as great as in the rural areas for agriculture.

3(c)(4) Increased Horizontal and Vertical Communication

Increased communication is needed both among sectors and between initiative levels (from government to the grassroots) in order to coordinate programs and create a stronger, comprehensive plan for addressing water problems. The MWI has a five-year national strategy, but a gap exists between government planning and the situation on the ground.¹¹⁷

One challenge in increasing cooperation between sectors is overcoming the general distrust of the national government's ability to address community needs adequately. Nepotism can result in government officials that are hired based on connections instead of professionalism or technical competency, which tarnishes the overall credibility of government officials attempting to implement policy change. With water proposals, this has led locals to doubt the efficacy and appropriateness of top-down projects.

Finding ways to promote communication and cooperation between government and the grassroots can build trust as well as technical knowledge at all levels. One model for integrated water management could be the EMPOWERS project, a four-year regional endeavor implemented in coordination with Care International and Mercy Corps.¹¹⁸ This project focused on a decentralization of water management by collecting community input and developing strategic planning from the bottom upwards instead of from the top down. Visioning, water resource assessments, and strategic planning were conducted by the community to assess its medium-term needs. Through scenario building, consensus, and improved organization structure, the community developed a water plan tailored to its own needs.

The same format of dialog and visioning could be applied to the governate or national level, especially if linked to increased accuracy and availability of information. The process would take time, and it would need large amounts of manpower and coordination, but the element of community involvement and input offers to make this sort of coordinated water strategy more sustainable long-term.

3(c)(5) Fighting Brain

The MWI could retain existing talent and attract potential “drainees” by offering a fellowship program that pays for higher education and technical training in return for an enforceable pledge to work for the Ministry for a set amount of time. This could be modeled on programs such as the U.S. Presidential Management Fellowship (PMF) and might imbue the Jordanian public sector with greater prestige, while retaining talent where it is most needed.

Another option is to encourage close working partnerships between the Ministry and private firms located in Jordan. A close HR partnership between the two sectors would allow Ministry employees to understand the internal dynamics of private firms, while allowing firms’ employees to exploit a better understanding of the decision-making hierarchies that exist inside the government, giving them an advantage over competitors that lack such an understanding. In terms of costs, a PMF-like recruiting and retention program for entry-level Ministry officials could cost as much \$4 million per cohort (\$10,000 per year for four years for 100 Ministry fellows).

3(c)(6) Enforcing Regulations

Jordan, like other water poor countries, has strict regulations governing weekly household water consumption and illegal drilling for groundwater. As stated previously, groundwater in Jordan is considered government property. In practice, however, compliance with water regulations is imperfect, especially in rural areas in the south and east of the Kingdom. One observer suggested that the power of some tribes has led MWI enforcement officers to avoid patrolling their communities for fear of physical attack.

The government could create a more robust enforcement mechanism in the case of particularly egregious water abusers, transferring these duties to the military or police instead of the MWI in order to make an example of certain communities. Alternatively, the king and/or his personal representatives could enter into negotiations directly with troublesome enforcement cases.

Another regulatory solution includes legislation requiring new buildings to have a rainwater harvesting system installed. Such legislation currently varies by municipality, and there is not strict enforcement of new building codes.¹¹⁹ Standardizing building code legislation at the national level and enforcing these regulations would change policy so that more water was harvested at the household level.

A major problem with stricter enforcement of regulations is that it could expose underlying tribal conflict and create social unrest in rural areas, negating the positive impact of water usage enforcement. However, making an example of one particularly rebellious community that abuses water quotas could have a deterrent impact on neighboring communities and eventually lead to greater compliance with well drilling regulations across the country.

In the short term, policing illegal wells would increase the water table, reduce demand, and improve the rule of law. A drawback, though, is that transferring water enforcement duties from the MWI to the police and/or military without increasing their budgets would divert officers from other tasks that are within their traditional purview.

3(c)(7) Harnessing Community Dynamics to Propel Water Conservation

On a small scale, micro financing has had a demonstrable effect in spreading much-needed water conservation technology. The Jordan branch of the international NGO Mercy Corps provides USAID-funded micro loans to rural municipalities. These loans allow communities to construct rooftop cisterns that help families to collect rainwater, reducing their dependence on municipal supply.¹²⁰ Loan repayment was enforced by utilizing kin ties within the municipality – failed borrowers came under pressure from new applicants because the success of the latter’s proposals depended on prior borrowers not defaulting.

Tribal dynamics such as honor, saving face, and community obligation can be harnessed to encourage group participation where compliance might be difficult to enforce in an anonymous urban setting.

The MWI could adopt this model to encourage compliance with water conservation standards, ensuring that no member of a community exceeds the allotted weekly water quota or digs an illegal well. Tying the fate of community members together would help ensure compliance and reduce waste by encouraging self-policing where government enforcement has failed in the past.¹²¹ Water usage in Jordan is a zero-sum game in the short-term: one community member drawing water beyond an allotted quota means less water for a neighbor. Publishing the names and/or addresses of water abusers could encourage community compliance, reducing enforcement costs for Ministry and law enforcement officials.

A concern is that “shaming” water violators could exacerbate tribal and community tensions rather than produce higher rates of compliance. Also, assigning MWI resources to micro projects and small scale enforcement could divert attention away from mega projects with greater potential. Conversely, expanded compliance would reduce demand and increase supply, even in the short term. Community enforcement would make every community member a stakeholder, rather than a passive actor, and could ensure a greater commitment to future conservation projects.

3(c)(8) Tying Water to Existing Regional Diplomatic Efforts

Jordan sits downstream from two crucial neighbors – Syria and Israel – over which it holds varying levels of leverage in regional discussions about Palestinian track negotiations, Syrian track negotiations, diplomatic talks on Iraq and Iran, and regional peace.

In Syria, for instance, even the shortest visit by King Abdullah is perceived as a tremendous diplomatic boost. Jordan is one of only two Arab countries that have bilateral relations with the Jewish state and is therefore instrument in applying pressure on the Palestinian Authority or securing peace treaties from other regional powers. While the MWI struggles to achieve tactical gains in negotiations with its counterparts in Syria and Israel, the Foreign Ministry has crucial bargaining leverage at the table.

The Jordanian government, perhaps most effectively under the leadership of the Royal Cabinet, could tie diplomatic efforts to water treaty negotiations with other riparian states. One partially successful example of this was the side agreement between Jordan and Israel to the original 1994 peace treaty. Syria, for example, is responsible for constructing additional Jordan River dams outside a bilateral agreement governing the bilateral project. The northern neighbor has also contributed to the industrial pollution upstream, increasing the cost of making the headwaters of the Jordan River potable.

Each water system has a regional hegemon: Turkey for the Euphrates-Tigris and Israel in the Jordan River.¹²² Despite Israel’s hegemonic status in the Basin and Jordan’s resource scarcity, the Kingdom has parlayed its prestige in the Arab world and bold regional diplomacy into a close and beneficial bilateral military relationship with the U.S. There is no obvious reason that Jordan could not expand this influence to water resource negotiations.

Tying water negotiations to Jordan’s regional diplomacy would mean recognizing the existential nature of the water scarcity threat. It would mean explicitly tying Jordanian efforts to help Israel and the U.S. in Iran, Iraq, and the PA to (1) unilateral Israeli reductions in Basin intake and (2) U.S. pressure on Syria regarding Jordan River water usage as an integral part of Syrian track negotiations with Israel *and* the U.S.

4. Section IV: Recommendations

A dramatic change in Jordan’s water resource management is necessary to avoid the realization of worrisome scenarios. If current supply and demand trends continue, by 2020 Jordan is expected to have a

sustainable water supply that is only sufficient to meet industry and municipal needs and not the demand from agriculture, even as water tables continue to drop.¹²³ Only an ambitious and wide-ranging set of coordinated macro- and micro-scale projects will enable supply to meet demand sustainably.

Due to the interdisciplinary nature of the problem, as well as the fact that steps to address long term outcomes should be taken now, Jordan should develop a comprehensive plan for averting a worsening water crisis. A comprehensive plan allows for costs and benefits to be weighed over time – this perspective especially is needed in light of criticisms that the MWI historically has adopted policies that are too reactive or scattered instead of exploring more methodical approaches with a long-term vision of sustainability.

The MWI has already developed a five-year national strategy, but a comprehensive plan should look beyond the five-year timeframe to incorporate short, medium, and long-term steps that will make sustainable and coordinated progress toward a more secure water future.

For example, the drastic imbalance in the agriculture sector between water consumption and GDP contribution stands out as a major opportunity for future reallocation of scarce resources. However, any change to current agricultural practices cannot occur without a number of preparatory steps, all of which will take time. Therefore, what appears to be one of the most sustainable changes in terms of decreasing demand can only be achieved through a holistic approach and a carefully developed long-term strategy.

Based on the analysis and options described in the previous sections, the following recommendations may serve as a template for developing a comprehensive, sustainable plan for addressing Jordan's water crisis. Figure 1 provides a schematic representation of this plan, which organizes recommendations by time period (short, medium, and long term) and by thematic area (infrastructure and human capital, government, and diplomacy).

4(a) Strengthening Infrastructure and Human Capital

The long-term objectives of this series of programmatic changes – geared toward an eventual shift in the agriculture sector – are to:

- Strengthen competence and communication across sectors and between levels of society
- Improve technical training and awareness
- Empower communities to take ownership of local water initiatives

4(a)(1) Water Network

In the short run, the government should continue updating the water network, recognizing the long term importance of reducing water loss despite high immediate project costs. If information and data are made more accessible, the success of the network update can be monitored and reevaluated on an ongoing basis, allowing the government to create future initiatives based on a firmer understanding of what has worked in the past.

4(a)(2) Mega Projects

In terms of larger infrastructure projects, tapping the Disi aquifer and other non-renewable sources may buy time for Jordan, but such projects do not offer a long-term solution. The Red Sea-Dead Sea Canal offers a sustainable source of water, but at an incredibly high price, especially since the political stability of such a project is not guaranteed. While such projects may become a sub-optimal necessity, the Jordanian government should seriously evaluate whether the funds for mega projects could be better allocated toward slower but more sustainable efforts, namely addressing demand and institutional facets of the water problem.

4(a)(3) Human capital

Meanwhile, a three-pronged strategy for strengthening human capital should be developed for implementation within the next 2-5 years. This strategy entails:

- Improving education (both technical training and public awareness)
- Increasing access to information for better monitoring and training
- Building community-level programs to identify locally-appropriate mechanisms for addressing water scarcity.

Based on this foundation, further policies can be implemented addressing community needs and providing incentives to train and retain employees key to this process. Such individuals include technicians, teachers, local leaders, and higher-level government staff.

4(a)(4) Rural Education and Technical Training

Once the government has a stronger understanding of local needs and a stronger workforce to implement change, it can move ahead with its long-term objectives that will shift water consumption patterns, especially in rural Jordan. Loans, training, and technical support are all elements of addressing water demand at its source and helping communities to find alternative or more efficient ways of using their water resources.

4(b) Reducing Inefficient Agricultural Practices

With these training systems in place, the Jordanian government can finally implement policies that directly provide incentives to change agricultural production. The Ministry of Agriculture should pursue interventionist policies that will shift the nation's agricultural production to a bundle of crops that are more water efficient. While a hard pill to swallow, reducing demand in this inefficient sector (high demand relative to GDP contribution) will address macroeconomic distortions and go a long way in reducing national water demand.

Possible policies can include tariff or tax changes, a restructuring of the water pricing system, and/or debt forgiveness programs. These policies should be accompanied by the appropriate technical and financial support necessary to ease individuals' transition between livelihoods. The goal is to help farmers transition from water intensive crops with low returns to more efficient crops, closing the gap between the agriculture's high level of water consumption and its low contribution to GDP.

4(c) Government**4(c)(1) Lawmaking**

Within the next few years, both the executive and legislative branches should explore further legislation to restrict the use of non-renewable wells. Building codes should be modified at the national level to mandate the incorporation of water harvesting systems into new buildings. Long term government goals should include even better law enforcement as well as a hiring process of government officials that stresses expertise and relevant prior experience.

4(c)(2) Enforcement

Increased enforcement of existing laws is needed to ensure compliance and to prevent the even more rapid depletion of Jordan's non-renewable water resources. Given the current attention on water problems due to contamination concerns, the king has an opportunity to promote a positive image of Jordanian water management while at the same time pressuring tribes to comply with national water regulations.

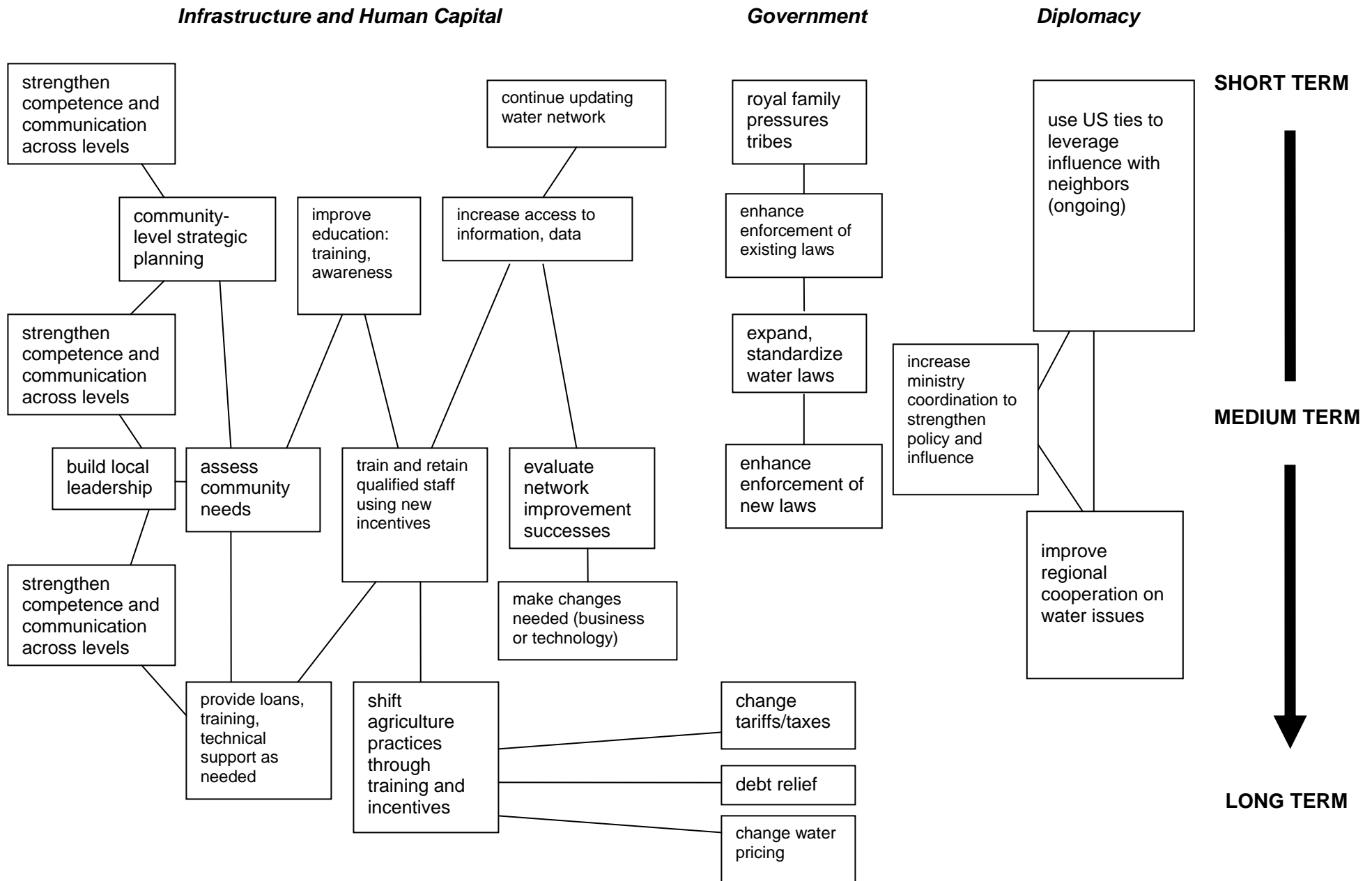
4(d) Diplomacy***4(d)(1) Increasing Bargaining Leverage in Water Negotiations***

Jordan's long term goal at the international level is to increase communication and cooperation between states so that resource crises can be addressed peacefully and effectively across borders. Regardless of the time frame, Jordan should pursue mechanisms for leveraging influence in the regional arena to effect favorable water accords. Currently, Jordan's role as a strategic ally in the United States' campaign in Iraq creates an opportunity for Jordan to lobby the U.S. for assistance in pressuring its neighbors, especially Israel, on water policy.

Bureaucratically, this would mean increasing coordination between the Foreign Ministry and the MWI. There are currently a number of inter-agency committees, usually enjoying high-level participation. A long-term strategy, however, would detail MWI employees to Foreign Ministry positions for a period of months or years and even create a Directorate of Water Resources within the Foreign Ministry to ensure that the latest status of water negotiations is included in diplomatic talks with riparian (Syria, Israel, even Saudi Arabia) and non-riparian states (U.S.).

Given finite diplomatic resources and many pressing diplomatic concerns for Jordan, giving such prime billing to water negotiations in the Foreign Ministry's agenda may limit Jordan's diplomatic bargaining potential in the long run. Yet, making water an integral part of regional discussions would underscore the importance of the issue, highlight possibilities for regional and bilateral cooperation, and might even spur progress on Syrian track negotiations. Furthermore, integrating water into foreign policy is costless in dollar amounts and does not require a rearranging of any agency's annual operating budget.

Figure 1: Comprehensive Water Policy Plan for Jordan



APPENDIX A: List of Field Meetings

Amal Dababseh. Environment Analyst, United Nations Development Programme. Sunday, February 24th, 2008.

Abdel Rahman Sultan. Friends of the Earth Middle East. Sunday, February 24th, 2008.

Khaldoun Khashman. Secretary General, Ministry of Water and Irrigation. Monday, February 25th, 2008.

Dina Dabbas, Sireen Hikmat, and Salem Ghawi. Executive Privatization Commission. Monday, February 25th, 2008.

US Embassy in the Hashemite Kingdom of Jordan. Monday, February 25th, 2008.

United States Agency for International Development (USAID) in Jordan. Monday, February 25th, 2008.

Sana Naffa. National Program Officer, World Health Organization. Wednesday, February 27th, 2008.

Shadi Bushnaq. Project Director for Community Based Initiatives and Demand Management, Mercy Corps. Thursday, February 28th, 2008.

References

- ¹ IRIN. "Water contamination incidents highlight Jordan's water problem." UN Office for the Coordination of Humanitarian Affairs. 19 November 2007. http://yubanet.com/artman/publish/article_70799.shtml (Accessed: January 22, 2008)
- ² Drake, Christine. "Water Resource Conflicts in the Middle East." *Journal of Geography*. 96 v4-1 p.2 January/February 1997.
- ³ Embassy of Jordan. "Information Bureau: Environment and Water." Washington, D.C.: Embassy of the Hashemite King of Jordan. <http://www.jordanembassyus.org/new/jib/factsheets/environment.shtml> (Accessed: January 21, 2008)
- ⁴ Drake, Christine. "Water Resource Conflicts in the Middle East." *Journal of Geography*. 96 v4-1 p.2 January/February 1997.
- ⁵ Mercy Corps project staff, interview by authors, Amman, Jordan, 28 February 2008.
- ⁶ CIA "World Factbook. Country Profile: Jordan." Washington, D.C.: CIA <https://www.cia.gov/library/publications/the-world-factbook/geos/jo.html> (Accessed: March 13, 2008)
- ⁷ Hummel, Diana. "Population Dynamics and Conflicts on Water Resources in the Jordan River Basin." Institute for Socio-Ecological Research (ISOE), 2006. http://isoe.de/ftp/tagungen/dh_popdynamik_2006.pdf (Accessed: January 22, 2008)
- ⁸ Embassy of Jordan. "Information Bureau: Environment and Water." Washington, D.C.: Embassy of the Hashemite King of Jordan. <http://www.jordanembassyus.org/new/jib/factsheets/environment.shtml> (Accessed: January 21, 2008)
- ⁹ Leyne, Jon. "'Water factory' aims to filter tensions." BBC. 7 September 2004. http://news.bbc.co.uk/2/hi/middle_east/3631964.stm (Accessed: January 22, 2008)
- ¹⁰ Drake, Christine. "Water Resource Conflicts in the Middle East." *Journal of Geography*. 96 v4-1 p.2 January/February 1997.
- ¹¹ Aquastat. "Jordan." Rome: Food and Agriculture Organization of the United Nations, 1997. <http://www.fao.org/nr/water/aquastat/countries/jordan/index.stm> (Accessed: January 22, 2008)
- ¹² Ministry of Water and Irrigation. "National Water Master Plan." Amman: Ministry of Water and Irrigation, The Hashemite King of Jordan. <http://www.mwi.gov.jo/NWMP/> (Accessed: January 21, 2008)
- ¹³ Mercy Corps project staff, interview by authors, Amman, Jordan, 28 February 2008.
- ¹⁴ Ministry of Water and Irrigation, "National Water Master Plan," Amman: Ministry of Water and Irrigation, The Hashemite King of Jordan. <http://www.mwi.gov.jo/NWMP/> (Accessed: January 21, 2008)
- ¹⁵ H.M. Queen Noor of Jordan. "Message from HM Queen Noor of Jordan. "Water: Dispute Prevention and Development" Conference." Amman: The Hashemite Royal Court of Jordan, <http://www.noor.gov.jo/main/watermsg.htm>, (Accessed: January 19, 2008)
- ¹⁶ *ibid.*
- ¹⁷ *ibid.*
- ¹⁸ IRIN. "Water contamination incidents highlight Jordan's water problem." UN Office for the Coordination of Humanitarian Affairs. 19 November 2007. http://yubanet.com/artman/publish/article_70799.shtml (Accessed: January 22, 2008)
- ¹⁹ Ministry of Water and Irrigation, "Private Sector Participation (PSP)," Ministry of Water and Irrigation <http://www.mwi.gov.jo/mwi/PSPIntroduction.aspx> (accessed January 20, 2008)
- ²⁰ Friends of the Earth Middle East, "Jordan NGO Shadow Report Non Governmental Report on The Way to Sustainability Presented at the World Summit for Sustainable Development," Friends of the Earth Middle East, July 2002 http://www.foeme.org/index_images/dinamicas/publications/publ47_1.pdf
- ²¹ LEMA, "About LEMA," LEMA, <http://www.lemma.com.jo/index.php?ID=64> (accessed January 21, 2008)
- ²² Namroqa, Hana. "Jordan Water Company to replace LEMA." *Jordan Times*. 22 October 2006. <http://www.highbeam.com/doc/1G1-153159209.html> (1/22/08)
- ²³ Friends of the Earth Middle East, "Jordan NGO Shadow Report Non Governmental Report on The Way to Sustainability Presented at the World Summit for Sustainable Development," Friends of the Earth Middle East, July 2002 http://www.foeme.org/index_images/dinamicas/publications/publ47_1.pdf
- ²⁴ Peter H. Gleick, Gary Wolff, Elizabeth L. Chalecki, and Rachel Reyes, "The World's Water, 2004-2005: The Biennial Report on Freshwater Resources: Chapter 3, The Privatization of Water and Water Systems," Island Press, 2004

-
- ²⁵ United Nations, Economic and Social Commission for Western Asia, “Module 3 Legislative and organizational frameworks,” Workshop on “Training of Trainers on the Application of IWRM Guidelines in the Arab Region” Kuwait, 14-18 May 2005, http://www.cap-net.org/TMUploadedFiles/FileFor154/Module_3_Legislative_and_organizational_frameworks.pdf
- ²⁶ *ibid.*
- ²⁷ Friends of the Earth Middle East. “Jordan NGO Shadow Report Non Governmental Report on The Way to Sustainability Presented at the World Summit for Sustainable Development.” Friends of the Earth Middle East, July 2002, http://www.foeme.org/index_images/dinamicas/publications/publ47_1.pdf (Accessed: March 19, 2008)
- ²⁸ Worth, Robert F. Rising Inflation Causes Unrest in the Middle East. New York Times. February 25, 2008. http://select.nytimes.com/mem/tnt.html?_r=1&emc=tnt&tntget=2008/02/25/world/middleeast/25economy.html&tntemail0=y&oref=slogin (Accessed: February 25, 2008)
- ²⁹ Hummel, Diana. “Population Dynamics and Conflicts on Water Resources in the Jordan River Basin.” Institute for Socio-Ecological Research (ISOE), 2006. http://isoe.de/ftp/tagungen/dh_popdynamik_2006.pdf (Accessed: January 22, 2008)
- ³⁰ Embassy of Jordan. “Information Bureau: Environment and Water.” Washington, D.C.: Embassy of the Hashemite King of Jordan. <http://www.jordanembassyus.org/new/jib/factsheets/environment.shtml> (Accessed: January 21, 2008)
- ³¹ IRIN. “Water contamination incidents highlight Jordan’s water problem.” UN Office for the Coordination of Humanitarian Affairs. 19 November 2007. http://yubanet.com/artman/publish/article_70799.shtml (Accessed: January 22, 2008)
- ³² Drake, Christine. “Water Resource Conflicts in the Middle East.” *Journal of Geography*. 96 v4-1 p.2 January/February 1997.
- ³³ Hummel, Diana. “Population Dynamics and Conflicts on Water Resources in the Jordan River Basin.” Institute for Socio-Ecological Research (ISOE), 2006. http://isoe.de/ftp/tagungen/dh_popdynamik_2006.pdf (Accessed: January 22, 2008)
- ³⁴ *ibid.*
- ³⁵ *ibid.*
- ³⁶ Gillespie, Kristen. “Jordan Faces Major Water Shortage.” *National Public Radio*. 14 August 2007. <http://www.npr.org/templates/story/story.php?storyId=12768985> (Accessed: January 21, 2008)
- ³⁷ Ministry of Water and Irrigation. “National Water Master Plan.” Amman: Ministry of Water and Irrigation, The Hashemite King of Jordan. <http://www.mwi.gov.jo/NWMP/> (Accessed: January 21, 2008)
- ³⁸ Ministry of Water and Irrigation. “National Water Master Plan.” Amman: Ministry of Water and Irrigation, The Hashemite King of Jordan. <http://www.mwi.gov.jo/NWMP/> (Accessed: January 21, 2008)
- ³⁹ Lucy Dean. “The Middle East and North Africa 2006.” Routledge, 2006
- ⁴⁰ Rosegrant, Mark. “2020 Vision Brief 21: Dealing with Water Scarcity in the Next Century.” IFPRI. June 1995. <http://www.ifpri.org/2020/briefs/number21.htm> (Accessed: January 22, 2008)
- ⁴¹ Werner Doppler, Amer Z. Salman, Emad K. Al-Karablieh, Heinz-Peter Wolff, “The impact of water price strategies on the allocation of irrigation water: the case of the Jordan Valley,” *Agricultural Water Management* 55 (2002) 171-182
- ⁴² Ministry of Water and Irrigation. “National Water Master Plan.” Amman: Ministry of Water and Irrigation, The Hashemite King of Jordan. <http://www.mwi.gov.jo/NWMP/> (Accessed: January 21, 2008)
- ⁴³ *ibid.*
- ⁴⁴ Ministry of Water and Irrigation. “National Water Master Plan.” Amman: Ministry of Water and Irrigation, The Hashemite King of Jordan. <http://www.mwi.gov.jo/NWMP/> (Accessed: January 21, 2008)
- ⁴⁵ *ibid.*
- ⁴⁶ Mercy Corps project staff, interview by authors, Amman, Jordan, 28 February 2008.
- ⁴⁷ *ibid.*
- ⁴⁸ The Hashemite King of Jordan. “Government, The Executive Branch, The Prime Minister and Cabinet.” Amman: <http://www.kinghussein.gov.jo/government2.html#The%20Prime%20Minister%20and%20Cabinet> (Accessed: March 19, 2008)
- ⁴⁹ Mercy Corps project staff, interview by authors, Amman, Jordan, 28 February 2008.
- ⁵⁰ IRIN. “Water contamination incidents highlight Jordan’s water problem.” UN Office for the Coordination of Humanitarian Affairs. 19 November 2007. http://yubanet.com/artman/publish/article_70799.shtml (Accessed: January 22, 2008)
- ⁵¹ The Secretary-General, Jordanian Ministry of Water, interview by authors, Amman, Jordan, February 25, 2008.

-
- ⁵² USAID Jordan officials, interview by authors, U.S. Embassy, Amman, Jordan, February 25, 2008.
- ⁵³ Ministry of Water and Irrigation, The Hashemite King of Jordan. Amman: <http://www.mwi.gov.jo/mwi/ministry.aspx>, (Accessed: January 20, 2008)
- ⁵⁴ Meuss, Marina. "Regulation and Supervision in Water Supply and Sanitation (WSS)." Division Environment and Infrastructure. German Development Corporation. 2006. http://www2.gtz.de/dokumente/bib/06-0644_I.pdf (Accessed: January 22, 2008)
- ⁵⁵ FAO. "FAO's Information System on Water and Agriculture." Rome: Food and Agriculture Organization of the United Nations. <http://www.fao.org/nr/water/aquastat/countries/jordan/index.stm> (Accessed January 22, 2008)
- ⁵⁶ United States Department of Agriculture. Natural Resources Conservation Service. Soil Quality Resource Concerns: Salinization. Soil Quality Information Sheet. January 1998. http://www.urbanext.uiuc.edu/soil/sq_info/saline.pdf (Accessed: April 5, 2008)
- ⁵⁷ Shatanawi, Muhammed. R. "Legal and Institutional Aspects of Water Management in Jordan." <http://www.isgi.cnr.it/stat/publicazioni/sustainable/187.pdf> (Accessed: January 22, 2008)
- ⁵⁸ Gillespie, Kristen. "Jordan Faces Major Water Shortage." National Public Radio, Morning Edition, August 14, 2007. <http://www.npr.org/templates/story/story.php?storyId=12768985> (Accessed: January 24, 2008)
- ⁵⁹ The Secretary-General, Jordanian Ministry of Water, interview by authors, Amman, Jordan, 25 February 2008.
- ⁶⁰ Drake, Christine. "Water Resource Conflicts in the Middle East." *Journal of Geography*. 96 v4-1 p.2 January/February 1997.
- ⁶¹ Moffett III, George D. "If Jordan Valley Wells Run Dry..." The Christian Science Monitor. 14 March 1990. <http://www-tc.pbs.org/wgbh/globalconnections/mideast/educators/resource/gotwater.pdf> (Accessed January 21, 2008)
- ⁶² *ibid.*
- ⁶³ *ibid.*
- ⁶⁴ Drake, Christine. "Water Resource Conflicts in the Middle East." *Journal of Geography*. 96 v4-1 p.2 January/February 1997.
- ⁶⁵ Greenberg, Joel. "Jordan River, sacred to many, is dying." *Chicago Tribune*, Chicago, IL. 1 December 2006.
- ⁶⁶ *ibid.*
- ⁶⁷ Drake, Christine. "Water Resource Conflicts in the Middle East." *Journal of Geography*. 96 v4-1 p.2 January/February 1997.
- ⁶⁸ IRIN. "A catalyst for peace? The case for water cooperation." UN Office for the Coordination of Humanitarian Affairs. 23 January 2008. <http://www.irinnews.org/InDepthMain.aspx?InDepthId=13&ReportId=61077> (Accessed January 23, 2008)
- ⁶⁹ Drake, Christine. "Water Resource Conflicts in the Middle East." *Journal of Geography*. 96 v4-1 p.2 January/February 1997.
- ⁷⁰ "Wahdah dam details agreed." *International Water Power & Dam Construction*. March 2004, v56 i3, p. 6.
- ⁷¹ *ibid.*
- ⁷² *ibid.*
- ⁷³ Gillespie, Kristen. "Jordan Faces Major Water Shortage." *National Public Radio*. 14 August 2007. <http://www.npr.org/templates/story/story.php?storyId=12768985> (Accessed January 21, 2008)
- ⁷⁴ *ibid.*
- ⁷⁵ Moffett III, George D. "If Jordan Valley Wells Run Dry..." The Christian Science Monitor. 14 March 1990. <http://www-tc.pbs.org/wgbh/globalconnections/mideast/educators/resource/gotwater.pdf> (Accessed January 21, 2008)
- ⁷⁶ Greenberg, Joel. "Jordan River, sacred to many, is dying." *Chicago Tribune*, Chicago, IL. 1 December 2006
- ⁷⁷ *ibid.*
- ⁷⁸ PA Consulting Group. "Jordan Disi-Amman Water Supply Project." PA Consulting Group. http://www.paconsulting.com/industries/international_development/government_contract_vehicles/water_iqc/case_studies/cs_mwh/cs_jordan_disi_amman.htm (Accessed: March 13, 2008)
- ⁷⁹ IRIN. "JORDAN: US\$600 million project to end water shortage." UN Office for the Coordination of Humanitarian Affairs. 7 October 2007. <http://www.irinnews.org/Report.aspx?ReportId=74679> (Accessed: March 13, 2008)
- ⁸⁰ *ibid.*
- ⁸¹ Ministry of Water and Irrigation. "National Water Master Plan." Amman: Ministry of Water and Irrigation, The Hashemite King of Jordan. <http://www.mwi.gov.jo/NWMP/> (Accessed: January 21, 2008)
- ⁸² *ibid.*

-
- ⁸³ *ibid.*
- ⁸⁴ water-technology.net. “Greater Amman Water Supply Project, Jordan.” water-technology.net. http://www.water-technology.net/projects/greater_amman/ (Accessed: March 13, 2008)
- ⁸⁵ Khalaf, “The Disi project” *What’s up in Jordan?* December 07, 2005 <http://ajloun.blogspot.com/2005/12/disi-project.html> (Accessed: March 13, 2008)
- ⁸⁶ USAID – Jordan. Securing Jordan’s Prosperity through Improved Water Management. http://www.sabeq-jordan.org/SABEQ_Files/633376232540818400.pdf
- ⁸⁷ water-technology.net. “Greater Amman Water Supply Project, Jordan.” water-technology.net. http://www.water-technology.net/projects/greater_amman/ (Accessed: March 13, 2008)
- ⁸⁸ Israel Ministry of Foreign Affairs. “The Red Sea and the Mediterranean Dead Sea canals project.” Israel Ministry of Foreign Affairs. http://www.mfa.gov.il/MFA/MFArchive/2000_2009/2002/8/The%20Red%20Sea%20and%20the%20Mediterranean%20Dead%20Sea%20canals (Accessed: March 13, 2008)
- ⁸⁹ *ibid.*
- ⁹⁰ Bank Information Center. “Red Sea - Dead Sea Water Conduit Project.” Bank Information Center. <http://www.bicusa.org/en/Project.58.aspx> (Accessed: March 15, 2008)
- ⁹¹ USAID in Jordan. “Red Sea – Dead Sea Water Conveyance Feasibility Study and Environmental and Social Assessment.” Amman: USAID in Jordan. http://jordan.usaid.gov/project_disp.cfm?id=118 (Accessed : March 15, 2008)
- ⁹² *ibid.*
- ⁹³ IRIN. “JORDAN: US\$600 million project to end water shortage.” UN Office for the Coordination of Humanitarian Affairs. 7 October 2007. <http://www.irinnews.org/Report.aspx?ReportId=74679> (Accessed: March 13, 2008)
- ⁹⁴ Israel Ministry of Foreign Affairs. “The Red Sea and the Mediterranean Dead Sea canals project.” Israel Ministry of Foreign Affairs. http://www.mfa.gov.il/MFA/MFArchive/2000_2009/2002/8/The%20Red%20Sea%20and%20the%20Mediterranean%20Dead%20Sea%20canals (Accessed: March 13, 2008)
- ⁹⁵ Israeli/Palestine Center for Research and Information, <http://www.ipcri.org/files/spragg.html> (Accessed: March 20, 2008)
- ⁹⁶ Ministry of Planning and International Cooperation. “Aquaba Special Economic Zone, Investment Projects.” Amman: Ministry of Planning and International Cooperation, The Hashemite King of Jordan. http://www.jordanech.org/pdf/investment/majdev_asezainvest.pdf (Accessed: March 19, 2008)
- ⁹⁷ Benoit Morel, Igor Linkov, “Environmental Security and Environmental Management: The Role of Risk Assessment”, Springer, 2005, 324 p.
- ⁹⁸ *ibid.*
- ⁹⁹ water-technology.net. “Greater Amman Water Supply Project, Jordan.” water-technology.net. http://www.water-technology.net/projects/greater_amman/ (Accessed: March 13, 2008)
- ¹⁰⁰ *ibid.*
- ¹⁰¹ The Secretary-General, Jordanian Ministry of Water, interview by authors, Amman, Jordan, 25 February 2008.
- ¹⁰² *ibid.*
- ¹⁰³ Namroqa, Hana. “Jordan Water Company to replace LEMA.” *Jordan Times*. 22 October 2006. <http://www.highbeam.com/doc/1G1-153159209.html> (Accessed : January 21, 2008)
- ¹⁰⁴ USAID in Jordan. “As-Samra Wastewater Treatment Plant Project.” Amman: USAID in Jordan, http://jordan.usaid.gov/project_disp.cfm?id=35 (Accessed : March 15, 2008)
- ¹⁰⁵ Peter H. Gleick, Gary Wolff, Elizabeth L. Chalecki, and Rachel Reyes, “The World’s Water, 2004-2005: The Biennial Report on Freshwater Resources: Chapter 3, The Privatization of Water and Water Systems,” Island Press, 2004
- ¹⁰⁶ UNDP in Jordan staff, interview by authors, Amman, Jordan, 24 February 2008.
- ¹⁰⁷ Lucy Dean. “The Middle East and North Africa 2006.” Routledge, 2006
- ¹⁰⁸ Mercy Corps project staff, interview by authors, Amman, Jordan, 28 February 2008.
- ¹⁰⁹ USAID in Jordan staff, interview by authors, Amman, Jordan, 25 February 2008.
- ¹¹⁰ Mercy Corps project staff, interview by authors, Amman, Jordan, 28 February 2008.
- ¹¹¹ *ibid.*
- ¹¹² Friends of the Earth-Middle East project staff, interview by authors, Amman, Jordan, 24 February 2008.
- ¹¹³ Mercy Corps project staff, interview by authors, Amman, Jordan, 28 February 2008.

¹¹⁴ *ibid.*

¹¹⁵ Middle East Business Intelligence. "Jordan sets up committee to develop water sector." Middle East Business Intelligence.

http://www.meed.com/jordan/news/2008/02/110208_webnews_jordan_sets_up_new_water_committee.html

(Accessed: March 19, 2008)

¹¹⁶ UNDP in Jordan staff, interview by authors, Amman, Jordan, 24 February 2008.

¹¹⁷ Mercy Corps project staff, interview by authors, Amman, Jordan, 28 February 2008.

¹¹⁸ *ibid.*

¹¹⁹ *ibid.*

¹²⁰ *ibid.*

¹²¹ *ibid.*

¹²² Allan, J.A. "Hydro-Peace in the Middle East: Why no Water Wars? A Case Study of the Jordanian River Basin." *SAIS Review* 2 (2002): 257.

¹²³ USAID in Jordan staff, interview by authors, Amman, Jordan, 25 February 2008.