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REVIEW OF WATER POLICIES IN JORDAN AND RECOMMENDATIONS FOR STRATEGIC PRIORITIES

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A REVIEW OF WATER POLICIES IN JORDAN AND RECOMMENDATIONS FOR STRATEGIC PRIORITIES

FINAL REPORT

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ACRONYMS

ACC	Agricultural Credit Corporation
AFD	Agence Française de Développement
ANE	Asia Near East Bureau
AWC	Aqaba Water Company
BOD	Biological Oxygen Demand
BOO	Build-Operate-Own
BOT	Build-Operate-Transfer
CBI	Community Based Initiatives for Water Demand Management
CBO	Community-Based Organization
CP	Condition Precedent
CPI	Consumer Price Index
DALY	Disability Adjusted Life-Year
DFID	Department for International Development (UK)
EU	European Union
FOEME	Friends of the Earth - Middle East
FTE	Full-Time Equivalent
GAP	Good Agricultural Practices
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GoJ	Government of Jordan
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit GmbH
IDARA	Instituting Water Demand Management in Jordan
ISSP	Institutional Support and Strengthening Program
IWRM	Integrated Water Resource Management
IQC	Indefinite Quantity Contract
JD	Jordanian Dinar
JRSP	Jordan Red Sea Project
JVA	Jordan Valley Authority
JWSA	Jordan Water Sector Assessment
KAC	King Abdallah Canal
KAFA'A	Education and Information Program to Improve Irrigation Water Use Efficiency
KTR	King Talal Reservoir
LEMA	Lyonnaise des Eaux – Montgomery Watson - Arabtech Jardanesh
LCD	Liters per capita per day
O&M	Operation and Maintenance
M&I	Municipal and Industrial
MCC	Millennium Challenge Corporation
MCM	Million Cubic Meters
MOF	Ministry of Finance

MOPIC	Ministry of Planning and International Cooperation
MWI	Ministry of Water and Irrigation
NRW	Non-Revenue Water
NWC	National Water Council
PEP	Public Expenditure Perspectives of the Jordan Fiscal Reform II Project
PMP	Performance Monitoring Unit of the MWI/WAJ
PNA	Palestinian National Authority
PSP	Private Sector Participation
RIG	Regional Inspector General
RSCN	Royal Society for the Conservation of Nature
USAID	United States Agency for International Development
USG	United States Government
USGS	United States Geological Survey
WAJ	Water Authority of Jordan
WEPIA	Water Efficiency and Public Information for Action Project
WDMU	Water Demand Management Unit/MWI
WHO	World Health Organization
WWTP	Waste Water Treatment Plant
WRG	2030 Water Resources Group
WRE	Water Resource and Environment Team of USAID/Jordan
WREC	Water Resource and Environmental Conservation Project
WSD	Water Saving Devices
WUA	Water User Association

EXECUTIVE SUMMARY

The review team for this assessment worked in-country from January 7 through January 27, 2012 under a task order for the Water IQC (Indefinite Quantity Contract). Its scope of work is attached as Annex 1. An entry briefing was held on January 8. Two formal presentations on January 18 and January 25 were made to USAID by the team. A first draft was submitted to USAID review on January 27, 2012. A final draft report for review was submitted on February 12, 2012. This document reflects final comments by USAID on the final draft made in March 2012. It is the final report.

MAJOR TRENDS IN WATER RESOURCE MANAGEMENT OVER THE PAST 10 YEARS

WATER SUPPLY.

Jordan is a naturally water scarce country. Its climate ranges from semi-arid in the northwestern part of the country to arid desert in its eastern and southern reaches. Jordan is subject to periodic droughts that may extend for four to five years in duration. Water supply from surface sources has declined substantially over the past ten years. The Ministry of Irrigation and Water (MWI) attributes part of this decrease to reduced rainfall levels. Most recent (2010-2011) climate models for Jordan predict decreases in rainfall over the long-term (El Nesr et al 2010, Black et al 2012, Smiatek et al 2011),

Significant reductions in surface flows are also caused by human activities throughout the watersheds that drain into the Jordan River Valley. Jordanian officials point to the construction by Syria of upstream dams and a doubling in wells in Syria as major causes for the decades-long decline in Yarmouk River flood and base flows. The Yarmouk River historically provided much of the fresh water needed for municipal use and agriculture. Over the past 50 years, Jordan has come to depend primarily on groundwater for its municipal, industrial, and its Highlands agricultural sectors. During the past 20 years Jordan's public and private sector has engaged in extensive well-drilling and over-pumping of groundwater that is far beyond natural recharge capacity. This over pumping has reduced the natural base flows into the side-wadis and natural springs along the rift causing significant economic and environmental harm. Programs in rain-water harvesting in rural and urban settings have been limited in geographic scope and have had negligible total impact on surface water capture for domestic use or groundwater aquifer recharge.

Jordan is facing a future of very limited water resources- among the lowest in the world on a per capita basis at 147 m3 per person per year in 2010. Renewable water resources have fallen below 130 m3 per person per year. Current total uses exceed renewable supply. The difference comes from non-renewable and fossil groundwater extraction and the reuse of reclaimed water. If supply remains constant, per capita domestic consumption is projected to fall to approximately 90 m3 per person per year by 2025, putting Jordan in the category of having an absolute water shortage that will constrain economic growth and potentially endanger public health.

Over the past two decades, Jordanian public and private sector actors have invested in water supply through : 1) the development of public desalination facilities for municipal use, and micro and small private desalination facilities for drinking water and agricultural use; 2) the extraction of fossil fresh water from the aquifer shared with Saudi Arabia; 3) the exploration of very deep (1,000 -2,000 m) sources of brackish water for eventual desalination; and 4) the study of options for Red Sea-Dead Sea conveyance to halt the decline of the Dead Sea and provide desalinated sea water for municipal and

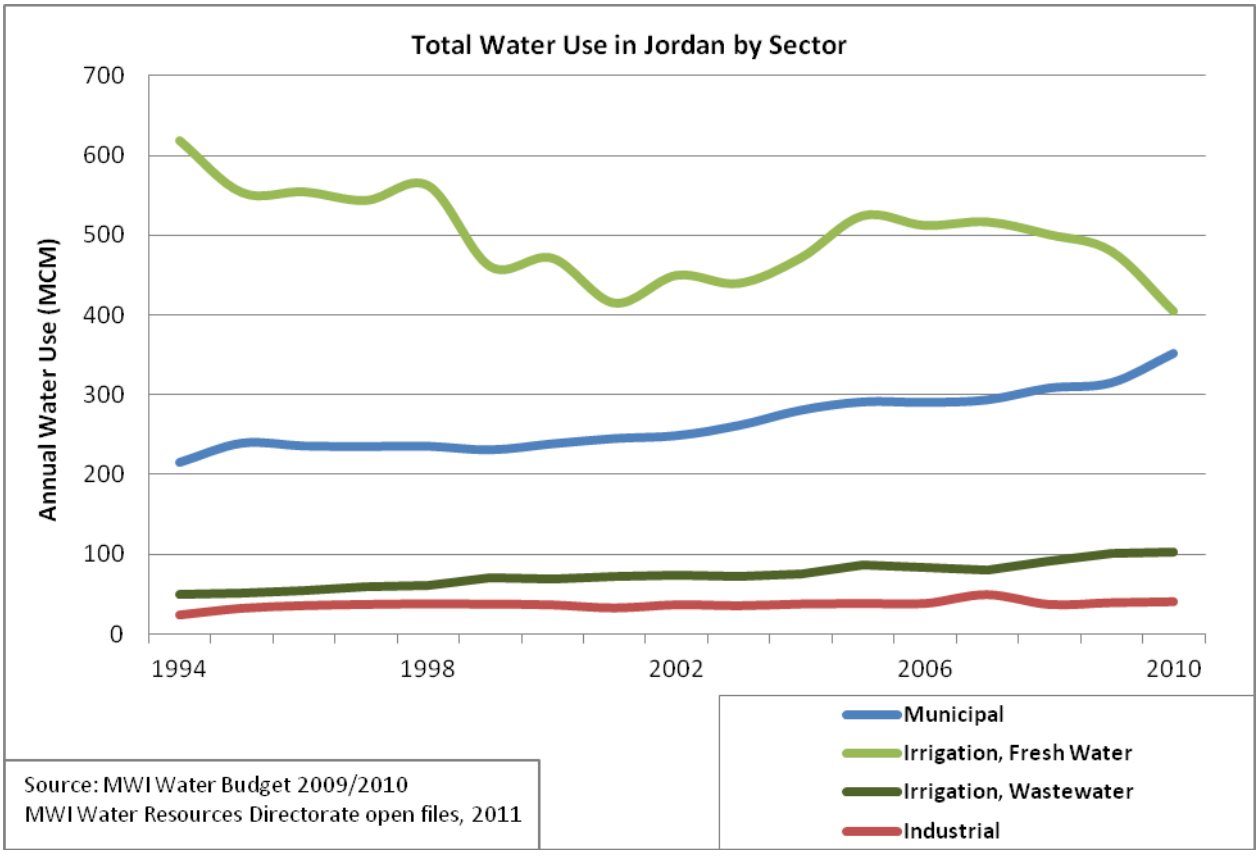
industrial use. The cost of new urban bulk water supply to Amman is expected to exceed USD 1.35 per m3 as in the case of the Amman Water Conveyance Project.

The increasing cost of water supply has added a large burden to the Kingdom's fiscal budget in terms of new capital expenditure and subsidy needs. The gap between current tariff levels and full cost recovery is too big to be bridged by tariff increase alone because full cost recovery is too expensive for the majority of the water users, especially the low income underserved. Also, while subsidies to water users are very large relative to full cost of supply, they are still much smaller in relative terms than public subsidies to food, energy, and fuel. Water subsidies have historically been easier to sell within the context of the annual national budget. However, rapidly increasing direct costs and financing costs have pushed up the cost of the water subsidies over the past five years to a level where they will have to be reduced.

WATER USE

The chart shows the total water use by sector in Jordan. Agriculture uses about two-thirds Jordan's water supply. The large depression in irrigation use in the late 1990s and early 2000s is due to extended drought. During extended droughts, the Jordan Valley Authority purchases water from farmers in the Valley for pumping to Amman and the Water Authority of Jordan purchases well water from farmers who are close to conveyance pipelines serving cities. However, many of the agricultural groundwater wells are too far from urban conveyances to supply water in these emergencies.

Total Water Use in Jordan by Sector since 1994



Municipal use is met primarily by groundwater sources. Per capita municipal consumption levels have remained fairly constant level since 1994. This is an impressive achievement given that population growth over that same period has been on the order of 48 percent (1.97 million). However, almost all urban domestic water, with the exception of Aqaba and a few sectors in Amman, is supplied on an intermittent, rationed basis that requires household storage in cisterns and/or roof tanks. Most Jordanian urban households purchase drinking water and supplement municipal supplies with tanker water especially during the summer months.

Industrial water use in 2010 was 40 MCM. The largest portion of water in the industrial sector is consumed by fertilizer industries, potash, phosphate, oil refinery, thermal power plants, cement factories and various light and medium industries. A key use issue is industrial effluent releases to wastewater streams that are increasing with the current and planned growth of consumptive use by businesses (tourism, medical facilities) and industry (mining, power supply) and increases in the release of brine from industrial desalination.

Irrigation water is heavily subsidized, with very low tariffs for surface water deliveries to the Jordan Valley, and very low tariffs and little quantitative restriction of over- abstraction of groundwater in the Highlands. Many studies have concluded that agricultural water use is of low economic return and that large scale re-allocation to municipal and industrial use is feasible. They cite the sector's declining contribution -- now about 3.2 percent -- to Gross Domestic Product (GDP) for use of 65 percent of total water supply. However, irrigation in the Jordan Valley supports a large number of jobs that would be difficult and very expensive to replace, uses much of the country's reclaimed waste water that has no other current use, is trending towards higher water use efficiency, supports export-oriented value chains, and enjoys substantial political support.

Groundwater over-abstraction in the Highlands is unsustainable and will terminate at different rates in the 11 over-exploited groundwater basins as supply is exhausted, saline water is encountered, or pumping costs exceed financially supportable levels on private farms. While USGS modeling shows that over-extraction at current rates can continue for up to 30 years in some well fields, extraction costs and water quality issues may lead to earlier closure in others. A groundwater extraction by-law in 2002 began imposing abstraction tariffs and requiring well registration and monitoring, but has not slowed extraction rates. External factors such as market competition and increasing energy costs appear to be pushing Highlands agricultural users towards adoption of higher efficiency irrigation methods, but this trend seems to be offset by the use of groundwater to increase the value of land for speculative real estate investment, notably in the planting of low-value olive trees.

Tariff increases, shifting to higher value crops and more efficient production technologies, and administrative closures will be needed to reduce over-abstraction of groundwater and shift its allocation towards domestic and industrial use.

WATER TREATMENT AND RE-USE

National and donor investment in wastewater treatment in Jordan has expanded over the past three decades, resulting in about 65 percent of the population being connected to wastewater collection and treatment systems. Currently, there are 27 wastewater plants serving the country. The number of treatment plants has almost doubled since 1993 (then 14 Waste Water Treatment Plants -WWTP) as well as the capacity (then 58 MCM/year). These plants processed about 105 MCM of raw wastewater in 2010 with effluent usable for irrigated agriculture of about 103 MCM.

Re-use of treated wastewater is an essential element in the Kingdom's water strategy. Government and donors made substantial efforts over the past two decades to convince agricultural producers to use treated

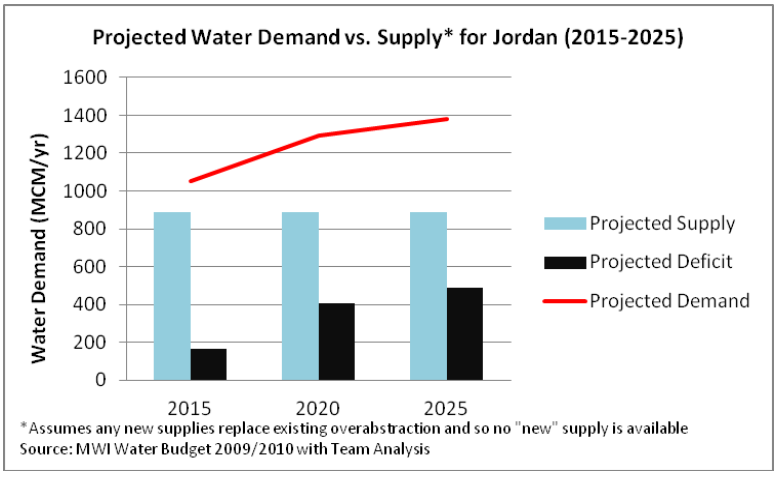
wastewater as a new and additional resource, ensure that treatment levels aligned with agricultural re-use standards, and to convince consumers of the safety and health of food produced from reclaimed water blended with fresh water. The use of treated waster in the Northern and Middle Jordan Valley increased from about 40 percent in 2000 to about 56 percent in 2010. This percentage is increasing on an annual basis due to the increasing amounts of treated wastewater from the As Samra plant, as well as other plants discharging water towards the Jordan Valley. By the year 2015 treated wastewater is expected to increase by an additional 76 MCM/year bringing the total wastewater available for reuse to about 180 MCM/year, most of which would be used to irrigate food crops, fruits and vegetables, and tree crops, with a small allocation to support forage and fodder production for livestock.

Expansion of the re-use of reclaimed waste water to industry has been limited by the location of these industries relative to wastewater treatment facilities, the quality of treated water relative to industry standards, the cost of increasing the treatment levels to higher standards, and the cost of building new conveyance from central waste water treatment facilities to industrial sites. Currently there are no facilities that treat waste water to the potable level so that it could be re-injected into groundwater for aquifer maintenance in the over-drafted Highlands. The costs of treatment, conveyance, and injection of this water would be high. Experience in other countries suggests that substantial study, investment in communication, and time would be needed to gain regulatory and social approval for this form of re-use.

WATER DEMAND

Water demand in Jordan greatly exceeds supply. Population growth from natural increase, and waves of immigrants from regional conflicts starting in 1948 and continuing through today's Arab Spring, has placed unusual and unpredictable demands on Jordan's water supply. Projections done by the MWI and international organizations differ on the amount of future supply and demand for water, but they agree, without exception, that there is a serious gap and that filling the gap will lead to an increase in bulk water supply costs for priority domestic use from average current levels of 0.35 JD/m^3 to 0.95-1.10 JD/m^3, or more.

Projected future water supply availability from all sources has shown that the water deficit will increase with time as shown in the chart below. Despite the huge investment in the water sector programmed through the year 2025, a considerable water deficit will be facing Jordan. For example, the water deficit for all uses will grow from about 160 MCM in 2015 to 490 MCM by the year 2025. Part of this huge water deficit will likely be met by a combination of suppressed demand and rationing distribution programs for domestic uses as well as irrigated agriculture. The remainder of the gap will most likely be filled by some combination of desalination of seawater and of brackish groundwater for which regional, bilateral, and national options have been studied since the early 1970s.



Water resource management in Jordan is constant crisis management of dwindling quantities and deteriorating quality of supply to avoid disasters in drinking water supply and waste water treatment. Water demands, now and in the foreseeable future, greatly exceed supply. That demand may soon outrun Jordan's ability to finance and refinance investment and current operation and maintenance (O&M). Reallocation of water from its current 65 percent use in agriculture to municipal, industrial, and commercial use is evolving slowly because of the socioeconomic costs of dislocation in the Jordan Valley, political resistance in the Highlands, and continuing public tolerance for the current service levels of intermittent weekly domestic water supply.

None of the currently built or financed and under-construction projects will solve the demand-supply imbalance. The review team confirms and extends earlier studies that have found that system improvements, reductions in physical and administrative losses, improved efficiency and higher economic use of irrigation water, reallocation from agriculture that is employment neutral, and increased fossil water extraction will provide breathing space. This time needs to be used to carry out the management, financing, and institutional changes essential to the sustained maintenance of basic domestic services and the provision of water for greater industrial and commercial use. The review team concludes, along with many others, that desalination of sea water is a necessary part of the long-term, sustainable solution to threat of reduction in per capita water supply.

The review team makes a cautionary note on the Red Sea-Dead Sea conveyance options to provide sea water for desalination and to rescue the Dead Sea World Heritage Site as part of the peace process. The objectives are worthy and honorable. The team feels, however, that it will be difficult to achieve a market-driven financing solution to the $9-$14 billion dollar project. Jordan will soon launch an international campaign for donor and private contributions to buy down the capital costs of the project to the point that a Master Developer could structure creative financing for the project.

Should the financial tipping point not be reached, USAID should stand ready to support an effort to assist in the design and mobilization of financing for a desalination of Red Sea water by Jordan in Aqaba. While this project would not achieve the intensely desired outcomes of the Red Sea-Dead Sea conveyance, it still would help to build trans-boundary trades of water of mutual benefit to Jordan, Israel, and the West Bank of the Palestinian National Authority (PNA).

THE CURRENT STATE OF WATER RESOURCE INFRASTRUCTURE, INSTITUTIONS, AND POLICIES

The current state of water infrastructure, institutions, and policies seems to indicate that stabilization or improvement in the water security situation for the Jordanian people will come gradually. Fundamental factors of increasing energy costs and difficulties in financing capital expenditures, operating costs and covering subsidies will slow capital investments, especially as traditional donors reduce their spending. However, that same financial stress improves the likelihood that water policy makers and the Jordanian government will support initiatives that that seek efficiencies, and improve water allocation decisions among subsectors, and study and adopt policies that target subsidies to the needy.

This conclusion may change as regional donors could make up the capital financing gap for conventional projects (Saudi Arabia, Gulf Cooperation Council - GCC Fund, and regional infrastructure funds). Regional funds may carry fewer conditions precedent for institutional and policy reform than USAID, GIZ, the EU, and other donors have incorporated in their programs. The availability of regional funds increases the already existing need for better donor coordination around a common Jordan roadmap for the water sector.

There is a real need for more open and transparent reporting and communication on the plans, services, and performance of the main water institutions. The apparent lack of agreement among the key water

institution leaders about the Water for Life Strategy and the breakdown in the functioning of the Water Sector Master Plan information systems are troubling. Taken together, they suggest that there is a not a trusted and shared base of information and analysis upon which to base decisions or measure progress. Managers are primarily skilled engineers with long operating experience who operate their systems conservatively to avoid the risks of disrupting agricultural, municipal and industrial water supply. This conservatism poses real challenges in the transition to a decentralized and corporatized water utility environment. An overarching challenge is the importance of low nominal water tariffs to the maintenance of public approval for the government at many levels of Jordanian society.

Despite these challenges, the municipal water supply and sewerage sector in Jordan has undergone significant changes during the last 10 years by focusing on improving financial sustainability by increasing efficiency. However, in spite of efficiency improvements from corporatization and multiple development projects to reduce costs and enhance revenues (e.g. reduction of Non-Revenue Water-NRW), the financial performance of the Water Authority of Jordan (WAJ) and water utility companies on a consolidated basis has deteriorated during the last six years (2005 through 2010). The key reasons appear to be: 1) the inability of the Government to control costs as prices of key inputs and energy costs have risen, and 2) the massive amounts invested in new water supply sources and to improve wastewater treatment. The level of debt is climbing rapidly and will require increases in revenue. Tariff increases will be necessary, but tariff increases alone cannot be expected to provide for cost recovery of rapidly escalating operating expenses, utility level capital expenditures, and depreciation. Tariffs need to be restructured for equity reasons between wealthier and poorer water customers. Fixed charges and/or taxes will need to be modified to charge more to wealthier households. Budgetary transfers, or an appropriate level system subsidy, will be required to sustain the operations and maintenance of the municipal water sector, as is the case in many countries.

The current state of the water system provides basic and safe, but only intermittent, water supply to the vast majority of city dwellers and commercial businesses in urban areas. Domestic and commercial users supplement utility deliveries with private water purchases, especially for drinking water. Continuous 24-hour service supply is available in Aqaba and in a few zones in Amman to domestic and commercial users. However, there seems to be little enthusiasm or belief among the leadership of water institutions that a 24-hour continuous supply, a WHO (World Health Organization) water best practice, can be achieved in Amman or Irbid without greatly increasing physical and administrative losses and building unrealistic levels of demand and service expectations. There is a gap between urban and rural per capita domestic water supply and the level of wastewater treatment needed to protect the environment in smaller towns and rural communities, but this gap seems to be narrowing.

Agriculture benefits from very high rates of water subsidy in the Jordanian Highlands and the Jordan River Valley. Studies suggest that water tariffs could be increased substantially, pushing famers to select higher value crops to grow and to invest in more efficient modes of production. The greatest opportunity to use tariffs to improve water use productivity appears to be in the Jordan Highlands, where agricultural leaders are already concerned that declines in well levels and water quality – along with increased market uncertainty and the rapid increase in pumping costs -- signal the need to finally confront the over-abstraction problem. In the Jordan River Valley, two key determinants of agricultural productivity are the quantity of water that is allocated and the quality of reclaimed water that is being delivered to the Jordan Valley. The impact of substantial additional fresh water exports to Amman could have a devastating effect on production levels and cause significant job loss in a country where job creation is expensive.

Jordan provides a reliable base supply of water to petroleum refineries, power plants, mining operations, and small and medium industry. A key concern in the industrial sector is point-source pollution. While biological and microbiological treatment has improved, industrial disposal of saline brine derived from industrial processes or in-plant desalination is degrading reclaimed water quality.

USAID AND OTHER DONOR IMPACT ON WATER RESOURCE MANAGEMENT IN JORDAN

Donor investments in water sector infrastructure, technical assistance and debt reduction have enabled the Hashemite Kingdom of Jordan to continue to manage its continuing crisis of absolute water scarcity; slow its rate of movement towards absolute water poverty; and plan and begin implementation of a strategy to maintain basic water supply to its population and its economy. Without this assistance decision-makers within MWI, WAJ, JVA, water utilities, Parliament, and the National Farmers Union believe that the government would have had to shift from crisis to disaster management in the water sector.

USAID investments over the past ten years, especially in key infrastructure projects (e.g., Zara Ma'in, Es Samra, and Zai) and in Private Sector Participation (PSP) projects have helped Jordan to address and solve major municipal and industrial water supply and wastewater treatment problems in Amman/Zarqa, Aqaba and an expanding list of secondary cities. Millennium Challenge Corporation (MCC) investments will mobilize additional fresh water supplies and expand water treatment capacity in ways that will improve overall water quality and improve the economic utility of some reclaimed water flows, but with the added requirement to dilute radon radioactivity levels to World Health Organization (WHO) norms through large-scale water blending. USAID infrastructure investments have helped to develop treated wastewater flows that are of sufficient quantity, quality, and regularity to supply irrigation water of acceptable quality (after filtering and blending) for use in high-efficiency irrigation systems in the northern and middle reaches of the Jordan Valley. Corollary USAID and other donor investments in pilot treated water re-use projects, policy and regulatory development, and broad stakeholder consultation and social marketing have led to gradual and broad acceptance of reclaimed water. These efforts have led to a microbiological standard for treated wastewater that permits unrestricted use on field crops, fruits and vegetables according to international (e.g. Global GAP- Good Agricultural Practices) and national consumer standards.

Community-based initiatives (CBI) have addressed both equity and environmental initiatives. They appear to have empowered a small but growing number of women in their roles as managers of household water, and as new providers of services to the sector. There is substantial favorable opinion for the extension of CBI programs, as they are seen centrally as generating rural and secondary city political support through improvements to services, health, and the environment at project sites.

Top level institutional change in the restructuring of the main water institutions has been slower than USAID and other donors want. Results in institutional change have been slower than expected from donor support to the legal and institutional reform. Reform targets the creation of an independent water regulator, two bulk water suppliers (WAJ and JVA), corporatized municipal utilities, and independent agricultural water user associations functioning as irrigation districts.

Progress towards restructuring will require work on many policy, regulatory, operational and contractual issues before a new water law will be implementable. Establishing parameters and ceiling levels for tariff change, direct fixed fees, and other revenue within which corporatized management can operate without requiring Cabinet of Ministers approval is a key step. The establishment of the new National Water Council (NWC) should raise the level and transparency of inter-ministerial and private sector discussion of investment priorities, restructuring, water allocation policies, and enforcement issues. The NWC's ability to convene a full set of stakeholders would have been improved if the Chairman was the Prime Minister. Enforcement of groundwater by-laws has fallen far short of national needs. Establishment of the Highlands Water Forum is an important step towards addressing the political economy of enforcement decisions.

The review team disagrees with the Inspector General's finding that USAID has failed to build sustainability into its water sector investments. The measure used, full cost recovery through tariffs alone of operating expenditure, depreciation, and capital expenditure is one that few bulk suppliers or retail utilities can fully meet anywhere in the world. It is not the standard used in the USAID strategic water framework that informed the past sector strategies and incorporated the full range of revenue sources employed worldwide by the water sector. The review team agrees that substantially more effort should be placed on improving all sources of revenue (tariffs, fixed fees, taxes, and transfers) along with improved financial management practice and transparency to fully cost water supply and treatment and to manage or minimize -- to the extent socially and politically possible -- the level of subsidy that is applied.

Further, USAIDs portfolio in Water Resources and the Environment (WRE) should be seen as an important part of building Jordan's capacity to adapt to climate change, which is fundamental to long-term sustainability.

Conditions Precedent (CPs) have been effective in bringing water sector issues up to an inter-ministerial level of discussion and improved the visibility of these issues within the government and -- to a certain extent -- non-government experts. In some cases, Conditions Precedent have been written to meet global best practice standards, but these global standards have not always been best fit with the Jordanian implementation environment Levels and timelines for achievement of standards (e.g. NRW, groundwater extraction rates, cost recovery rates) need to be adjusted to better fit the water scarcity status and the challenging political economy of the Kingdom.

RECOMMENDATIONS FOR THE USAID WATER RESOURCE STRATEGY

USAID/Jordan should continue to provide support to the water sector and consider increasing its projected WRE allocation to a higher level.

USAID/Jordan has a long-term history of successful investment in the water sector that has provided significant benefits to the Jordanian people in water supply, wastewater treatment, water resource monitoring and demand management, community wastewater collection and treatment, and privatization of water utilities to improve service levels and efficiency. The USG (United States Government) is perceived by Jordanian officials as the historic lead donor in the sector. The average annual budget for the USAID Water Resource and Environment (WRE) program was about $43M a year over the 2000-2011 period. The projected $25 million a year average WRE budget of the future planning period is significantly less than that of prior years. This reduced allocation to WRE occurs at a time when external events have sharply increased energy costs, a major contributor to water supply and distribution costs. The cost for Jordan to continue to serve as a political safety valve in the region has increased, placing increased pressure on its ability to accept large numbers of refugees from the region who require water supply and wastewater services. Continuing civil disruption in the region will likely sustain refugee pressure on national water resources and related services for years.

USAID/Jordan should re-balance the WRE portfolio to one with a greater focus on infrastructure investments that are planned and needed to improve water supply, environmental quality, and water resource sustainability. National firms appear to have the capacity to design and implement small and medium-scale infrastructure projects, enabling USAID to meet FORWARD procurement objectives.

There is an average trend within USAID budgetary allocations over the past ten years to greater use of Technical Assistance than has been the case historically. At the same time, there is a clear need for infrastructure development and, in some cases, substantial investment in re-equipping or re-tooling to gain energy efficiencies and support NRW recovery. USAID should carefully consider the infrastructure/technical assistance make-up of its water portfolio to ensure that it is able to continue to support infrastructure works, even if the scale of these works will be smaller than prior large-scale projects such as Zara Ma'in or As-Samra. Medium-scale infrastructure projects can meet critical needs in secondary cities, especially in regards to wastewater collection and treatment, and these infrastructure projects also may provide negotiating leverage for complementary technical assistance programs that focus on institutional and policy change.

There appear to be Jordanian goods and service suppliers in the water sector who have the technical capacity and management capacity to implement projects in the USAID FORWARD framework. Current national procurement procedures set a cut-off point of about $7 million before international bidding is required. The $5 million ceiling for local procurements in USAID's new source and nationality policy (ADS 310) could also provide a practical benchmark for planning this work. While USAID has experienced some problems with small project implementation, improved infrastructure supervision should enable projects to be contracted nationally at the $5 million level that target system efficiencies (energy efficient pumps, non-revenue water (NRW) reduction programs to reduce physical losses or improve metering for 24-hour supply), and address smaller-scale water supply, wastewater treatment, and reuse projects in secondary cities and towns. The review team did not have the capacity to assess the ability of these firms to fully respond to financing and financial pre-award audit standards of the USG.

USAID should continue to support community-based initiatives in water resource management (supply, use, treatment and re-use)

Given the on-going success of CBI, the high payback ratios of the micro-loan portfolio, the backlog of demand by households for the micro-loans, and the unique niche that this space occupies for USAID in Jordan's political economy, it is recommended that this program be extended and expanded. Although the 3rd stage of the current CBI (Community Based Initiatives Project) intends to enter into the more complex arena of integrated water resource management (IWRM), micro-loan programs at the household and community level should be maintained in subsequent projects. Revolving funds have a multiplier effect on USAID's original capital contribution, and the nature of the CBI program directly impacts the household and community level. Detailed cost-benefit analyses would be required to determine the appropriate scale of investment, at the local landscape- and household-scale. At the household level, given the current success of USAID's CBI program in putting in place revolving funds to provide initial capital for rainwater harvesting structures, it is recommended that similar programs be pursued in the future.

Beyond the level of CBI programs, USAID should support the development of medium-sized wastewater treatment plants where these can be developed with strong re-use plans.

It is recommended that USAID build upon its strong past track record in this arena, because the need for increased wastewater treatment capacity still exists. Future infrastructure projects could provide support to the expansion and development of medium-sized wastewater treatment plants in Jordan

USAID should support Non-Revenue Water reduction programs to the point that cost:benefit ratios are positive and substantial

A pilot NRW reduction program carried out on three sectors in Amman in 2009/10 uncovered a litany of issues on the water supply network. It is reasonable to assume that these are replicated throughout the Amman network. The pilot study was undertaken by 3 contractors with input and assistance from Miyahuna. On the basis of the anticipated cost of the water, a program to develop and deliver a NRW program in Miyahuna should be cost effective. NRW is also high in the Al-Yarmouk Water Company. Target NRW reduction should be based on the marginal value of the saved water and increased revenue rather than a fixed best-practice percentage target. Projects should introduce targets into the management contracts with payment based on performance. In the case of utility companies, starting with Miyahuna and Yarmouk, it is essential that the skills of NRW detection and reduction are transferred to the local utility, and that NRW reduction is institutionalized in each of them. Both institutions should be encouraged to establish permanent NRW reduction teams. The Aqaba Water Company network already has a low level of NRW; therefore it is advisable to consult AWC in the design of the program and perhaps to build some type of technical assistance exchange program between AWC and the other two utilities.

USAID should work with public and private sector stakeholders to design and pilot a Highlands Strategic Groundwater Reserve Program to lay out a government and donor coordination roadmap of communication, technical, administrative, and financial steps to reduce extraction rates.

Highlands renewable aquifer conservation requires steady strategic investment to shift users from current unsustainable over-abstraction rates. USAID should support the design and piloting of a Highlands Strategic Groundwater Reserve Program that could incorporate the following elements. The design of a communications program and lobbying effort with registered and unregistered well users should be done to raise their awareness of over-extraction issues and strategies to reduce over-extraction. This design should be accompanied by a realistic, time-phased effort to reduce extraction rates, improve energy efficiency to maintain profitability, and increase revenues from adjustment of extraction tariffs. It is important to sort properties by their financial and economic performance in water use. Expertise could be obtained from the WAJ WDM –Water Demand Management- Unit, the Highlands Water Forum, USAIDs IDARA project, and Utah State University studies. Zero- or negative-return properties wells would become candidates for closure against compensation for land value or water rights. USAID might design and seed a fund to support alternate use financing (e.g. solar farms) for land or a straight single payment or Trust Fund annual payments for water rights, if a water rights market can be established. On wells where returns were profitable USAID could examine the supply of seed capital for loans or loan guarantees to structure crop conversion and production intensification (e.g., high density tree production, plastic greenhouses, and semi-hydroponic controlled atmosphere greenhouses at the high end). Finally, using the existing groundwater abstraction bylaw, USAID should continue to push for progressively increasing groundwater extraction surcharges and suppressing illegal and abusive extraction as a Condition Precedent for the Cash Transfer program. .

USAID should support WAJ to determine how to increase revenue and to target subsidies for municipal water supply to those who are poor and to ensure that those who can afford to pay the full cost of water supply do so.

WAJ and the companies need to focus on increasing financial sustainability, rather than on using price to reduce municipal demand. Discussions should be expanded beyond volumetric tariffs and fixed unit hook-up and infrastructure charges to include taxes or other fees to identify acceptable ways to increase sector revenues. The Government needs to reduce total subsidies granted through volumetric tariffs. A large portion of the current water subsidy benefits the wealthy. The Government, WAJ, and utilities face imminent increase in water supply costs as the project goes online. Consideration should be given to raising revenue by other methods, such as studying the potential revenue gains from a capital recovery charge graduated according to property valuations obtained from tax records as an indicator of the customer's ability to pay. This is not a new idea; but the timing may be right because of current budget pressures. National capacity exists to do the social science surveys needed to identify the presence in service zones of low income households in order to design and test billing procedures in highly mixed neighborhoods.

USAID should stand ready over the projected 2013-2018 strategy period to support the scoping and pre-feasibility study of an Aqaba desalination facility.

The Aqaba Water Company indicated that a study and tender documents for a 23 million cubic meter (MCM) desalination facility has been done to meet water requirements for growth. The review teams suggests that a larger facility on the order of 75 to 100 MCM may be needed to support the water demands from growth, slower than anticipated development of the Jordan Red Sea Project, and a significant trans-boundary demand. Energy supply and brine disposal are two key issues for all desalination facilities and are worthy topics for broader regional support by USAID/ANE (Asia Near East Bureau).

USAID/Jordan should reduce its expectations for rapid institutional change adopting a stepped approach to support the restructuring and regulation of the water sector.

Considering the political, institutional, and legal difficulties facing implementation of a new water law, USAID should first do those things with will improve accountability and incentives with the existing law, then moving on to full restructuring. Corporatizing the remaining governorate utilities should be a priority. The review team was told by Jordanian officials that corporatization can be completed without further law changes. Assistance to design performance agreements with tangible rewards and penalties into existing and future agreements between WAJ and utility companies should have positive short-term effects on both WAJ and company performance.

USAID should seek to put a few individual senior advisors into the Water Authority of Jordan (WAJ), Miyahuna and the Performance Management Unit (PMU) to help guide their search for and implementation of solutions for financial sustainability.

USAID should consider putting a few individual senior advisors into WAJ, Miyahuna and the PMU (Performance Monitoring Unit) to help guide the process; but encourage WAJ and company management to develop, and be accountable for their own solutions. Considering the expertise of the Jordanian private sector and the institutional memory of many of the Jordanian firms working in the sector, Jordanian nationals should be used to the maximum extent possible.

USAID should adjust its support to industrial wastewater treatment programs to incorporate control of saline releases to waste water flows.

Incorporate salinity into current and future industrial wastewater treatment programs. The long-term costs to Jordan Valley agriculture of avoiding this issue are likely to be tremendous. USAID is well placed to address this issue given its WREC project.

USAID should revise its Cash Transfer program to pursue a road map of sector reform established with substantial donor coordination to establish Conditions Precedent for the retirement of eligible debt and counterpart funding of agreed reform projects.

USAID/Jordan indicated that cash transfer payments have been made annually, with revisions of CPs to permit Jordan to access funds. USAID should revise the program to:

- Link performance and projects over multiple years, clearly linking a jointly developed and agreed road-map on how the reform will be achieved, with a series of annual CPs designed to move the reform along. Counterpart and corollary funding could be used to support the reforms beyond the cash transfer level.
- Use the repetitive CPs as a means to ensure that agreed activities are sustained from year to year. For example, a CP could require that audited financial statements, or performance measures for the companies, be published by a certain date each year. By keeping the CP in the agreement for multiple years it should result in a sustain behavior.
- Increase the transparency and visibility of negotiated CPs across ministries, with donors, and with stakeholder groups.

However, this Cash Transfer program should not be continued if there is no realistic political potential to stop payments when Jordan fails to perform to the originally negotiated standard.

Depending on the availability of funds, and in coordination with other donors who have been more recently engaged in the Jordan Valley, USAID should consider support to the Jordan Valley Authority to improve energy efficiencies, reduce main system conveyance losses and improve the efficiency of use of current fresh and reclaimed waste-water allocations. There appears to be little current availability to allocate additional fresh water flows from the valley to Amman for drinking purposes, without causing significant declines in farm and value chain employment.

Three potential points of entry should be considered:

- To set seasonal fresh water allocations and water prices at a rate that will not lead to substantial reduction in cropped surface area. There appears to be much more room to adjust water tariffs than there is to increase water exports to Amman from the King Abdullah Canal (KAC).
- Identify the source of the 15 percent conveyance losses quoted by the JVA leadership and design ways to reduce these losses in order to better supply fresh water to valley water users. A corollary investment could be examination of the potential of medium-term 5-10 year development of a fresh water piped conveyance from the North end of the valley at a higher elevation above the King Abdullah Canal. This could reduce conveyance losses, reduce the energy needed to pressurize water for delivery to farmers, and reduce the energy needed to pump fresh water up the slope to the Amman municipal supply.
- Make the investments needed to adjust the flow rates of the secondary water delivery system at the farm turnout assembly to better match the available flow rates from the primary system.

Current fresh water allocations need to be retained until the effects of flows on the quality of reclaimed water flows to the Valley can be evaluated. This effort may include relatively small investments to re-activate the JVA sensors used to track flows and water quality in the main distribution circuits and at water blending points.

Water Use Association (WUA) development into utility companies or irrigation districts in the Jordan Valley seems premature. Most of the WUAs are relatively small in area and operate with important operating subsidies from the JVA. WUA's visited express their desire to expand functions beyond water billing to group input, equipment, and service supply. They appear to want to function more like farmer-controlled businesses rather than WUAs or cooperatives. Corporatization of JVA-supplied services in O&M may hold some promise, but the review team was unable to examine this issue in any detail.

SECTION 1. INTRODUCTION: A DELICATE BALANCE

Water policies in Jordan are managed as a delicate balance of interests whose combined demand for water greatly exceeds both renewable and currently financed non-renewable supply. Jordan's people, who currently live in state of severe water scarcity index at 147 cubic meters of water available each year per person could move to deep water poverty at only 90 m^3 $year^{-1}$ by 2025. At this level basic hygiene and sanitation becomes threatened, along with crop and livestock production and associated jobs.

The fundamental issues for water management in Jordan are that:

- Water demand exceeds supply and the gap is forecast to widen;
- Surface water delivered to Jordan via the Jordan River is reducing in quantity and worsening in quality, as is the water in the Yarmouk River. To an important extent this is outside the control of Jordan and is the consequence of the actions of its neighbors Israel and Syria;
- One of the principal sources for municipal and agricultural water, groundwater, is currently used at an unsustainable rate;
- Some water is used in agriculture for relatively low value produce, but diverting this water via retail pricing to higher value use appears to be difficult politically in the Highlands and Jordan Valley and very costly in employment losses if implemented in the Jordan Valley;
- Irrigation water in the Jordan Valley is becoming increasingly saline;
- New water sources will be expensive (desalination and long conveyances).

Shared surface water resources have declined as Syria appears to have greatly exceeded well drilling limits and constructed new dams on the Yarmouk River in contravention of the 1987 Jordanian-Syrian Agreement. Drought cycles periodically reduce Yarmouk flows and groundwater recharge rates in Syria, Israel, and Northern Jordan and increase the salinity of stream flows and base flows from underground aquifers to springs and wadis. Most recent climate change models suggest that average rainfall will decline over time and that increased minimum temperatures may result in higher rates of evapotranspiration from natural vegetation and crop plants(Hamdi et al 2009, El Nesr et al 2010,Smiatek et al 2011, Black et al 2012,) that could further reduce surface and groundwater flows. These changes threaten municipal and industrial supply in Jordan's main urban population concentrations. They also threaten agricultural water supply to the Jordan Valley.

Arid climates are always subject to high variability in rainfall. Centuries of deforestation and overgrazing in the upper watersheds means that watershed capture of rainfall for groundwater recharge is at best modest, despite generally permeable soil conditions. No reversal of this degraded situation is expected. Localized water harvesting may make sense for spring rehabilitation, small remote-area domestic water supply, and some agriculture using run-off, but wide-scale watershed rehabilitation appears to be extremely unlikely even over very long periods of time.

Groundwater extraction in excess of sustainable recharge rates has occurred in Jordan for several decades. These excess extractions are physically unsustainable in the long term, but have supported the maintenance of Jordan's per capita water supply for essential municipal and industrial supply. The additional burden of both legal and illegal well-drilling to support agricultural production in the Highlands has greatly added to over-abstraction rates and created a difficult political problem between the central government and powerful "first-in, first rights" agricultural users of groundwater. Over-extraction is now rampant in 10 of 12 major groundwater basins and recent studies assisted by the United States Geological Survey (USGS) indicate that the long-term average decline in groundwater levels is about 1 meter per year. This continuing decline raises major concerns about: the threats of increasing energy costs of pumping from deeper wells,; increased investment costs of well redevelopment to sustain water

yields; the potential for rapid increase in the salinity of municipal drinking water supplies; and. further damage to spring flows and base flows to side wadis and Khors.

Efforts to reduce household water demand are beginning to show success from donor assisted investment in new K-12 school curricula, social marketing, policy and regulatory changes in building codes and the institutionalization of a Water Demand Management Unit at the Ministry of Water and Irrigation (MWI) with the assistance of USAID. USAID and other donors have supported changes in the building codes that have transformed the importation and sale of water-saving devices for domestic and commercial use.

Jordan has made impressive strides over the past decade in the collection and treatment of waste water from its main urban areas and secondary cities, although there are continuing issues of groundwater contamination and unhealthy exposure to waste and wastewater in smaller towns and rural communities. High volume, good quality and reliable wastewater treatment has enabled the Government with donor support to demonstrate and extend acceptance of reclaimed water for use in irrigation in the Jordan Valley and some Highlands zones. This has permitted a gradual increase in the use of treated wastewater to about 57 per cent of irrigation applications in the Northern and Middle Jordan Valley, in turn gradually increasing the availability of fresh water from the King Abdullah Canal for treatment and release to the Amman municipal water supply.

There has been less success in addressing the issue of industrial contribution to the salinization of the water supply. In the Zarqa basin, industries of all scale concentrate salts in cooling tower blow-down, reverse osmosis brine, filter backwash, and spent salts from ion-exchange columns used in water softening filters. Enough salt is released by industry, and a much smaller domestic contribution, into waste-water flows to raise salinity from about 500 mg/liter to about 1,275 mg/liter (Jaar, 2009). Enforcement of waste-water pre-treatment regulations does not adequately address the salinity of water releases from industry that concentrate salts to levels that reduce its potential for use in treated wastewater for urban or rural irrigation or groundwater recharge.

Extraction of fossil water supplies from the aquifer shared with Saudi Arabia currently supplies the city and governorate of Aqaba, the Economic Free Zone industries, and localized irrigated agriculture. The major new well-field and conveyance to the North are expected to provide 100 MCM of good quality fresh water for 50-100 years of distribution to Amman and southern governorates. The flows will provide side benefits for 6-8 (2014-2022) years of potential reduction in groundwater over-extraction during winter months for municipal use, improved flexibility in meeting peak demand requirements in the hot summer months, and dilute the salinity of treated wastewater improving the ability of farmers in the Jordan Valley to shift to higher value, salt-sensitive crops.

No conventional sources of water supply can meet projected demands and reduce projected water deficits. Increased investment in desalination of sea water is the most evident long-term solution but is a costly option in terms of finance, energy, and the environmental problem of brine disposal that is already evident with Jordan's existing desalination capacity.

Conventional water resources, even with implementation of current projects to reduce losses, improve sub-sectoral allocation and efficiency of use, and extraction of an additional 100 MCM per year of fossil water from, will not supply a solution to basic demand requirements as population grows and industry and commerce expand. USAID and other donor projects in wastewater reuse and fossil water extraction over the past 10-15 years have provided some vital breathing space to make needed change. Undoubtedly, the resilient and imaginative Jordanian water sector will continue to push for the capture of more conventional water sources through the development of additional groundwater well fields, continued expansion of treatment plants for wastewater reclamation, water-harvesting in rural and urban rooftop environments and improvements in efficiency and economic productivity of water use. But, these efforts will not fill the ever growing water deficit that looms on the 18-20 year time horizon (Section 2 and Annex 3).

Expensive desalination and expensive conveyance appear to be the only long-term solutions to providing water for human needs, public health and sanitation, and the economic activity needed to generate jobs for a growing and young population with new and high expectations of their leaders. However, the key dilemma is whether Jordan, and its neighbors Israel and the West Bank/Gaza, have the ability to raise the capital and provide the energy needed to implement aggressive desalination of brackish groundwater or much saltier seawater at costs that do not drive the retail price of water beyond the reach of their people, businesses, and industries.

Desalination of brackish groundwater is one resource, but its availability is definably finite and the brine disposal issue that it presents will be significant. Many consider that Jordan's brackish groundwater should be saved as a strategic reserve, or used only for localized temporary use for drinking water purposes. Its advantage resides in the lower cost of desalination of water that is only 4,000 to 8,000 ppm of dissolved salts compared to the higher cost of desalination of Red Sea water at about 42,000 ppm.

Jordan has only one point of access to seawater, the Gulf of Aqaba. Gaza has one, the Mediterranean Sea. Israel has two, the Gulf of Aqaba and the Mediterranean. All three states border the Dead Sea, a super-saline environment that has been shrinking as surface and base flow contributions from the Jordan River Watershed shrink due to surface water diversions, groundwater extraction, and industrial evaporation increases due to potash production and other mineral extraction processes. There are high hopes among all three parties that huge amounts of donated international capital can be used to save the Dead Sea as a World Heritage Site and generate water, power, tourism, business, industry, and mining investment. This investment is viewed as a necessary step for the sustained and peaceful economic development that is needed to increase employment opportunities for a large base of increasingly restive Arab youth.

Saving the Dead Sea requires more water to reverse its decline. There are two general routes to deliver this water. The shortest, and less expensive in financial terms, is from the Mediterranean Sea. However, joint action among the three Border States is not likely without a solution to the Palestinian-Israeli Peace Process. The longest, and most expensive in financial terms, is from the Red Sea's Gulf of Aqaba through Jordan. There appears to be support from all three parties for this route.

Studies and plans for the Red Sea–Dead Sea conveyance have been made since the early 1970s. Jordan has advanced a project called the Jordan Red Sea Project that seeks to see this project start with the first phases of the Dead Sea conveyance to be built and desalination to start by about 2018. Jordan has selected Master Developers for this mega-project. In the first part of 2012, Jordan will select three and task them with developing creative plans to lever private and public capital and international donations. The donations to buy down the high capital cost of this project are crucial to the market financing of the remainder of the project. Jordanian and Master Developer fundraising for the project is starting in a decade marked by major budgetary crises and global recession of unusual depth and breadth. There is a real risk that the JRSP project may be delayed beyond the hopes of its ardent proponents. The review team wishes Jordan the very best in its innovative efforts to find a solution to water scarcity, while this report team focuses on shorter-term efforts that USAID may undertake to stretch current resources as far and as productively as possible. Such measures are essential to fill the gap until large-scale desalination can be developed, and to delay the need for the enormous investment capital and operating costs of such a project.

SECTION 2. TRENDS IN THE WATER SECTOR: FINDINGS AND RECOMMENDATIONS

WATER RESOURCES IN JORDAN

Jordan is one of the most water scarce countries in the world. Its water scarcity has become more acute with time, as population, economic growth and the associated water consumption have grown. Due to its geographic location, Jordan is heavily dependent upon its neighbors (Syria and Israel) for its surface water flows. Water, therefore, is intricately woven within the already complex regional political landscape. The following sections will summarize the complex water supply, water use and water demand situation in Jordan.

WATER SUPPLY

Annual water supply in Jordan has been on the order of 800 - 900 MCM over the past 15 years (Figure 1). This total includes groundwater, surface water and recycled wastewater (Figure 2). The majority (64 percent) of Jordan's water is drawn from groundwater aquifers, both renewable and non-renewable. The remainder comes from surface water that is limited primarily to the Yarmouk River with some contribution also coming from side wadis along the Jordan Valley. It is important to note that excluding wastewater reuse, actual water introduced into the system is on the order of 50-100 MCM less than the total available. In 2010 for example, wastewater reuse was 103 MCM and so freshwater introduced into the system was only 798 MCM. Through the capture and treatment of wastewater, Jordan has been able to increase its water availability for productive use.

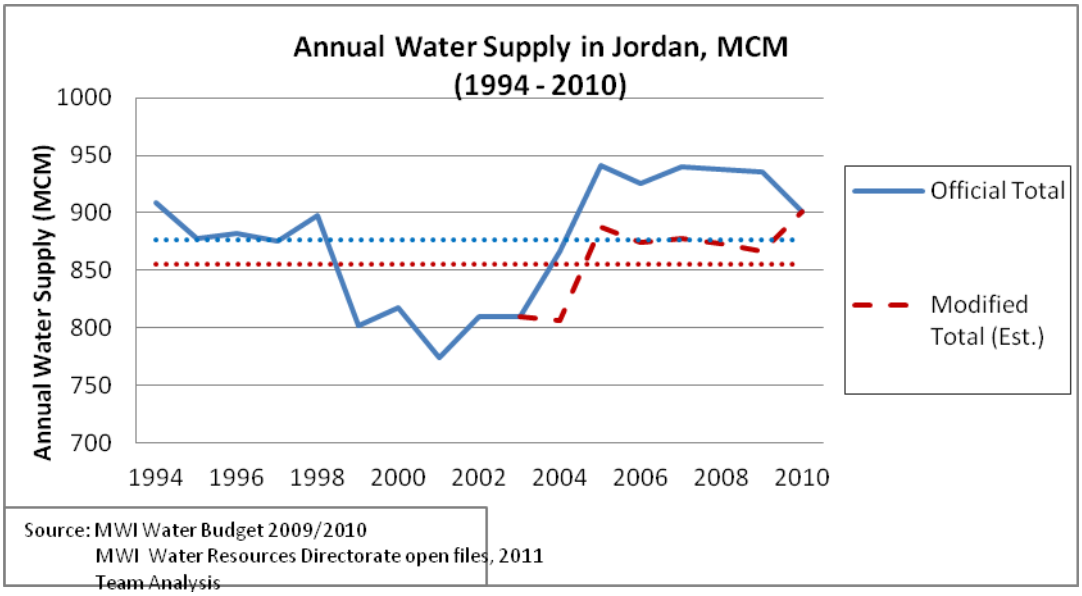


Figure 1. Annual Water Supply in Jordan. (See note in *Data Quality Issues* section on the modified average.)

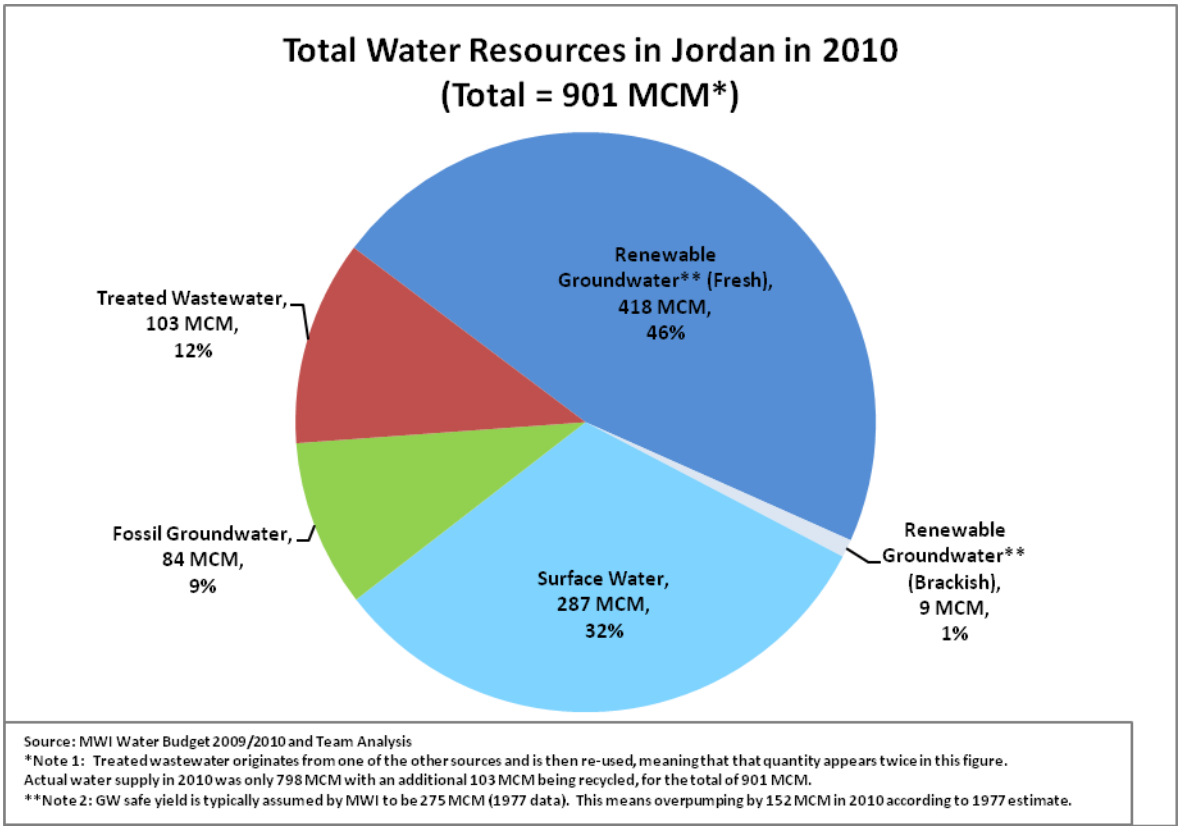


Figure 2. Total Water Resources in Jordan (2010)

Groundwater

Groundwater is the major water supply source for most population centers of Jordan, and is the only water resource available in others. In order to meet the demands of Jordan's growing population and economy, Jordan has been pumping from its available renewable groundwater sources at an unsustainable rate for many years. Table 1 shows that in 2010 renewable aquifers, aquifers that receive annual recharge, were overdrawn by roughly 55 percent of their estimated safe yields. Attention should be given to the fact that the estimated safe yield figures for the renewable sources may be overestimated, as these figures were calculated in a 1977 study (National Water Master Plan, GTZ) and have not been updated since that time. The MWI Water Budget indicates that precipitation for Jordan has fallen to 7,550 MCM in 2010 and it would be expected that recharge rates have correspondingly decreased.

As for non-renewable fossil aquifers, Table 1 shows that they were being pumped within their safe yield limits, which were set with the intention of maintaining the resource for a certain life expectancy (e.g., a 100-year design life). Although not explicitly studied in depth during this assessment, given that Jordan's principal fossil aquifer () is shared with neighboring Saudi Arabia, it seems worthwhile reassessing the risks of limiting Jordanian extraction to such low levels if both parties are not using the same extraction design.

Table 1. Groundwater Abstraction Rates (2010). Source: MWI Water Budget 2009/2010

Groundwater Source	Safe Yield (MCM/yr)	2010 Abstraction (MCM)	Difference (deficit)
Renewable	275	427.2	(152.2)
Non-renewable / fossil	143	83.7	59.3
Total	**418**	**510.9**	**(92.9)**

Groundwater in the Highlands

Groundwater use for highland agriculture is a major component of Jordan's water budget. It merits a serious long-term management approach. Since 1994, the average use by Highlands' agriculture has been 207 MCM/year, or 24 percent of total water use for the entire country. As a point of comparison, the Jordan Valley consumed on average 120 MCM/year of fresh water for irrigation during that same period. Considering the large volumes of water involved (200 MCM) and the low water productivity in the Highlands, irrigated agriculture in the Highlands may be the component of the water balance that should be viewed as a priority intervention area for water managers.

To date, success in harvesting this seemingly low-hanging fruit by bringing down abstraction rates to sustainable levels has been limited due to a number of complicating factors e.g., political power of the Highlands farmers, "first in use, first in right". However, there does appear to be some recent progress. Figure 3 shows that there has been a decline in abstraction rates, likely due in part to the 2002 by-law that put in place surcharges for groundwater abstraction. The Highlands Water Forum is also active in this field. It includes high levels of government (Secretary General of MWI), major water institutions, and key local stakeholders. Nevertheless, a recent USGS study confirms that groundwater levels in the Highlands are declining by at least 1m per year; therefore abstraction rates are still exceeding recharge. There are possibilities to move farmers out of agriculture (e.g., solar farms, farm buyouts by the government, eco-tourism) and these water-efficient alternatives could reduce the pressure on the Highlands aquifers.

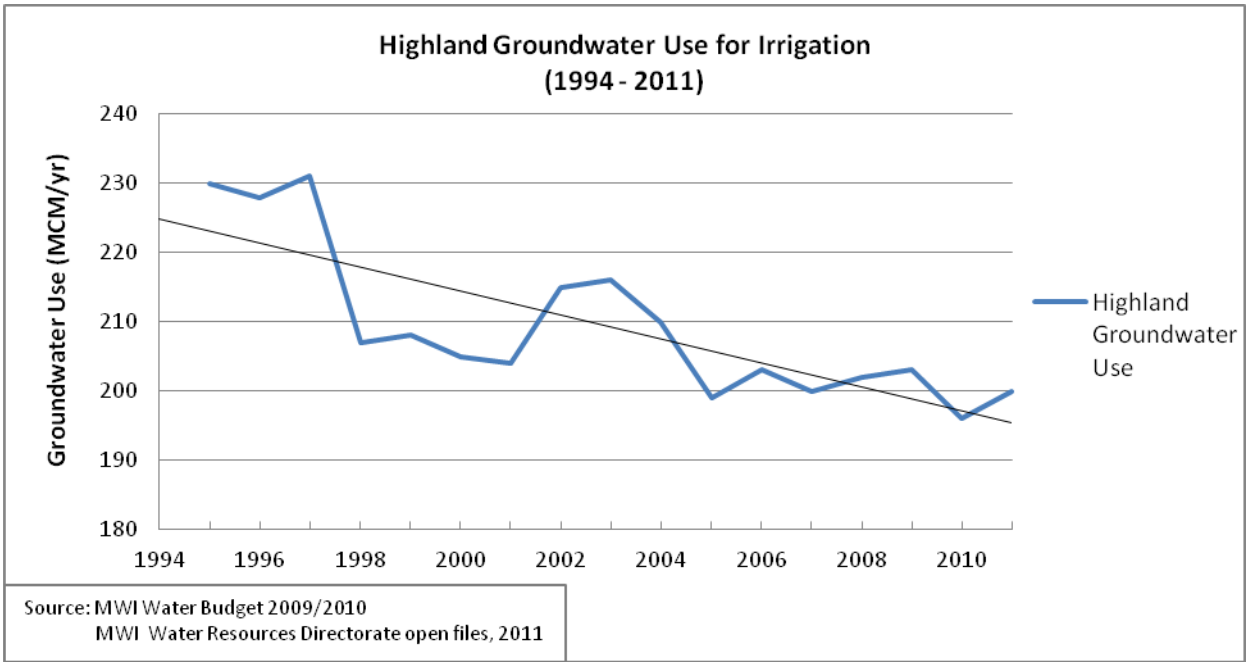


Figure 3. Highland Groundwater Use for Irrigation

Surface Water

Flows of the Yarmouk have significantly decreased (Figure 4) primarily due to dam construction upstream by Syria and decreased precipitation over the past 30 years (Table 2 and Annex 3). The abstraction by Syria is in violation of the 1987 agreement signed between the two countries (Jordan-Syrian Agreement, 1987). In terms of storage capacity, Jordan currently has approximately 215 MCM of capacity from their large dams (e.g., King Talal, Karameh); however, due to decreased runoff and base flow into the dams in recent years, the actual storage is typically less than 50 percent of capacity. The other two primary rivers of the country (Zarqa and Jordan) are severely polluted and are essentially used as wastewater conveyors to the Jordan Valley and the Dead Sea.

Table 2. Precipitation Trends in Jordan. Source: MWI Water Budget 2009/2010

Historical Rainfall Averages	
Long-Term Average (1937 – 2009)	8,249 MCM
30-Year Average (1980 – 2009)	7,556 MCM

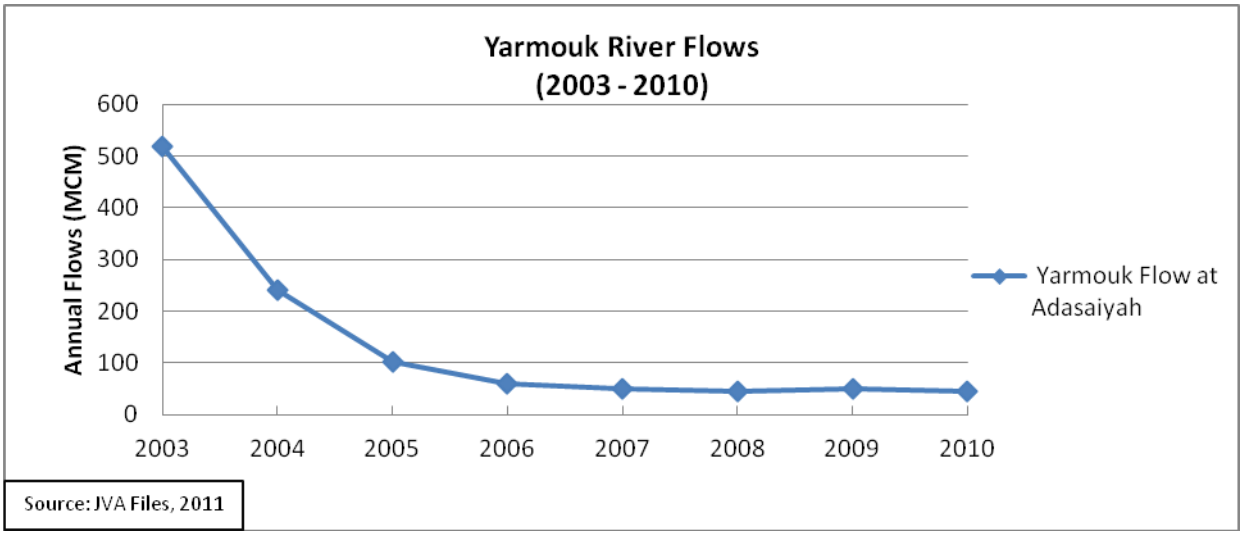


Figure 4. Historical Yarmouk River Flows

As mentioned above, the over-abstraction of groundwater in the Highlands not only compromises the long-term strategic groundwater reserves of the country, but also negatively impacts current spring flows in the principal wadis of the Jordan Valley, springs that traditionally provided water for domestic and agriculture purposes (Figure 5).

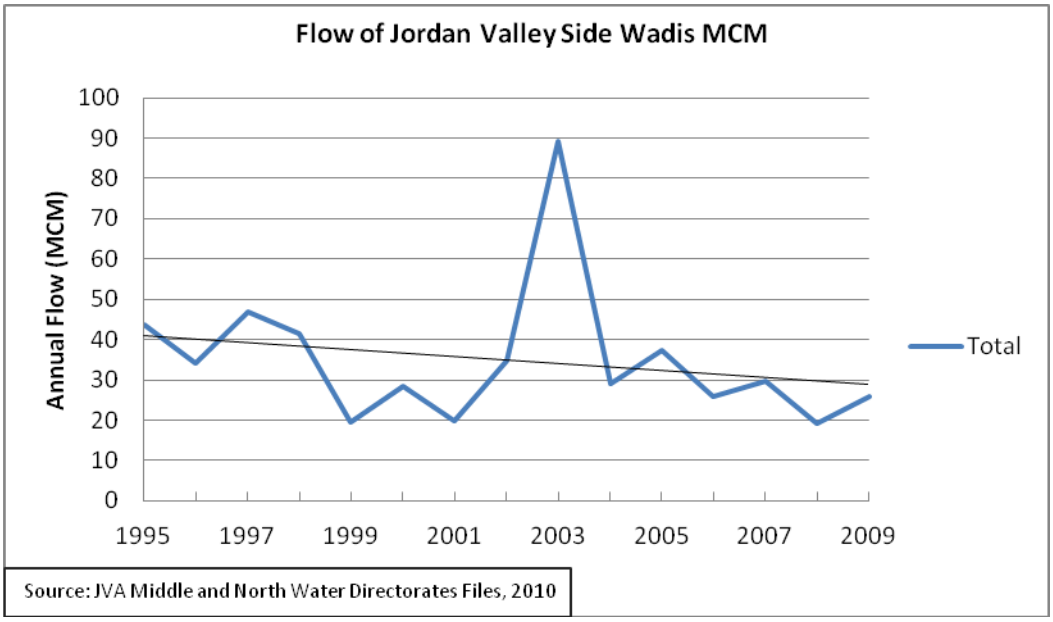


Figure 5. Flow of Jordan Valley Side Wadis – showing impact of GW over pumping in the Highlands.

Rainwater Harvesting

The Ministry of Environment oversees the UN funds that are received as compensation for the first Gulf War. A large portion of these funds are used to build earth dams and large-scale rainwater harvesting structures (20+ MCM) by the Ministry of Agriculture and the Ministry of Water and Irrigation. The government sees large potential at the catchment scale for this type of work and will continue to use UN funding for these activities.

Rooftop catchments in urban and rural areas have been considered as a potential source of additional water. As seen through USAID's Community Based Initiatives for Water Demand Management (CBI) program, household demand and willingness to pay for water saving devices and water harvesting structures does exist across the country. For example, households are able to cover the entire cost of RWH (Rain Water Harvesting) systems over a 30-month payback period. This shows that households value the additional storage capacity to cope with municipal supply shortages and that RWH can play a critical role in filling this gap. At the country-wide level, however, rainwater harvesting from rooftops has limited potential to become a major provider of domestic supply. A 2009 study found that if every residential rooftop in Jordan were to collect every drop of water that fell on it, the maximum quantity available would be 15.5 MCM/year, or approximately 5 percent of current domestic supply (Fayez and Al-Shareef, 2009). Considering that typical rooftop systems effectively collect 60-70 percent of available water, water from rooftop rainwater harvesting would be on the order of 9 MCM. Although this is only 3 percent of Jordan's total annual domestic water budget, household-level rainwater harvesting does provide an opportunity to meet demand outside of the large-scale water development projects.

Rainwater harvesting at the landscape- and household-scale is viewed positively by the Government of Jordan and individual stakeholders. It may be fruitful to investigate further with the Ministry of Agriculture and Ministry of Water and Irrigation the potential for USAID participation in the landscape-scale activities. At the household level, given the current success of USAID's CBI program in putting in place revolving funds to provide initial capital for rainwater harvesting structures, it is recommended that similar programs be pursued in future. Revolving funds have a multiplier effect on USAID's original capital contribution, effectively expanding their impact, and the nature of the program directly impacts the household and community level. Detailed cost-benefit analyses would be required to determine the appropriate scale of investment in both approaches, at the landscape and the household levels.

Data Quality Issues

Historical data quality issues were found within the MWI Water Budget 2009/2010. The lack of consistent and accurate data makes long-term planning and management extremely difficult. One specific case that came to the attention of the assessment team was the 2030 Water Resources Group's determination that total water supply in 2009 was 866 MCM compared to the official record of 936 MCM, a difference of 70 MCM. The discrepancy was due to double counting of water from As-Samra treatment plant at both the plant outlet and once it arrives at the King Talal Reservoir (KTR). Under closer inspection of the official data by the assessment team, it became apparent that this double counting has been happening since at least 2004. By the end of the January 2012 mission, there was concurrence from the MWI that double counting had occurred, and that the MWI would need to revisit its official records. One role that the newly appointed National Water Advisory Council could play is to advocate for support to the MWI to clean up the historical data that is part of the National Water Master Plan.

WATER USE

For the purposes of this study, water use is considered among the three primary sectors: agriculture, municipal (domestic, commercial and light industry on municipal water systems) and industry. As agriculture is the primary user of wastewater, irrigation use has been further subdivided into freshwater and wastewater to highlight the possibility, or lack thereof, to transfer that water for domestic consumption. As shown in Figure 6 below, agriculture remains the largest consumer of freshwater, but the gap with municipal use is rapidly closing. Wastewater reuse is steadily increasing. It is approaching 10 percent of the total available water for the country and 20 percent of the total agricultural water use.

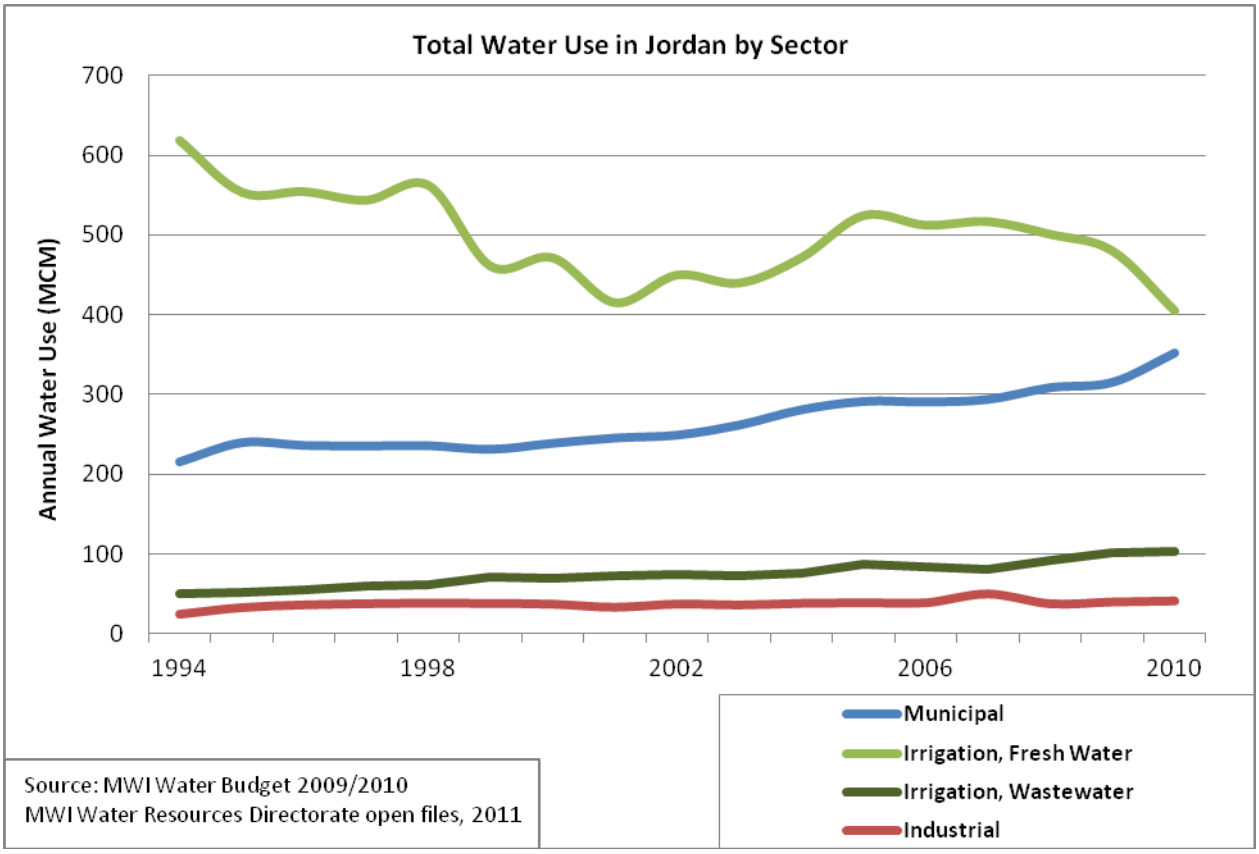


Figure 6. Total Water Use in Jordan by Sector

Municipal

Municipal supply is met primarily by groundwater sources. Per capita municipal consumption levels have remained fairly constant at an average of 142 LCD (liters per capita per day) since 1994 (Figure 7). This is an impressive achievement given that population growth over that same period has been on the order of 48 percent (1.97 million). Nevertheless, these figures are quite low compared to the world average. Municipal water supply is intermittent (fixed hours and days) in almost all areas. Aqaba is the major exception with 24-hour service. Intermittent supply has exacerbated water availability and water utilization issues across socioeconomic groups in Jordan for decades (Iskandarani, 2002). As discussed in subsequent sections of this report, the institutional, financial, social and political issues related to municipal water are a focal point for water sector managers. Given the severity of current pressures, it will be important for USAID to continue to play a significant role in this sub-sector.

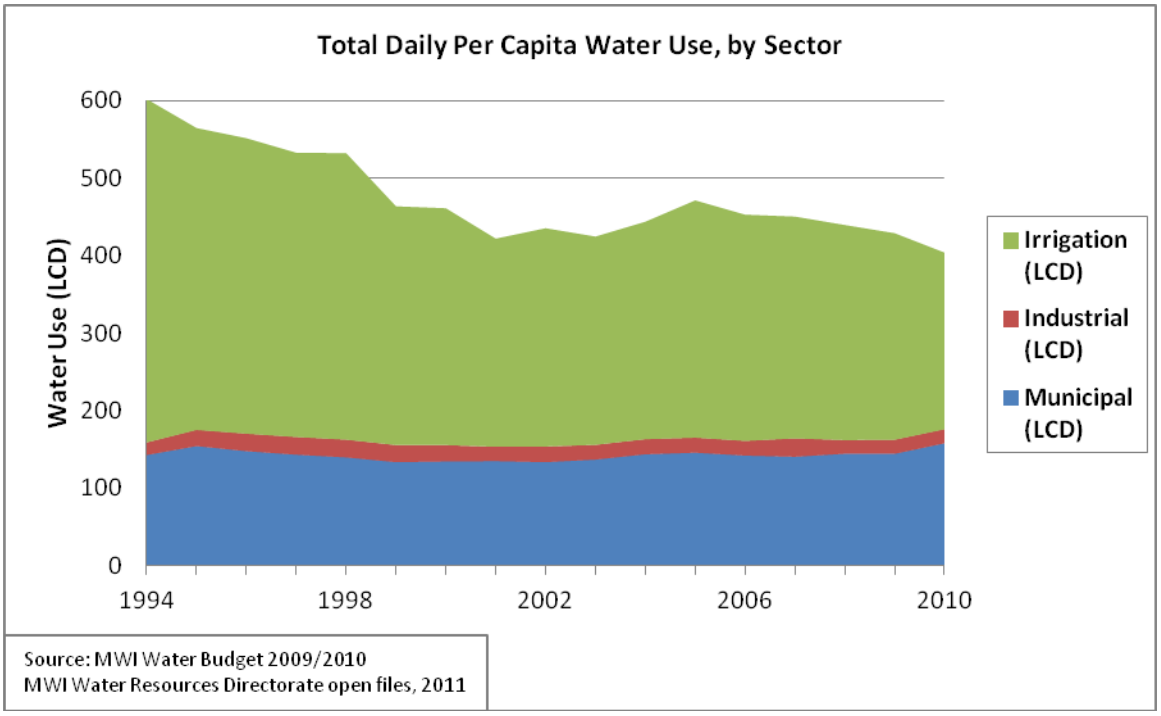


Figure 7. Total Daily per Capita Water Use by Sector

Agriculture

The most common criticism of the Jordan water sector is that the agriculture sector consumes nearly two-thirds of the available water, while contributing only 3.5 percent of GDP (2030 Water Resources Group-WRG 2030). This statistic merits closer examination:

> *First*, the global percentage of water used in agriculture (62 percent, 2030 WRG) figure blurs the distinction between Jordan Valley irrigation and Highlands irrigation, both of which merit individual analysis. As shown in the 2030 Water Resources Group paper, water productivity in the Jordan Valley is roughly three times greater than it is in the Highlands. Secondary and tertiary economic benefits (e.g., suppliers of inputs, services, and equipment to agriculture and providers of goods and services to those employed in agriculture and value chain companies) in the Jordan Valley is neglected in the global figure of 3.5 percent of GDP (Ministry of Planning, 2010).
>
> *Second*, by viewing the value of water solely through the lens of its direct contribution to GDP, the larger social and political values of water are obscured. The Jordan Valley represents the nexus between Israel, the West Bank and Hashemite Kingdom of Jordan and is of strategic importance for

all three parties. Jordan's agricultural sector in the valley, for example, is a vibrant cornerstone of Jordan's economy that supports a large population that would otherwise be forced to migrate to the larger urban centers of the region, placing additional stress on those cities. The Ministry of Planning and International Cooperation estimates that it costs USD 60,000 – 70,000 to create a sustained new job in the current climate.[1]

Third, the underlying assumption seems to be that agricultural water can be substituted directly for domestic water in the valley without substantial economic impact. This is true only to a limited extent. Agricultural water comes from both groundwater (42 percent) and surface water (58 percent) sources, with 56 percent of surface water being reclaimed wastewater. The groundwater component is being abstracted at rates that exceed recharge levels in the Highlands. Even if agricultural consumption declines, it would still be unsustainable to continue to over abstract from these aquifers for domestic purposes. Similarly, in the Jordan Valley during 2010, 37 percent of available fresh surface water (48 MCM) was already being pumped to Amman via the Zai treatment plant (Figure 9). The remaining 83 MCM per year begins to approach the minimum freshwater requirement threshold for the valley soils to avoid greater salinization and loss of productivity. Considering the declining levels of Yarmouk River Flows, the possibility to transfer additional water from the Jordan Valley to Amman will become less and less feasible.

Nevertheless, the need for increased water efficiency for agriculture in Jordan remains a priority, especially in the Highlands. In the Jordan Valley, agricultural water use efficiency has increased in recent years. Total irrigated area has increased while water use has decreased, suggesting that overall irrigation efficiency has improved.

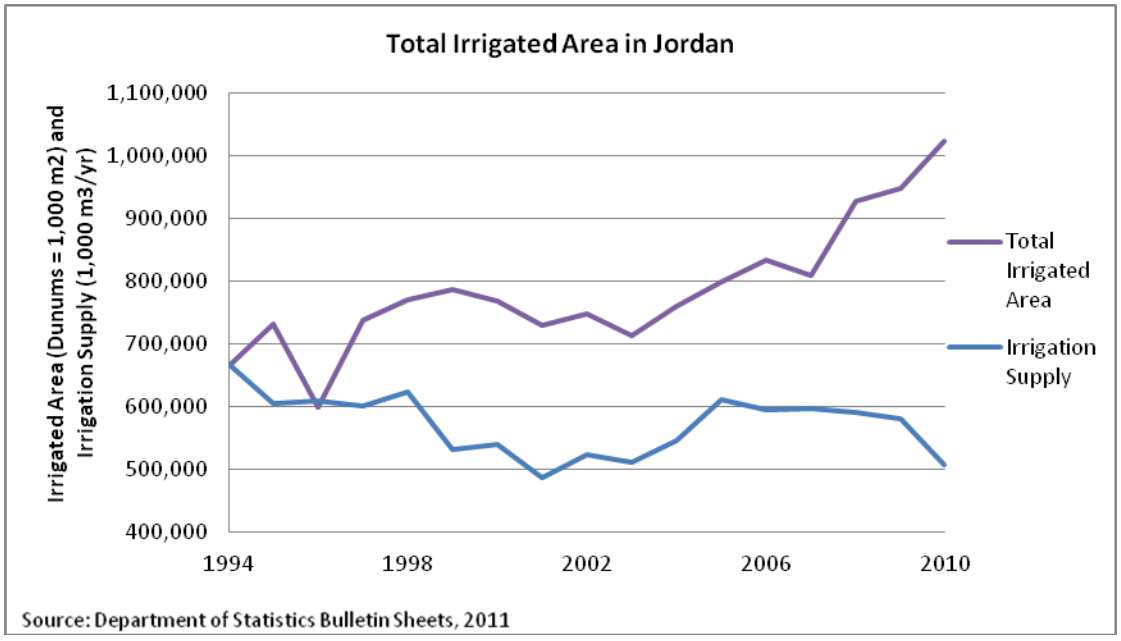


Figure 8. Irrigated Area and Irrigation Water Use (1994 – 2010)

[1] Job creation costs are a source of contentious debates. Recent debates in the US place costs of creation between $60,000 (marginal costs to add an employee to an existing SME) to $280,000 (U.S. Jobs Creation act). In 2011, South Africa launched a new industrial employment policy for industry with estimated costs (with capital investment) of about $47,000 per job.

Wastewater Reuse

As a result of Jordan's ambitious campaign since the 1980's, about 65 percent of the population currently is connected to wastewater collection and treatment systems (WAJ, 2011). Currently, there are 27 wastewater plants serving the country. The number of waste water treatment plants (WWTP_ has almost doubled since 1993 (then 14 WWTP) as well as their capacity (then 58 MCM/yr) indicating Government and donors efforts in utilizing the treated wastewater as a new and additional resource (El-Naser and Elias, 1993). These plants processed about 105 MCM of raw wastewater in 2010 with effluent usable for irrigated agriculture of about 103 MCM.

Treated wastewater is an essential element in the Kingdom's water strategy. Approximately 98 percent of the total treated wastewater is utilized for irrigation (MWI, 2011). In 2010, the treated effluent of major urban areas constituted about 20 percent of total irrigation water resources. Treated wastewater contributed to about 56 percent of the total water resources used for irrigation in the North and Middle Jordan Valley and this percentage is increasing on an annual basis due to the increasing amounts of treated wastewater from As Samra Plant and other plants discharging water towards the Jordan Valley, such as Wadi Al Arab WWTP, Wadi Es Sir, Kufranjah and Salt (Figure 9). By the year 2015 treated wastewater is expected to add an additional 76 MCM/yr bringing the total wastewater available for reuse to about 180 MCM/yr (Water Resources Group 2030).

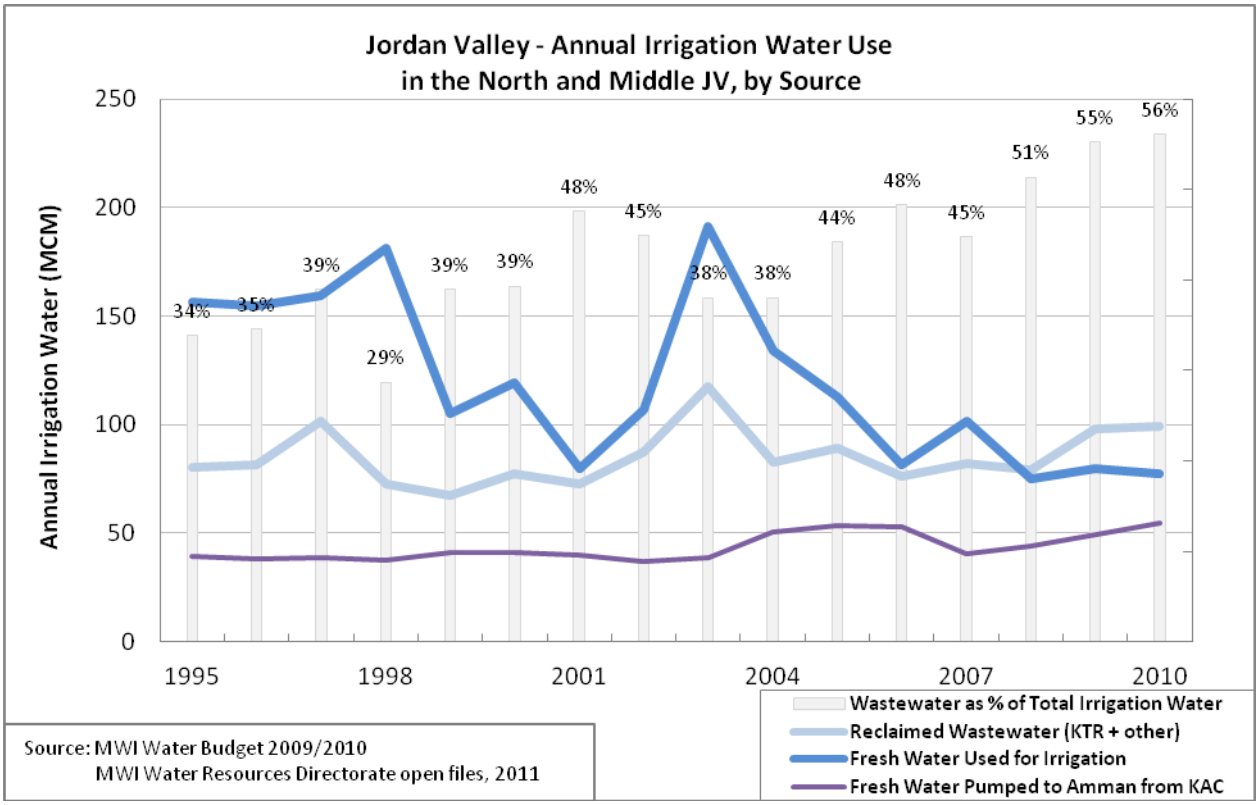


Figure 9. Jordan Valley Water Use

As demonstrated above, wastewater reuse has been a priority of the Government of Jordan. USAID projects, such as Water Reuse Implementation Project (WRIP) and Reuse in Industry, Agriculture and Landscaping (RIAL), were instrumental in bringing about policy changes around wastewater reuse. Given USAID's proven track record and the government's ambitions to continue to improve availability of wastewater effluent for agriculture, wastewater treatment should be a part of USAIDs strategy.

Industry

Industrial water requirements in 2010 were 40 MCM. Industrial sector water is consumed by fertilizer industries (potash, and phosphate), the oil refinery, thermal power plants, cement factories and various light- to medium-industries. Most of the larger industries are suffering from water shortage and would benefit from recycling industrial wastewater. However, recycling investments are in many cases too expensive for small industries. As discussed later in this report, the salinity problems associated with industrial effluent are a growing problem and this could have a negative impact on the operations of the As-Samra WWTP and the future for Jordan Valley agriculture. USAID's Water Resource and Environmental Conservation (WREC) program should play a key role in addressing this issue.

WATER DEMAND

Projections by the MWI Water Sector Planning & Associated Investment Program (2002-2011), the Accelerating Water Sector Transformation in Jordan by the 2030 Water Resources Group Study (2011) and the MWI Report for Annual Water Budget (2011) as well as many other studies done by MWI and international organizations differ on the exact amounts of future supply and demand for water. They agree, however, that there is a serious gap between demand and supply and that affordable, realistic solutions to close the gap are not apparent. For the purpose of this study, the team analyzed and synthesized the best available figures by MWI to assess the projected needs for all sectors within the coming years. In contrast to the 2030 WRG study and MWI estimates, the review team have assumed that agricultural demand will increase gradually over time to 550 MCM in 2015, 650 MCM in 2020 and 700 MCM in 2025 (Figure 10), rather than remain fixed at the current 510 MCM as estimated by the 2030 WRG study or rise sharply to 700 MCM by 2015 as estimated by MWI. The other major assumption used here is that the Jordan Red Sea Project (JRSP) will not occur within the time frame of analysis.

Projected future water supply availability from all sources has shown that water deficit is increasing (Figure 11). Despite the huge investment in the water sector programmed through the year 2025, a considerable water deficit will face Jordan. For example, the water deficit for all uses will grow from about 160 MCM in 2015 to 490 MCM by the year 2025. This huge water deficit will likely be met by a combination of suppressed demand and rationing distribution programs for domestic uses, as well as the use of increased waste water flows for irrigated agriculture. To further close the gap, desalination of Red Sea water will most likely be a selected option whether it is done as an Aqaba Water Company (23 MCM) project to pick up shortfalls that the team thinks may occur in the next 6 to 8 years, or a larger regional (50 to 100 MCM) project as part of a potential swap with Israel in exchange for additional releases from Lake Tiberias to Jordan. These options would require extensive feasibility, cost-benefit and risk analysis studies.

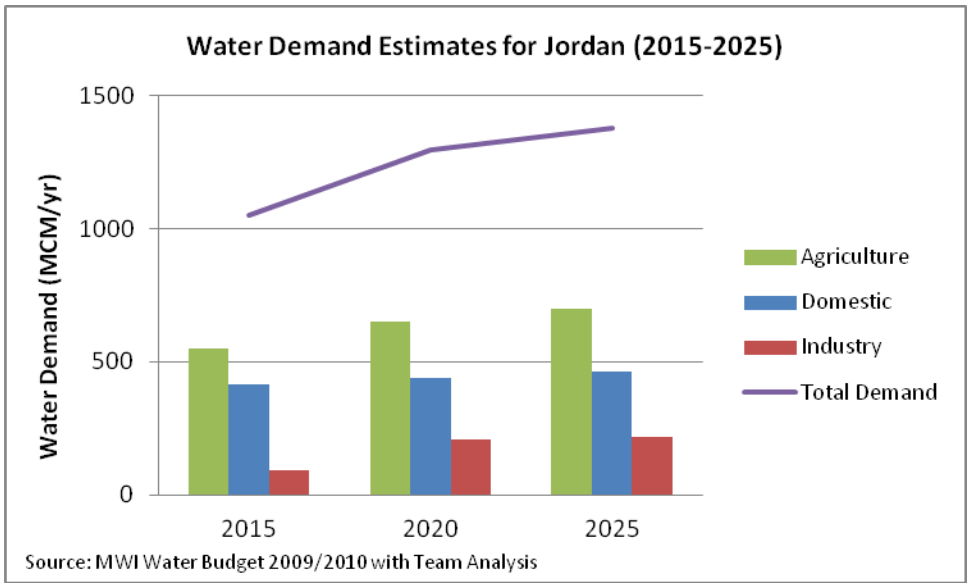


Figure 10. Water Demand Estimates for Jordan (2015-2025)

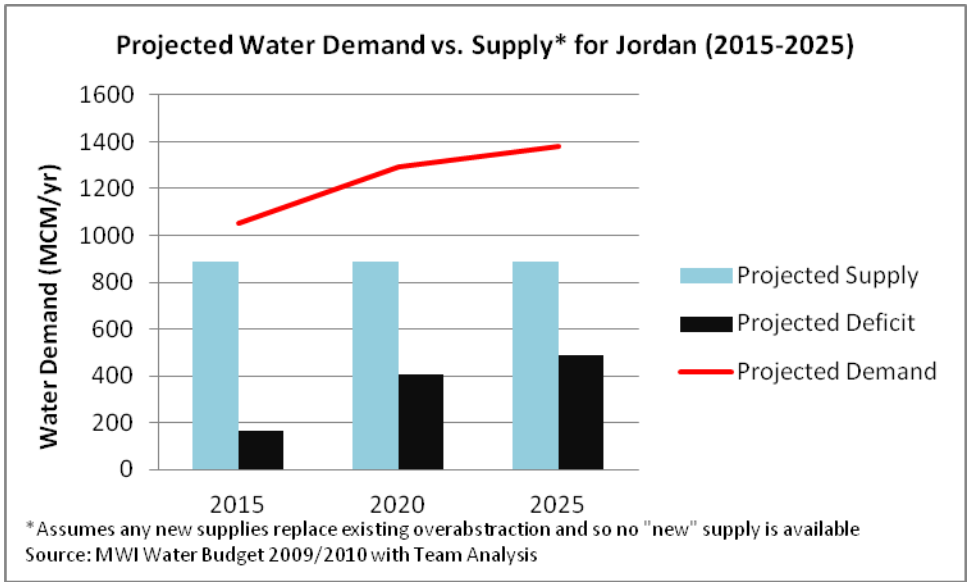


Figure 11. Projected Demand versus Supply for Jordan (2015-2025)

Current deficits are being covered by mining groundwater beyond their safe yields, and by exploitation of non-renewable, fossil groundwater. In the near future, demand can be met by desalinating the brackish and saline groundwater at medium cost, or higher cost future works could use sea water from Aqaba. The current trend of decreasing per capita availability of relatively low-cost, naturally occurring renewable supplies of water, and the future trend of increasing unit costs of water supply, carry economic and social threats that Jordan must develop ways to cope.

Water Demand Management

A number of studies and initiatives relating to water demand management have been conducted over the past 10 years funded by several donor organizations. These include:

- USAID Community Based Initiatives – Promoting Water Savings & Efficiency (2006-2012)
- USAID WEPIA Program (2000 – 2005)
- AFD (Agence Française de Développement) – Irrigation Optimisation in the Jordan Valley (2000 – 2006)
- USAID IDARA Program (2007 – 2012)
- MWI – AFD – Water Demand Management in Jordan (Final Report 2011)

The above list is by no means exhaustive. A cursory search shows that many organizations have worked on projects in this area in Jordan over the last ten years. Organizations that have been active include the World Bank, WHO, UN, GTZ and FOEME (Friends of the Earth Middle East). Three current programs of USAID – IDARA, WREC and PAP -- all include elements of water demand management.

The MWI has a Water Demand Management Unit (WDMU) which was established in 2002 and currently has six staff permanently engaged on WDM issues. They are responsible for demand management in the municipal and agriculture sectors, but to date have focused primarily on the residential and commercial sub-sectors. Their current focus appears to be the encouragement of installation of Water Saving Devices (WSD) through the introduction and enforcement of a revised building code for new buildings. Retrofitting of existing buildings has been piloted in two areas through sponsorships (HSBC Bank and PepsiCo). The WDMU is seeking additional sponsors to extend this initiative. Despite these successes, and the possibility of reducing the need for expensive infrastructure, the potential overall impact of water demand savings in the residential and commercial sectors is far less than those in the agricultural sector, where the majority of water use occurs.

A brief overview of the studies and initiatives listed above shows overlaps, inconsistencies, and the need for greater coordination of communication campaigns among projects and implementation participants. Future work in this area should ensure donor communication and collaboration; continue to focus on retrofitting existing commercial buildings (especially hotels and other high volume users), continuing work with industries, and expanding into the agriculture sector. Greater USAID expansion into these last two areas, industry and agriculture, holds potential for greater impact in terms of the absolute quantities involved (agriculture) and the possibility of reducing the quantities of poor quality effluents (industry).

WATER SECTOR INSTITUTIONAL SETUP

In the 1970's and 80's, a major merging of multiple water institutions resulted in the creation of two entities: The Jordan Valley Authority (JVA) in 1977 and the Water Authority of Jordan (WAJ) in 1988. These two authorities were setup as autonomous organizations, although owned by and reporting to the government. The JVA was assigned responsibility for water management in the Jordan Valley. It managed dam construction, operation and management; irrigation and drainage supply to farmers; and, bulk supply of water to municipal and industrial users. In addition, the JVA was made responsible for land management and distribution outside the municipal boundaries, and for tourism development in the Dead Sea area. The WAJ was established to focus on municipal and industrial supplies and wastewater collection and treatment. In 1992, the Ministry of Water and Irrigation was created to bring WAJ and JVA under one Minister. The reasons for creating the Ministry were: 1) the need to plan better and allocate water more effectively to growing utilities and many more users in the face of increasing water

scarcity and competition, and 2) the concept of autonomous entities fell out of favor politically with Parliament.

The main functions for MWI include:

- Formulation of water strategies and policies,
- Water resources planning and development of national master plans,
- Monitoring and evaluation of water resources,
- Conduct of water, wastewater, and irrigation studies,
- Implementation of awareness and outreach programs in the sector, and
- Establishment and maintenance of water data banks and information systems.

The water resources planning and project prioritization responsibilities of the MWI, to a great extent overlap with the functions of JVA and MWI. After 20 years of establishment, the MWI has not been able to take on the control of surface water or groundwater supply. Jordan's dams, dam development, and major canals are controlled by JVA. Groundwater resource development and the main permitting and licensing tools for groundwater use remain within WAJ. Both JVA and WAJ are bulk suppliers of municipal water, industrial water, and irrigation water. JVA regulates dam use and operates irrigation systems down to the secondary distribution level, making them an operating "utility." WAJ dominates groundwater development and use, operates municipal utilities, owns the corporatized water utility companies, and provides public waste water treatment.

The Jordan Valley Authority (JVA)

Under the 1977 law, the JVA acquired the primary authority to plan and implement water supply services and land development in the Jordan Valley. Article 3 of the 1988 law mandated JVA to undertake all works related to the development, utilization, protection and conservation of the water resources in the Jordan Valley. The law was modified by the Amended Law (30) of 2001. While JVA reports to the Minister of Water and Irrigation, it is still technically and legally an autonomous authority. In practice, it has not exercised certain powers, for example, the direct borrowing of funds, since the establishment of the MWI.

The JVA's main responsibilities are to:

- Study and develop water resources (both conventional and unconventional, the latter including rain water harvesting and brackish water use), provide them for different purposes, protect them;
- Provide bulk water to WAJ, and distribute water for irrigation;
- Raise the efficiency of agricultural water use;
- Study, design, implement, operate and maintain irrigation projects, all major dams in Jordan, and water harvesting;
- Develop, survey and classify lands for agricultural and residential purposes;
- Defend Jordan's rights to trans-boundary waters; and
- Conduct minor socio-economic development activities in some remote locations (this is a legacy function of the JVA's original role which include a broader remit to conduct such development).

The JVA's operating budget was ~7 million JD in 2009 and ~9 million JD in 2010. Revenue raised from the JVA's activities was ~5.5 million JD in 2009 and ~7 million JD in 2010. Most of the revenues come from water sales to industries. The revenues from irrigation water sales are very low, because the average price of irrigation water price is heavily subsidized at 15 fils (about 2 US cents) per cubic meter. Irrigation water tariffs are set by the Cabinet of Ministers, and have not moved in years.

The JVA's capital budget depends on allocations from the Ministry of Finance. In 2009 this was ~35 million JD and the estimate for 2010 was ~20 million JD. Typical capital allocations are 20~30 million

JD/year, which are spent on projects such as dam and irrigation infrastructure construction, the preparation of land for irrigation projects, and supporting infrastructure, such as road construction.

Table 3 below shows the available cost breakdown, both operating and capital, for 2009, the latest year for which such figures are available.

Program	Current Costs	Capital Investment	Total
Management and Support	1.2	0.3	1.4
Land and Rural Development	0.3	1.3	1.6
Irrigation	0.2	18.3	18.5
O&M	3.9	5.1	9.0
Dams	0.7	8.1	8.9
Southern Ghors and Wadi Araba	0.6	1.7	2.3
Totals	6.9	34.8	41.6

Table 3. Jordan Valley Authority Expenditure Data

The JVA has supported the creation and development of Water Users Associations (WUAs) at each pumping station and has transferred some operational functions for secondary and tertiary irrigation water delivery to these WUA's. GTZ (Gesellschaft für Technische Zusammenarbeit) GmbH now renamed GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH) has supported the organizational development of the WUAs along with improvements to JVA main system management systems. AFD (Agence Française de Développement) has supported the design, piloting, and some scaling of improvements to water delivery and on-farm irrigation. However, the associations have neither the capacity to take on the management of the retail system, nor the capacity to carry–out secondary and tertiary system maintenance works. JVA has transferred employees to the WUAs along with a budgetary allocation to cover their costs. The secondary and tertiary irrigation systems require major rehabilitation, replacement, and intensified maintenance. The systems were built in the 1980s and 1990s and are no longer very efficient. The required investments for these rehabilitation works may range between 25 - 30 million JD, which is beyond current JVA and WUA means.

The major challenges facing JVA are:

- Water supply/demand imbalance, particularly the massive decline in Yarmouk River flow (historically, flow was ~350 MCM/year; now it is ~60 MCM/yr). Competition between different uses causes problems for all clients in terms of both water quantity and quality.
- Low cost recovery from JVA operations and a dependence on substantial subsidies from the government for operation and maintenance costs
- Transfer of the retail water delivery system to WUA's is a big challenge, because of the limited human and financial capacity of these associations.

The Water Authority of Jordan (WAJ)

The WAJ was established in 1984, and then amended by Law 19 in1988. WAJ now operates under the Ministry of Water and Irrigation, while it is still technically and legally an autonomous authority. WAJ is governed by a Board of Directors chaired by the Minister for Water and Irrigation, representatives of the

Ministry of Planning, Agriculture and Health, as well as the Secretary General of WAJ and the Secretary General of the Jordan Valley Authority. WAJ functions extend over a wide range of regulatory and utility aspects, which creates overlaps and confusion with the Ministry's role, particularly related to water resources management and planning. WAJ is in charge of the implementation of policies related to the provision of domestic and municipal water and wastewater disposal services. Its responsibilities include the design, construction, and operation of these services, as well as the supervision and regulation of construction of public and private wells, licensing well-drilling rigs and drillers, as well as issuing permits to engineers and licensed professionals to perform water and wastewater related activities.

The WAJ Law was amended in 2001. Article 28 was introduced to allow for Private Sector Participation in the water and wastewater service delivery through the assignment of any of WAJ's duties or projects to any other body from the public or private sector or to a company owned totally or partially by WAJ. This amendment enabled WAJ to corporatize utilities and enter into BOT (Build-Operate-Transfer) contract arrangements and other PSP (Private Sector Participation) options. Prior to that, WAJ was able to outsource services to the private sector including design and construction services, and management contracts. Notably WAJ supervised the World Bank-financed LEMA (Lyonnaise des Eaux –Montgomery Watson-Arabtech Jardanesh) contract to manage Amman's water utility services. The LEMA contract showed the advantages of corporatization of utility functions in terms of improvement of operating efficiencies and service quality, technical innovation, and incentives-based management (Philip Ditzel, 2008). Government and public resistance to foreign management of water supply in Amman, however, led to a transition to nationally-owned public utilities in the three main urban centers of the country.

In 2007, the Jordanian Water Company (Miyahuna – "Our Water" -- LLC) was established under the Companies Law. The company is fully owned by WAJ and it provides water and wastewater services in Greater Amman Area. A similar set up was done for Aqaba by creating Aqaba Water Company (AWC) to run all services related to water and sanitation within Aqaba Governorate. The Aqaba experience seems to be a successful one in terms of cost recovery and financial viability. A series of micro PSP options were introduced to raise efficiency in metering and billing in more than one Governorate, namely: Madaba, Karak and Balqa.

The challenges that are facing WAJ and its utilities providing municipal water supply and wastewater services have been identified and studied by various groups for about two decades now. These challenges include:

- Systems inefficiencies induced by the governance and institutional structure of the water delivery system.
- Poor cost recovery and financial sustainability of the sector. The levels of subsidies by the government and donor agencies may reach up to 100 percent of the revenues from water delivery services.
- The institutional structures have not provided the incentive framework to hire and retain qualified people and manage the sector more efficiently. In the past decade, the brain drain in the sector has become a major challenge, with many people leaving to work in private sector in Jordan or in the Gulf states.
- The donors' technical support to the agencies has not been effective due to various reasons related to the organizational governance and framework, donors' programs design, and inability to engage the sector institutions in design and implementation of these programs.

The Performance Management Unit (PMU)

In the late 1990s, a project management unit (PMU) was established within the MWI to implement the rehabilitation of Amman Water Supply, which was funded by donor agencies. Part of its function was the monitoring of the Amman Management Contract. As the infrastructure works in Amman came to an end,

the European Union (EU) supported the extension of the PMU mandate and its transition to the Performance Management Unit of the MWI. The functions of the PMU include:

- Technical monitoring and performance auditing the private water companies in the country by applying agreed-upon indicators in order: to establish a fair basis for comparison among the utilities; and, to provide tools to evaluate their performance and the effectiveness of their service provision;
- Promotion of Private Sector Participation (PSP) in water services and management;
- Development of Public Private Partnership (PPP);
- Planning and providing strategic advisory to decision makers;
- Application of commercial principles on the retail side of municipal water supply and waste water treatment.

The PMU is governed by a Board of Directors chaired by the Minister of Water. Both the WAJ and the JVA Secretaries General are members. The PMU CEO reports to the Minister of Water, but historically has close reporting and coordination relationships with the Water Authority of Jordan.

Throughout its history, the PMU has played a significant role in the restructuring of the sector. Institutional reformers regard it as potential interim regulatory body of water utilities that would be responsible for monitoring and auditing functions including performance indicators and service benchmarking systems. In addition, the PMU has been supporting all PPP (Public Private Partnership) and PSP transactions of projects and government services.

The National Water Advisory Council

The National Water Advisory Council was created at the end of 2011 by a government by-law (By-Law No 54 for 2011) according to articles 5 and 32 of the WAJ Law No. 1988. The Council is chaired by the Minister of Water and Irrigation and has 10 member ministers and secretary generals of various government organizations. In addition, the council membership includes five members from the private sector and the civil society organizations. The latter members are nominated by the Minister of Water and approved by the Cabinet.

The Council will hold meetings by invitation from the chairman or the vice chairman in his absence, at least twice a year, more frequently when needed. The main functions of the Council are to:

- Discuss the water sector policy including the financial support and pass the recommendations needed and follow up its implementation.
- Review the water sector strategy, plans, and programs needed to implement it and pass the recommendations needed.
- Coordinate the efforts of institutions and commissions from public and private sector to enhance partnership and integration between them.
- Suggest procedures related to raising the level of service provided by the water sector and promote passage of these recommendations.

The Council may establish any committees needed to support its work and help achieve its goals. The Council could become an important platform for the discussion of water policy issues among public and private sector stakeholders, particularly on matters related to financial support from the government and to planning for the allocation of scarce water resources. The Council presents an opportunity for the Ministry of Water and Irrigation to gain support for sector reform across ministries and private sector groups.

Royal Water Committee

The Royal Water Committee was established in 2008 by a Royal Decree to develop the National Water Strategy. The Committee is chaired by Prince Feisal and has the Ministers of Water, Agriculture,

Environment, and Energy as members. The Committee has members from universities, the Farmers Union, and the private sector. The Royal Water Committee prepared the Water Strategy in 2009 and submitted it to the government, which approved and issued the strategy. Although the Committee still exists and Prince Feisal is reported to be very interested in the Strategy and its implementation, it does not carry any constitutional status beyond the mandate it was entrusted with. The royal sponsorship and support to the Committee may present an opportunity for sector monitoring, advocacy and outreach on major policy issues.

Other Government and Non-Governmental Players in the Water Sector

Other Government Ministries involved in the water sector include: the Ministry of Finance that oversees budgets and project financing; the Ministry of Planning and International Cooperation that is involved mainly in economic planning and donor affairs; the Ministry of Agriculture involved in the collection and communication of relevant data with regard to irrigated agriculture; and the Ministry of Health that monitors the suitability of drinking water that is supplied by WAJ, as well as effluents from public and private wastewater facilities.

Non-Governmental Organizations (NGOs) are mainly involved in developing public awareness and education on national environmental issues, identification of problems and proposed solutions for environmental protection (e.g., the Jordan Environmental Society and the Royal Society for the Conservation of Nature). Other NGOs are involved in water measurement, testing, training, education and monitoring work as third party independent inspectors mainly for water quality and material testing (e.g., Royal Scientific Society and the Water and Environment Research Center at the University of Jordan).

Annex Four summarizes the roles of the other government and non-governmental stakeholders involved in water sector management in Jordan.

CHANGES IN INSTITUTIONAL STRUCTURE

The municipal water supply and sewerage sector in Jordan has under gone significant changes during the last 10 years to improve financial sustainability by improving efficiency. In 2000, Jordan's municipal water supply and sewerage services were run by a national, vertically-integrated, bulk water supply and distribution, governmental authority – the Water Authority of Jordan (WAJ). Bulk water supply was, and still is, planned and managed centrally. Service delivery was managed locally in 12 governorates.By the end of 2011, three companies owned by WAJ had been formed: the Aqaba Water Company (2004), covering the Aqaba governorate; Miyahuna, covering the Amman governorates (2007); and, the Yarmouk Water Company, combining the four governorates of the Northern Region (2011).

The three limited liability companies formed under the Companies Act corporatized the utility operations in those governorates, enabling them to operate as commercial entities, removing restrictions that tend to limit performance in governmental institutions, e.g., allowing for market-based salaries and hiring and firing practices. It also changed the relationship between The Government, WAJ and the companies. The corporatized entities can no longer access the public bond market and can only receive government support through the price of bulk water or through capital injections from WAJ.

The Aqaba and Yarmouk water companies were transferred service area assets when they were formed, and are thus financially responsible for asset rehabilitation and replacement. Miyahuna is an operator, responsible for operations and maintenance of assets in its service area and for the installation, repair or replacement of the same-sized distribution network. WAJ remains responsible for major maintenance, rehabilitation or replacement of major bulk handling assets in the Miyahuna service area, such as water treatment plants, large diameter mains, tanks, etc. In lieu of depreciation, Miyahuna pays WAJ an "infrastructure usage fee" to cover repairs and rehabilitation of its major water supply assets.

At the end of 2011, WAJ remained responsible for water supply and sewerage service delivery in six governorates: Zarqa and Madaba in the Central Region and Karak, Tafilah and Ma'an in the Southern Region. The Madaba governorate utility is expected to become part of Miyahuna in 2012/2013. Zarqa and Balqa governorates are expected to corporatize over the next 2-5 years. The Millennium Challenge Corporation's grant to improve Zarqa's water supply and wastewater infrastructure is designed to encourage the Government of Jordan's current strategy of corporatizing the Zarqa governorate water utility and to encouraging full coverage of this utility's operations and maintenance costs. These three corporatizations are a condition of the Millennium Challenge Corporation grant to improve water supply and wastewater infrastructure. The Southern Region governorates will then follow the corporatization process, but probably take longer than five years to achieve it.

There is an institutional restructuring strategy, supported by donor activities, including USAID's ISSP in the water sector. It objectives are to: 1) establish a National Water Council (NWC) to review and to put external expert weight behind major legislative initiatives in the sector, 2) to separate WAJ as a bulk supplier of water from utility companies and corporatized municipal services that provide retail water services, and 3) to set up a sector regulator to monitor WAJ and company performance and contractual arrangements. The eventual creation of a single bulk water supplier from the merger of WAJ and JVA has been put forward, but the review team feels that this objective will take a very long time to realize because of the political strength of JVA's agricultural stakeholders, the weakness of the business model for water user associations to become irrigation utilities, and the complexity of the international and national mandates that JVA holds.

The National Water Council has been established and has just begun operations. WAJ appears to have accepted the vision of corporatized service delivery, but the review team feels that WAJ may not in the end accept the complete arms-length separation between WAJ as a bulk supplier and independent utility companies that is proposed in the Water Strategy. This move is supported by USAID and other donors as the final institutional reform to remove overlapping institutional responsibilities and conflicts of interest among overlapping boards.

Establishing enforceable and lasting contractual relationships between WAJ and the utility companies will be difficult. With all of entities owned by the Government, it will be hard to keep them from seeking political solutions when pressure on the parties builds up. It may make sense to try changing the ownership structure of the companies to create more separation, but separating them from WAJ will require a solution for their financially viability. A key issue would be how new Government equity will be injected into the companies, as they can't solely be financed with debt at market-rates and retained earnings. Establishing durable financial and legal arrangements to support full asset replacement and rehabilitation and to enable the companies to access capital at reasonable costs will complicate implementation of the restructuring efforts.

Creating a regulator with the necessary authority to enforce its decisions would also seem difficult in the current Jordanian environment. It will be hard to keep the regulator from becoming political, considering the challenges of PMU balancing: 1) the bulk water price from WAJ to the companies; 2) Ministry of Finance limits on budget support; 3) the need for increased revenue with the political sensitivity surrounding changes in tariffs and fixed charges and the current need for Cabinet to approve any adjustments.

Recommendations:

The review team believes that USAID's focus on the utility companies, the creation of a water sector regulator, and a municipal sector bulk water supply is a good long-term goal. However, the team thinks that WAJ will remain at the center of the municipal water sector for a much longer period than USAID anticipates. Therefore, WAJ needs to be strengthened in its current operations, even as the MWI and

USAID push it towards beginning the transition towards becoming a bulk regulator. The NWC, the proposed regulator and the independent companies will all put substantial political pressure on WAJ. Its management, staff and incentives systems will need to adapt well before it can become solely a bulk municipal water provider as recommended by ISSP. As bulk water supply costs increase as the Disi project comes on line, WAJ, the companies and the government will be under substantial pressure to take action to reduce costs and to raise revenues. WAJ and the companies will undoubtedly develop their own solutions, reaching out to the donors for funding and technical advice when needed. The review team recommends that USAID seek to put a few individual senior advisors into WAJ, Miyahuna and the PMU to help guide the process; but encourage WAJ, company management and the PMU to develop and be accountable for their own solutions. The review team recommends that Jordanian nationals be used to the maximum extent possible, considering the expertise of the Jordanian private sector and the institutional memory held by the Jordanian firms working in the sector,

Considering the difficulties in implementing structural reform, the recommendation is that USAID implement a stepped approach, first doing those things that will improve accountability and incentives within the existing law, then moving on to full restructuring. Corporatizing the remaining governorate utilities should be a priority. This, the review team was told, can be done without law changes. Incorporating performance incentives into the existing WAJ/company agreements would also help and would appear relatively easy to do. The PMU's independent monitoring of utility performance to qualify the awarding of performance incentives could also strengthen the role of the PMU. These changes would seem to require limited funding and could likely be brought about mostly by designing Conditions Precedent for incentive programs in USAID's annual cash transfer agreement with Government.

Accessible, timely, consistent and accurate operating and financial information will be critical to making this institutional restructuring vision a reality. In the review team's opinion, this needs continuous pressure rather than significant project investments. All costs of water supply development needs to flow through WAJ's books or the books of one of the companies. The information needs to be audited by an independent third party, technically and financially. WAJ and the companies can pay for this and Jordan has the financial and technical skills to execute audits without international help. The review team believes that USAID can bring this about by designing Conditions Precedent on financial reporting and transparency standards as part of USAID's annual cash transfer agreement with Government. The successful use of CPs requires tightening of the application of performance standards to the cash transfer program, which appears to be difficult to do politically.

MUNICIPAL WATER SECTOR FINANCIAL PERFORMANCE

In spite of efficiency improvements from corporatization and projects to modernize infrastructure, internal and donor supported program to enhance revenues (e.g. studies to identify and propose solutions to reducing NRW) and collection rates, the financial performance of WAJ and the companies on a consolidated basis has deteriorated during the last six years (2005 through 2010). The sector entities have not been able to raise revenue to match increases in operating and capital costs.

While WAJ and the water companies have been to be able to cover operating costs: salaries and wages, operations and maintenance, including BOT wastewater treatment costs (Miyahuna) and administration costs-- full cost coverage has decreased as operating costs have increased (See Figure 12). Operating costs increased significantly in 2011 to JD 172M (unaudited) from JD 155M in 2010 (audited), as electricity costs increased substantially. Subsidies buffered but did not completely offset the higher electricity costs. The current cost coverage shortfall will grow as electricity costs increase and the Disi water starts flowing with its higher bulk rate cost.

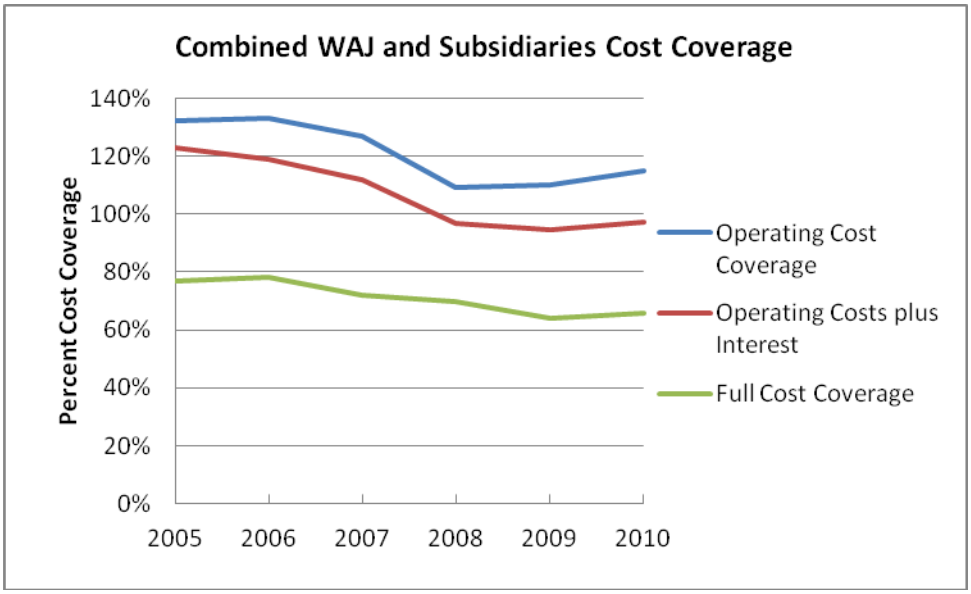


Figure 12. Combined WAJ and Subsidiaries Cost Coverage. Source: audited consolidated financial statements for WAJ and subsidiaries (2006 – 2010)

Capital cost recovery also poses a significant challenge. It appears that there is a policy or position that operating revenues should cover operating costs and that capital expenditures are to be funded by the government and donors --recorded as equity (capital contributions and grants) -- and by national and foreign loans – recorded as debt. As capital expenditures have increased, WAJ public bond debt has dramatically increased, even though WAJ has little direct capacity to repay.

Capital expenditures have been massive, considering the sector's financial capacity. Over six years from 2005 through 2010, WAJ has invested over JD 900M (1.3B USD) to rehabilitate and to construct new infrastructure (See Figure 13). This amount excludes the BOT investment in As Samar and Disi.

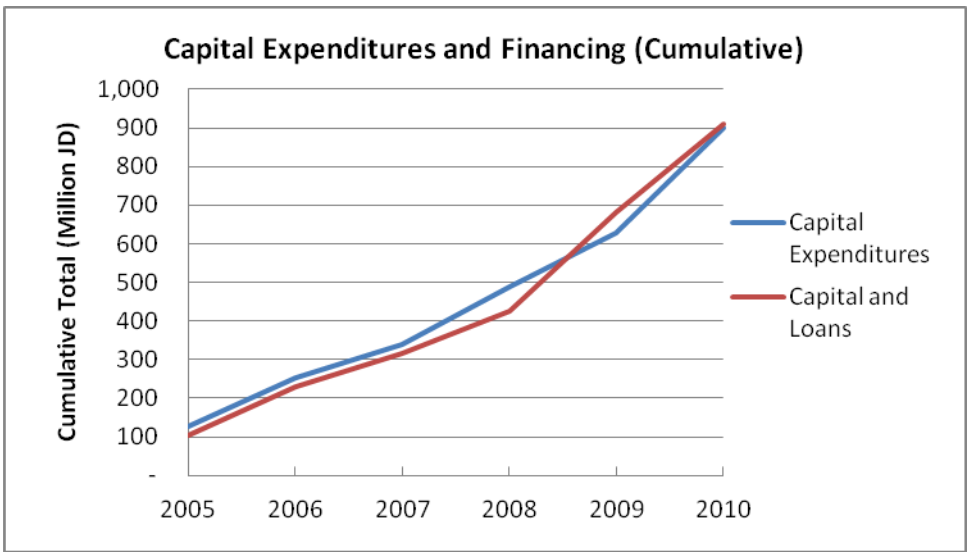


Figure 13. WAJ Cumulative Capital Expenditures and Financing
Source: audited consolidated financial statements for WAJ and subsidiaries (2006 – 2010)

International and public bond financing by WAJ has funded 39 percent of its capital expenditures or JD 352M over six years, excluding BOT financing (See Figure 14). This financing has increased interest costs from JD 6M to JD 24M over the period.

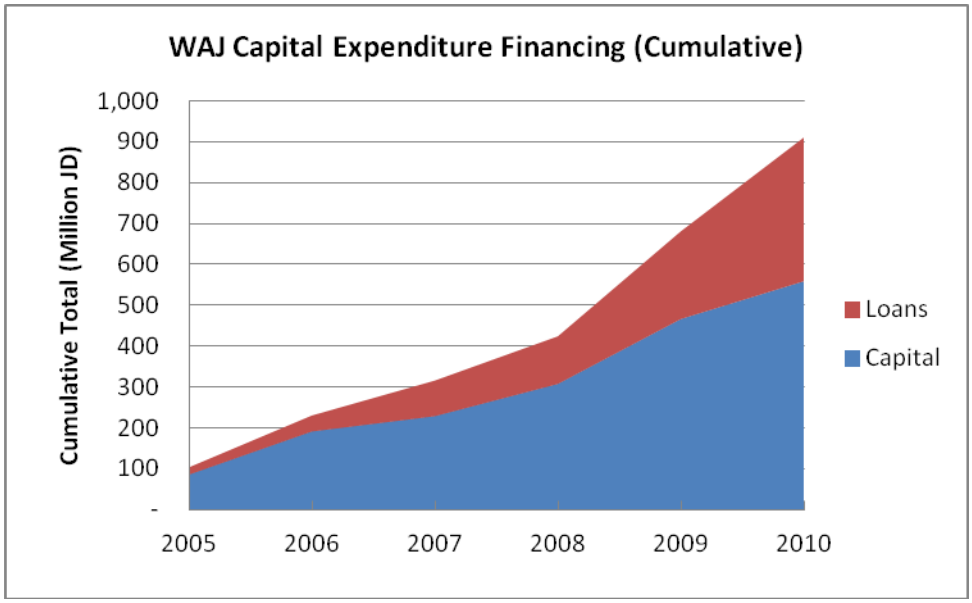


Figure 14. WAJ Capital Expenditure Financing by Type
Source: audited consolidated financial statements for WAJ and subsidiaries (2006 – 2010)

A substantial amount of the capital for infrastructure has come from donors. Over the last six years donors have added JD 255.78 M or 46 percent of total capital. USAID provided JD 188.48 M or 73 percent of donor capital contributions (See Figure 15).

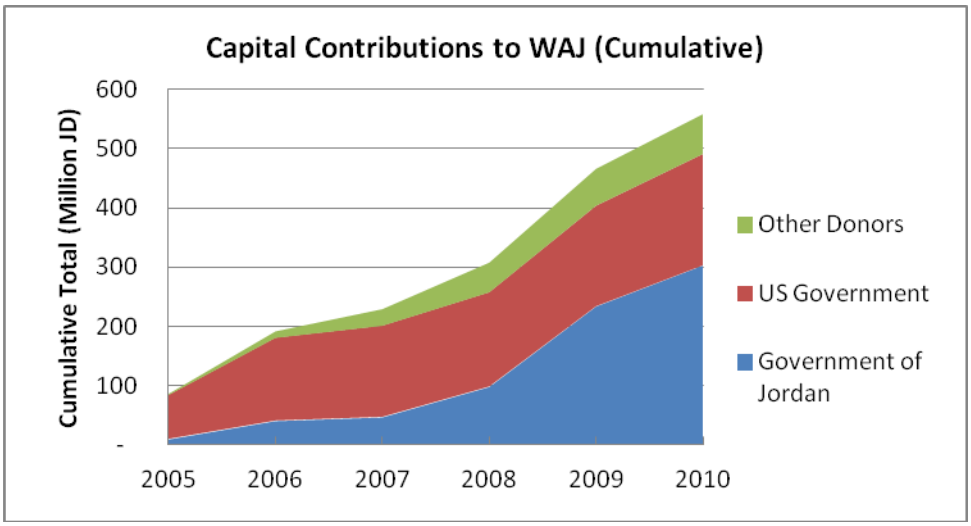


Figure 15. WAJ Cumulative Capital Contributions by Source
Source: audited consolidated financial statements for WAJ and subsidiaries (2006 – 2010)

The debt portion of financing for capital expenditures, other than BOTs and Disi, during the last six years has been made through the issuance of 3-year public bonds in the Jordan capital market. International loans make up a very small percentage of this debt (See Figure 16).

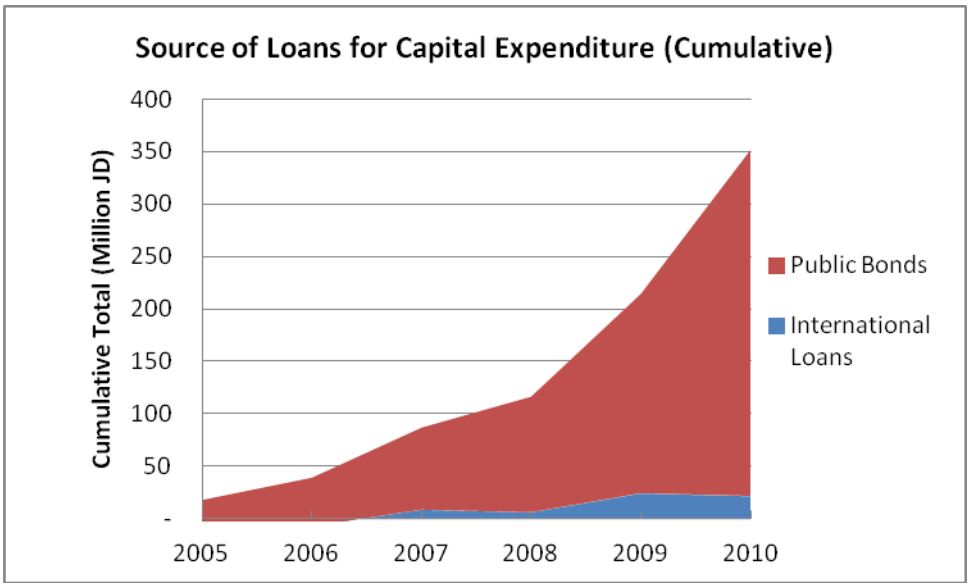


Figure 16. WAJ Cumulative Loans for Capital Expenditure by Type
Source: audited consolidated financial statements for WAJ and subsidiaries (2006 – 2010)

As WAJ revenues do not cover all its current interest charges nor any of the public bond installments, WAJ has had refinance its public bond debt when the three-year notes fall due, increasing its total debt by 900 percent from JD 64 M to JD 621 M in five years (See Figure 17). Public bonds are guaranteed by the Government of Jordan, which includes government loan guarantees in its national debt numbers. Currently Jordanian debt --as loans and loan guarantees- is 65 percent of GDP. The Government has a non-binding debt ceiling of 60 percent of GDP with the IMF (International Monetary Fund). While WAJ

debt is a small portion of the debt, the run-up in debt beyond the official ceiling means places upwards pressure on the interest rates that banks are willing to bid.

To date WAJ has not had any difficulty selling public bonds in the Jordanian capital market. Interest rates on these bonds currently range from 4 percent to 7 percent, but this could change should circumstances weaken Jordan's economy. And, WAJ cannot go on rolling its debt beyond its servicing capacity indefinitely. At some point, as has happened the late 1990's, the Government will likely have pay down WAJ debt to manageable levels. The review team also understands from the Ministry of Finance that Government intends to drastically limit loan guarantees over the next few years until its fiscal situation and the global economy improves.

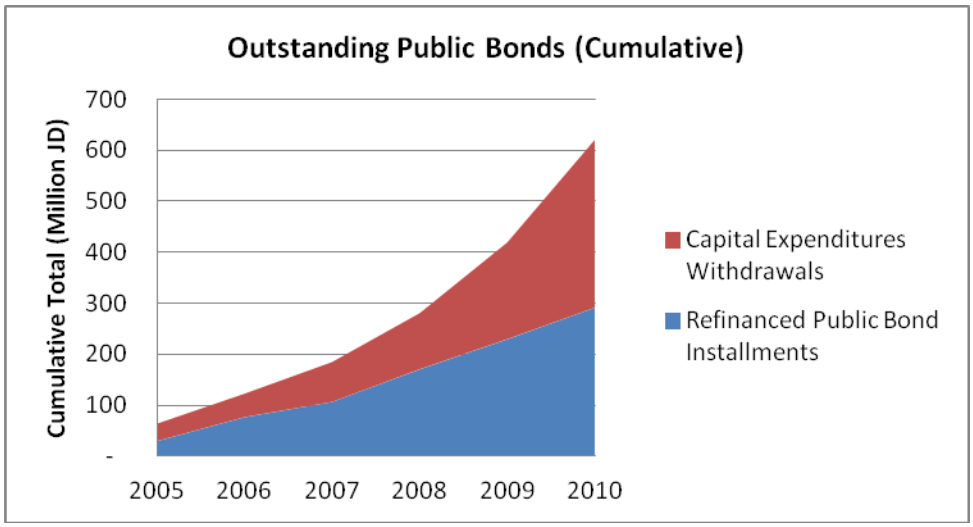


Figure 17. WAJ Total Public Bonds Outstanding by Use
Source: audited consolidated financial statements for WAJ and subsidiaries (2006 – 2010)

The Disi project, when it comes online in 2013, will also increase the financial burden on the water sector. The cost of water (expected to range between US$ 0.90 to US$1.05 per m^3 depending on the sale price indices contained in the BOT agreement) will significantly exceed the current costs of bulk water (around JD 0.30 - 0.35 per m^3). If the cost increase cannot be passed on to the customer, it will financially hurt either the utility companies or WAJ --- or require increased budget support from the Government.

Tariffs

The need to raise revenues in the sector has been obvious to all parties for many years. It appears that every Minister of Water and Irrigation over the past two decades has raised the issue. Project activities or CPs to raise or restructure the tariff have been part of multiple USAID initiatives over the years. Jordan should be able raise tariffs. Studies indicate that customers have the ability to pay. Household surveys have consistently indicated that water and sanitation costs makes up from about 1 percent to 1.5 percent of the household budget and those alternative sources such as trucked water (JD 4 /m3) cost much more than piped-water supply (See Figure 18).

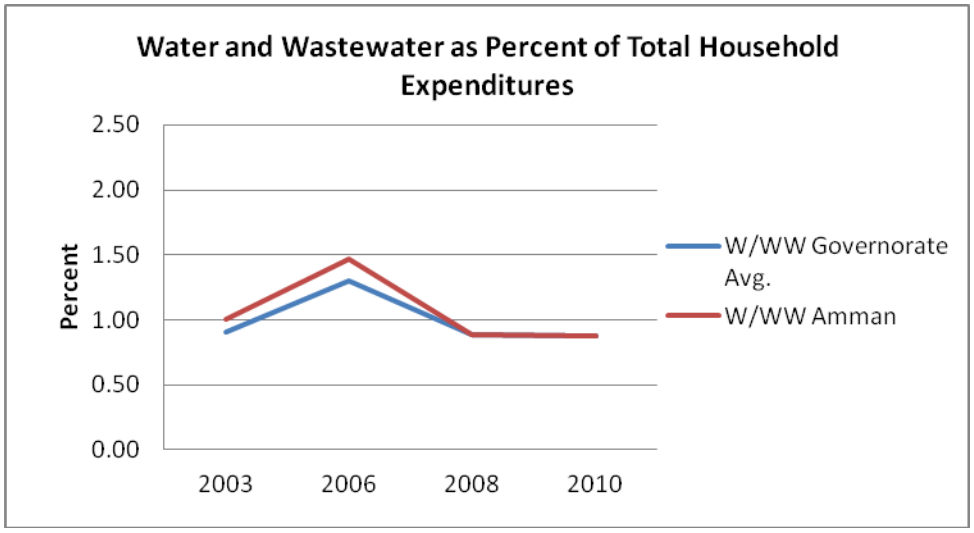


Figure 18. Water and Wastewater (W/WW) as percent of Total Household Expenditures
Source: http://www.dos.gov.jo/dos_home_e/main/index.htm (accessed 1/23/12)

Until 2011 tariff increases were very small. There were probably two reasons. First, operating revenues have in the past covered operating costs (See Figure 19). Second, WAJ was able to cover capital expenditures from donor contributions, Government capital injections and loans. Until electricity costs nearly doubled in 2011, sharply increasing operating costs, major tariff increases were avoidable.

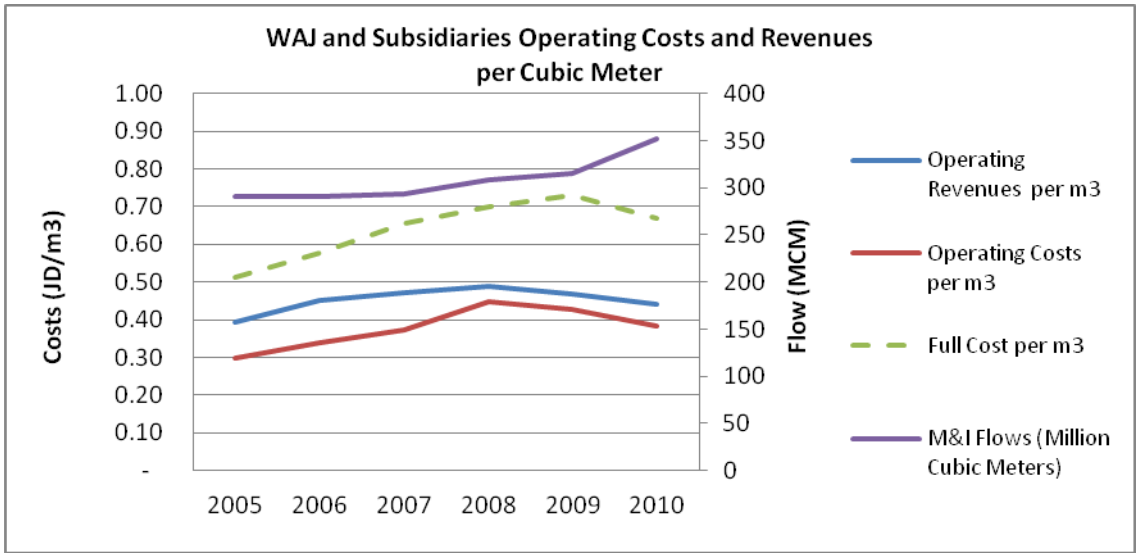


Figure 19. WAJ and Subsidiaries Operating Costs and Revenues and Full Cost of Supply
Source: audited consolidated financial statements for WAJ and subsidiaries (2006-2010) and M&I (Municipal and Industrial) flows, MWI and team analysis

As indicated in Figure 19 operating revenues covered operating costs during the 2005-2010 period, but generated very little "excess" cash to cover debt service or to contribute towards rehabilitating or constructing new infrastructure.

There are currently two tariff schemes in Jordan, one for Miyahuna and one for the rest of Jordan. Tariffs based on average sector cost policies will benefit some companies --like Aqaba which has a high industrial and large commercial demand -- and punish others that have primarily low volumetric use domestic demand. As corporatization is carried out, each water company will have a different set of costs and a different client base. The restructuring will require separate tariffs for each operating company, if Jordan is to level the management playing field for performance contracting and reduce the growing and projected gap between operating costs and revenues.

It does not appear that the current block tariff structure has worked as intended. Municipal and Industrial water use per capita is already low by international standards. And, consumption per capita has remained steady (See Figure 20) regardless of the volumetric block tariffs, dipping mainly in drought years. Also, wealthy users that do not use much water are subsidized in the low use blocks, while poorer households with large families that are billed in the high use blocks do not benefit from the intended subsidy. Higher fixed fees, assessed based on property-value or some other income measurement, could be used to ensure that at least those who can afford it pay full costs.

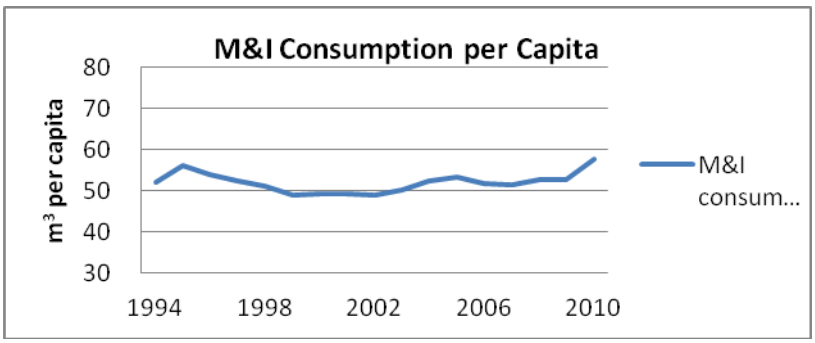


Figure 20. Annual Municipal and Industrial (M&I) Water Consumption per Capita
Source: MWI Water Budget 2009/2010

Taxes

Besides revenues from tariffs, the WAJ and the companies receive the collections from a sewerage tax, representing 3 percent of the assessed value of property, which is a good way to recover at least a portion of the capital costs when tariffs adjustments are as politically sensitive as they seem to be in Jordan. Taxes have the added benefit of removing some of the tariff subsidy from the wealthy - at least those with valuable property. However, Figure 21 shows that nominal sewerage tax receipts have remained relatively flat from 2008 to 2010 despite continuous real estate development and property revaluation in 2009.

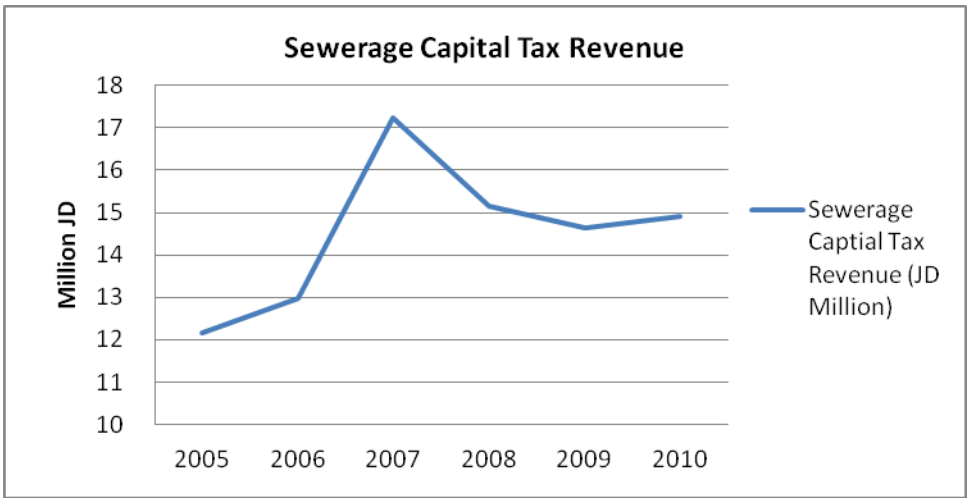


Figure 21. Sewerage Taxes in Nominal Revenue
Source: Sewerage tax from audited consolidated financial statements for WAJ and subsidiaries (2006 – 2010)

The real decline in sewerage tax revenue may indicate that tax collections have decreased or been redirected to other uses. Replacing or supplementing the sewerage tax with a fixed capital recovery charge on the bills of certain customers, possibly based on property values, could significantly increase revenues, considering the high collections ratio (Figure 22) for the sector

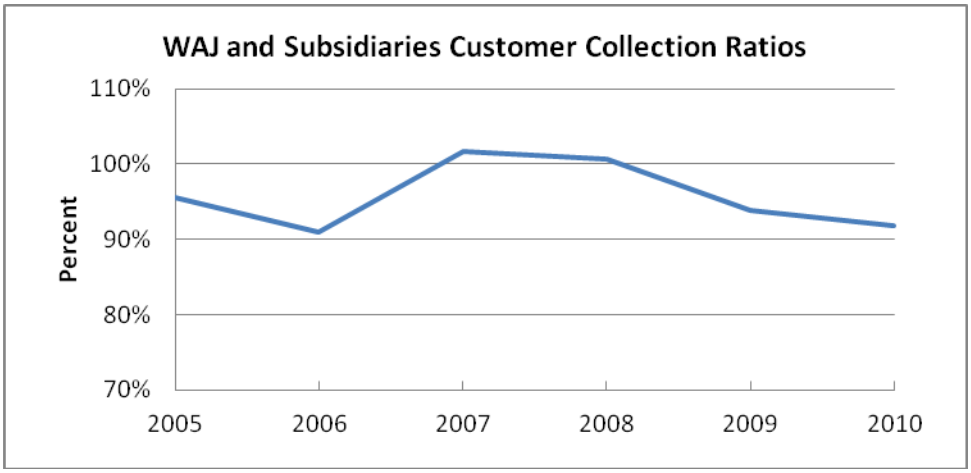


Figure 22. Combined WAJ and Subsidiaries Customer Collection Ratio.
Source: audited consolidated financial statements for WAJ and subsidiaries (2006 – 2010)

Subsidies

For purposes of this analysis, the government subsidy to the water sector is calculated as the difference between operating revenues and full cost recovery (including capital, interest and depreciation from the audited consolidated financial statements). It excludes any return on investment. For the last six years, the water subsidy has been approximately 0.4 percent of GDP (See Figure 23). This estimate is consistent with recent estimates prepared by the IMF. The subsidy is almost certainly understated, as not all loans for municipal infrastructure are on WAJ's books, but the team was unable to locate the supplementary data needed to make this calculation in the time available to it.

However, considering that water subsidy currently represents such a minor percent of GDP, especially as compared to electricity (~5.0 percent of GDP in 2010), the government does not appear overly concerned about reducing it, especially considering the political sensitivities around raising tariffs.

A larger percentage of the water subsidy goes to the richest segments of the population, according recent IMF studies. Removing the subsidy for the wealthier consumers, for example by introducing a capital recovery charge based on property values, could help the financial health of the sector significantly.

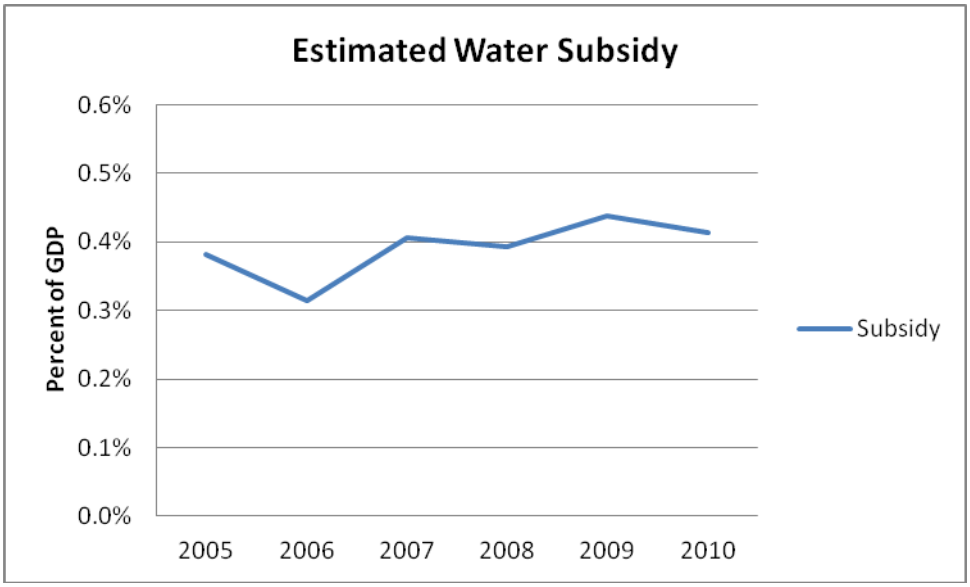


Figure 23. Estimated Water Subsidy (percent of GDP)
Source: audited consolidated financial statements for WAJ and subsidiaries (2006 – 2010), GDP – IMF estimate

Recommendation:

WAJ and the companies need to focus on increasing financial sustainability in the face of rapidly increasing energy and bulk water supply costs. Solutions are needed beyond the current dependence on volumetric tariffs. Considering that: 1) the Government needs to reduce total subsidies; 2) a large portion of the water subsidy benefits the wealthy; 3) there is an imminent increase in bulk water costs as the Disi project goes online; and, 4) there are substantial political difficulties in raising volumetric tariffs, USAID should support assistance to MWI/WAJ to design ways to raise revenue by other methods, such as a capital recovery charge based on property taxes. This is not a new idea; but budgetary pressures may make the timing right for its implementation.

NON-REVENUE WATER (NRW)

Tightly linked to the utility performance discussed above is the issue of Non-Revenue Water (NRW). NRW is water which is supplied by a water company but which is not paid for by the customer. The reasons for this are many and include, authorized non-metered use (e.g., firefighting), meter inaccuracies, illegal connections, and real leakage (often called technical losses). The NRW percentages for the three main water distribution companies are given in the Table 4 below. As can be seen, Aqaba Water Company currently has a low figure approaching the 20% level of many better-run water utilities worldwide, and has a target of 7% which is very close to global best practice level. Miyahuna and Yarmouk Water Company both have the potential to reduce NRW and increasing revenues. Total estimated average annual water losses to NRW for the three companies are on the order of 80 MCM/year. In a water- scarce country such as Jordan, where the marginal cost of new supplies is between $0.90 and $1.05 (Disi project and desalinated water), the economic benefit of reducing real losses should be of

correspondingly high value. The Miyahuna figures in the tables below include the "deep south" part of Miyahuna's service territory (rural areas outside of Amman) where NRW is estimated at 80-90 percent, or ~11 MCM/year. This service area geography deserves concentrated attention to generate savings.

Table 4. Non-Revenue Water Losses by Water Company

Company	Non-Revenue Water by Year (Percent)					
	2005	2006	2007	2008	2009	2010
Aqaba	29.92	27.24	28.38	23.57	23.3	20.68
Miyahuna	45.7	42.1	39.8	36.8	35.3	34.3
Yarmouk	-	42.9	39.0	43.5	40.8	-

Table 5. Estimated Annual Water Losses to NRW by Water Company

Company	**Estimated Annual Water Losses to NRW (MCM)**					
	2005	2006	2007	2008	2009	2010
Aqaba	-	-	-	-	4.9	4.5
Miyahuna	57.6	53.8	52.9	50.8	49.4	50.4
Yarmouk	-	29.6	26.5	30.0	27.7	-
Totals	**57.6**	**83.5**	**79.5**	**80.8**	**82.1**	**55.0**

Sources: Aqaba Water Annual Report 2010, Amman Non-Revenue Water Reduction Program - Pilot Project Report (Amended) November 2011, Management Contract for Yarmouk Water Company

The water companies claim that 50 percent of NRW is due to technical losses (i.e. real leakage). Assuming that this estimate is correct, and considering Yarmouk and Miyahuna only, then on the basis of the current water production this would mean leakage is currently on the order of 39 MCM/yr. It should be technically feasible and economically viable to adopt the objective of reducing leakages by half, leading to physical water savings of 19.5 MCM/yr, and the accompanying increase in revenues through metered sales.

In the case of both Yarmouk and Miyahuna, the water supply is currently intermittent. In Miyahuna the number of hours of water supply per week available to each area has reduced over the last 5 years from 66 in 2005 to 36 in 2010. Intermittent supply has a number of negative impacts including damage to the network, increased probability of meters under reading because of air entrainment, increased NRW due to high pressure while mains are live, and public health risk.

A pilot NRW reduction program carried out on three areas in Amman in 2009/10 uncovered a litany of issues on the water supply network, which it is reasonable to assume are replicated throughout the Amman network. The pilot study was undertaken by three contractors with input and assistance from Miyahuna and funding from USAID. The study provided a variety of approaches to NRW reduction that would improve supply at costs much lower than the Disi supply or through desalination. A program to develop and deliver NRW reduction to the point where marginal benefits are equal to marginal costs should be a cost effective way for Miyahuna to increase water supply and revenue.

Recommendations:

As outlined above, it is recommended that an NRW reduction program should be developed for Miyahuna. Considering the relatively poor performance of the Yarmouk Water Company in relation to NRW, consideration should also be given to developing a similar program for Yarmouk. Projects should introduce targets into the management contracts with payment based on performance. In both cases

(Miyahuna and Yarmouk) it is essential that the skills of NRW detection and reduction are transferred to the local utility, and that NRW reduction is institutionalized in each of them. Both institutions should be encouraged to establish permanent NRW reduction teams. Given the low NRW level in the Aqaba Water Company network, it is advisable to consult AWC in the design of the program and perhaps to build some type of technical assistance exchange program between AWC and the other two utilities, as well.

HIGHLANDS GROUNDWATER AND AGRICULTURE

The Over-Abstraction Rate is High and Much of the Agricultural Use is of Low Productivity

Groundwater over-abstraction far beyond natural recharge rates is being done for municipal water supply by WAJ and for agricultural production by a large numbers of farmers. The practice poses a well-acknowledged threat to a vital resource in water scarce Jordan. Groundwater is being over-extracted in 10 of 12 of Jordan's major groundwater basins. Long-term average decline is about 1 meter a year, according to USGS analysis of the MWI's Groundwater Monitoring Unit that was established with the assistance of USAID. The two basins that are not being over-extracted are too distant from infrastructure to be economically developed at this time.

The high rates of over-abstraction, reaching 215 percent in the Azraq Basin, impelled the government to develop a new groundwater strategy in the late 1990s. It put in place pricing policies to try to bring extraction rates in line with annual recharge by 2005, a daunting and unachieved task (Venot et al 2007). The policy also sought to induce a shift by farmers to higher value crops to try to use the water more productively. The Groundwater Control By-Law No. 85 was passed in 2002 and amended in 2004. It established a quota of 150,000 m^3 per year for each well, with block rate tariffs for amounts beyond this level. Illegal wells were supposed to be shut down, but the 2004 amendment permitted the registration of these wells in order to include them in the MWI monitoring program. The current policy is to reduce extraction to the natural recharge rate by 2020, substituting new non-renewable fossil water, small increments of surface capture through dams and rainwater harvesting, and brackish and seawater desalination.

Direct effects of exceeding the renewable rate of extraction are: increased pumping costs, increased well re-development costs to maintain flow rates, increasing groundwater salinity and salinity of base flows in some basins, decreased base flows to side wadis, and reduced or halted spring flows in many locations. In several basins excess extraction is leading to increasing salinization of base flows towards the Jordan Valley.

According to the then Minister of MWI at the time of the passing of the by-law, parliamentary leaders agreed to pass the original by-law only if written support could be obtained from farmer groups throughout the Highlands (El Naser personal communication). This support was obtained following a major and personalized communication campaign to present the state of water scarcity, the impact of over-extraction on the costs of farming and the declining quality of water, the effect on drinking water supply availability, quality, and costs for town and city dwellers, and the impact on natural springs and wadi flows that are important for humans and livestock.

The 2004 by-law amendment provided for revision of the block rate tariffs in three years in 2008. However, rates were not revised and have remained the same since 2002. According to the analysis done by the 2030 Water Resources Group (2011), the average amount paid by farmers for highlands water from all sources is about JD 0.02, representing an approximate subsidy of JD 0.13 over what they term the true cost of bulk supply of JD 0.15. The analysis also indicates that low-productivity olive trees are the largest concentrated users of water and that they destroy value as measured by the value added per m^3

of irrigation water applied. Scenarios that cap current agricultural use of water in the Highlands and increase tariffs to shift crop production away from olives and fruit trees to higher value vegetables are recommended by the as a way to improve to improve the economic value of current water use.

The 2030 WRG scenario simulations attempt to keep cultivated areas constant while only slightly reducing agricultural employment. Technical improvements are advocated to improve irrigation water use efficiencies to increase the return per unit of water. These scenarios are useful in stimulating further analysis by the government agencies and the private sector, but should be interpreted with care. They fail to incorporate market risks in much the same way that their analyses in the Jordan Valley have failed to examine the market price effects of concentration of cropping patterns on vegetables. These scenarios also fail to incorporate the limitations in crop choice that are driven by water availability and in some cases deteriorating water quality (e.g., salinity). Total profit (including land value, return on labor, etc.) is the key driver in crop selection by private farmers -- within the limits imposed by climate, soils, and water availability -- not water productivity rates.

The Political Economy of Groundwater

The political economy of highlands groundwater over-abstraction is absent from the many good technical and economic analyses that have been performed of the water sector. Yet, the political strength of wealthy individuals and of tribes in Jordan was regularly cited in reports and in our interviews as the reason for low enforcement of existing laws, resistance to tariff review, and the slow overall progress in reducing the rate of groundwater extraction.

It is typical of all water users to advance the position that they have “first-in, first use” rights to water. And, Highlands water users have developed operations that provide livelihoods with less investment support from the public sector than has taken place in the Jordan Valley since the 1960s. Further, it appears that use of water to enhance the speculative value of land, especially through the planting of olive trees, is a complicating factor in the analysis.

Anecdotal reports suggest that when land is planted with olives and supplied with water that its real estate value can increase 6 to 10 times. Since useable land in Jordan is limited, and because waves of immigration tend to push up land values, agricultural development of land may also be an important speculative land development play. Water creates this land value. There is a persistent belief in the Highlands that sustained development and use of land for 15 years confers ownership rights, including the right to alienate the developed property for sale.

While our legal research is not complete, and conflicting claims are difficult to confirm or refute, there seems to be a clear distinction in the law between authorized land development and the acquisition of rights to purchase land, as follows:

- Law 17 of 1974: The Law for Management of Treasury (State) Land. This law requires that individuals make application to develop land, obtain authorization, and productively develop and use the land for 15 years. After 15 years the individual may make an application and receive authorization to purchase the land from the State.
- An as yet unidentified law of the 1950s that is reported to regulate what is termed “Compromisable (Alienable) Land” that is outside of Treasury jurisdiction. This law is reported to require prior application to the Department of Land and Survey for rights to develop and use the land, with a similar requirement for continuous productive use

The team cannot claim to have done in-depth analysis of the political economy of Highlands’ agricultural water use, but it did talk to leaders in Parliament and the National Farmers Union, current and former Ministers, water users, and environmental NGOs. There is clear understanding at the leadership level that over-abstraction will lead to: reduced profits from steadily increasing pumping costs as water levels drop

and productivity suppression as water quality deteriorates; competition between agriculture and municipal uses that will increase public policy pressure to increase allocation of groundwater to municipal use to reduce the cost of bulk water supply; and, over-abstraction over time that is self-terminating because the aquifer is exhausted. There appears to be understanding that acting now may enable the agricultural water user in the Highlands to get a better deal now than may be available in 5 to 10 years time. However, despite the good progress supported by USAID in the development and integration of water conservation and efficient use curriculum in the K-12 environment, these leaders believe that many of the Highlands producers do not yet understand the gravity of the over-extraction situation. Advocacy programs targeting schools may not have spillover effect to the heads of households who are the key decision makers and who have the greater voice politically.

The review team was urged to consider more intensive, person-to-person or person-to-group physical communication to raise the awareness of the importance of the resources and livelihoods that are at stake and to identify market, technology, administrative, and political solutions to the problem. The Chairman of the Parliamentary Committee on Agriculture and Water sees the main problem as crop productivity and competitiveness of the Highlands agriculture. The Chairman of the Farmers Union sees the top three problems facing Highlands' growers to be: variable demand from markets; reduced water supply and quality; and increasing water extraction costs. Both leaders see the need for progressive enforcement of the Groundwater Control Bylaw in high over-extraction situations. The Highlands Water Forum is seen as a helpful structure to building consensus. USAID has made a valuable contribution by its support to the development of the Groundwater By-Law that established a tariff for groundwater extraction, improved the well registry, set-up a groundwater monitoring program, and built a groundwater monitoring unit within the MWI.

Recommendation: Design and Pilot a Highlands Strategic Groundwater Reserve Program

The objective would be to lay out a roadmap of communication, technical, administrative, and financial steps to reduce extraction rates by:

- Designing a communications program and lobbying effort with registered and unregistered well users to raise their awareness of over-extraction issues and strategies and to design a realistic, time-phased effort to reduce extraction rates, improve energy efficiency to maintain profitability, and increase revenues from adjustment of extraction tariffs;
- Sorting properties by their economic performance (WAJ WDM unit, Highlands Water Forum, IDARA, and Utah State University studies);
- Designating zero- or negative-return properties where wells would be closed against compensation for land value or water rights. USAID might design and seed fund for alternate uses financing for land or straight single payment or Trust Fund for water rights, if a water rights market can be established;
- Designating profitable properties for fund investments where water efficiency and agricultural productivity (higher tech) would be used to achieve slower extraction over time. Providing seed capital for loans or loan guarantees to structure crop conversion and production intensification (e.g., high density tree production, plastic greenhouses, semi-hydroponic controlled atmosphere greenhouses at the high end);
- Progressive increases in extraction surcharges and suppression of illegal and abusive extraction as a Condition Precedent for cash transfer.

JORDAN VALLEY AGRICULTURE

Water is Life and Livelihoods

There is a common misperception that there are substantial quantities of fresh water than can be diverted from use in agriculture in the Jordan to municipal use in the highlands. Agriculture in the North and Middle Jordan Valley has used progressively less fresh water over the past 16 years. The review team discuss below why the quantity and quality of fresh water, the apparent increase in salinity of reclaimed water, and the potential for large-scale socioeconomic dislocation all limit the likelihood that major re-allocations from agriculture in the Jordan Valley should be adopted as a policy objective of donors unless and until Jordan Valley agriculture becomes totally non-competitive on produce markets.

As mentioned above and detailed in Annex 3, supply to the JVA of fresh water has declined because of the reduced stream flows in the Yarmouk River and side wadis and reduced rainfall in the Jordan River watershed. Fresh water use in the Jordan Valley irrigation perimeters has declined because of the pumping of surface flows to the Zai treatment plant and subsequent delivery to Amman's municipal water supply. Expansion and upgrading of the As Samra WWTP with USAID assistance has created a stream of reclaimed water that flows to the King Talal Dam for storage and some mixing before it is released back to the valley. Reclaimed waste water flows that now reach 56 percent of total water deliveries to the Northern and Middle Jordan Valley have enabled famers to replace some of their water needs. Flows of treated effluent from As Samra should increase significantly within five years when the MCC program in Zarqa is completed.

The water balance in the Jordan Valley leads to continuing salinization of agricultural land. High efficiency, localized irrigation systems reduce water use, but concentrate salts in and around the roots of the crops. Reduced upstream flows are increasing in salinity because of upstream salt loading, increases in salinity of base flows into wadis and springs, and the increase in the salinity of reclaimed waste water flows from Amman. These salts end up in the Valley soils and need to be leached regularly because they threaten crop production and yields. Leaching occurs through rainfall (but not on land that is covered with plastic greenhouses and tunnels during the fall and winter rains) and when high rainfall and flood flows through the King Abdullah Canal permit higher doses of fresh irrigation water to be applied to move salts down through the soil beyond the rooting zone and eventually to drains (although this has the knock-on effect of increasing the salt loading of the Jordan River).

The cropping mix of the Jordan Valley has been shifting for three decades as increasing salinity levels and reduced fresh water flows have progressively reduced the area that can sustain salt-sensitive citrus in the middle reach of the Valley. The banning of summer crop production to provide fresh water flows for drinking water in Amman also complicates land management. Only small areas can be rotated with warm and hot season plants that would reduce pest and disease loads in the following seasons and improve soil organic matter. Farmers have had to make investments in individual on-farm holding tanks to enable them to blend lower and higher (generally reclaimed) salinity water to grow vegetable and fruit crops in the fall, winter, and spring months. The on-farm reservoir investments are combined with small diesel or electric pressurization pumps, filters, and fertilizer injectors to permit the use of high efficiency micro-irrigation equipment. These investments are often funded through supplier's credit and some loans from the ACC (Agricultural Credit Corporation).

Modeling work from a sample of famers in the central part of the Jordan Valley has been done recently (Al Naber 2010) to examine changes that would occur under reduction of water supply in a zone with constant acceptable water quality, no danger of frost (as is the case in the Northern Valley) and an increase in water tariffs. The simulation shows that water productivity measured as JD/m^3 would only

decrease less than 5 % even as water tariffs were increased to 5 times their current levels (Table 6 and Figure 24), because the current very low irrigation water tariffs represent a small part of production costs.

Table 6. Water tariffs by water quantity allocated. (Source: Al Naber et al, 2010.)

Water Tariff	Level (JD/m^3)	Water Quantity (m^3/ha/month)
W1	0.008	0-714
W2	0.015	715-1,000
W3	0.020	1,001-1,280
W4	0.035	>1,280

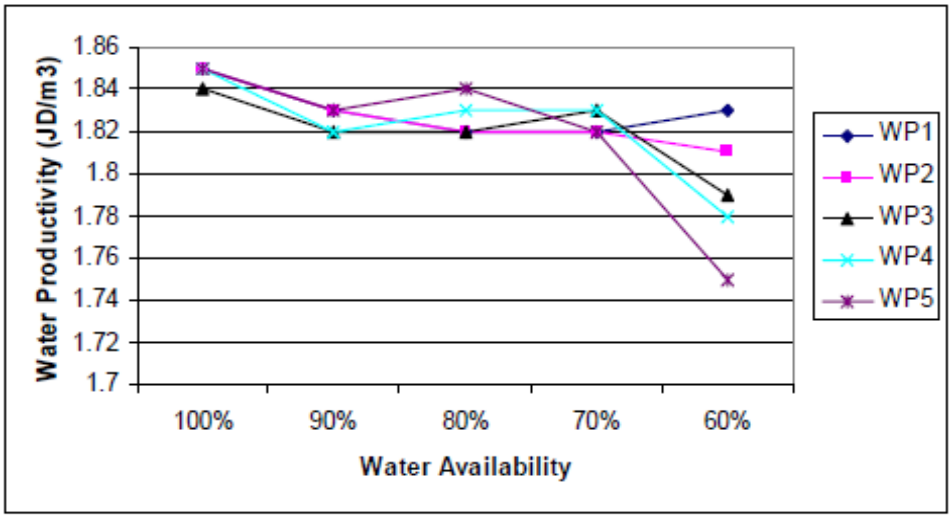


Figure 24. Changes in water productivity in JD/m^3 as water allocations decline and water prices increase (Source: El Naber et al, 2010)

However, the simulation also shows that profits per dunum would decrease by 30 percent as water allocations are reduced by 60% (Figure 25). Reduction in total profit per dunum is likely to mean that framers would confront reduced cash flow, decreasing their ability to repay current loans and refinance the succeeding crop, reducing their demand for inputs, maintenance, and labor, and increasing their exposure to risk from current input and market price volatility.

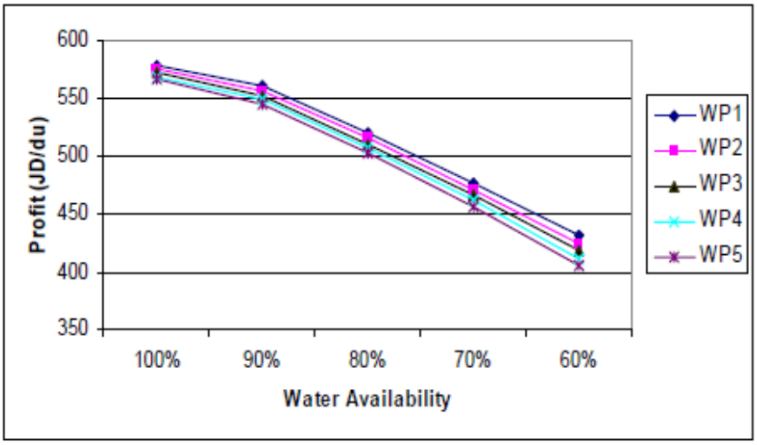


Figure 25. Estimated reduction in total profit with decrease in water allocations (Source: El Naber et al, 2010)

The combined effects of reduction in water allocations and increases in water tariffs in this simulation lead to a reduction in surface area in the central Jordan Valley of about 50 percent (Figure 26). Water availability rather than current or increased water tariffs is the primary limiting factor to agricultural production in the Jordan Valley.

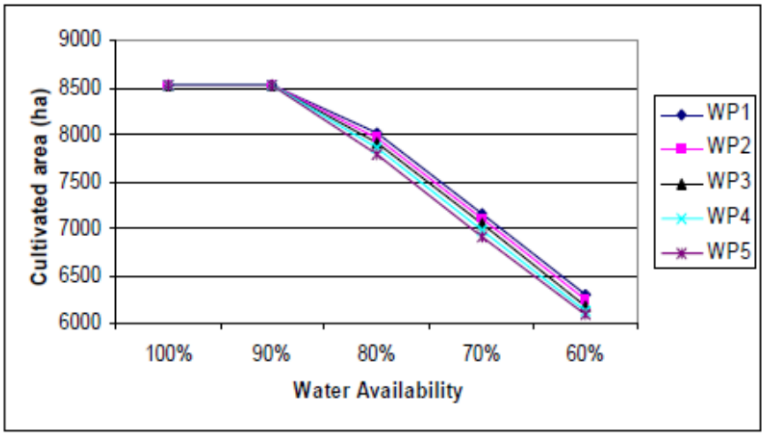


Figure 26. Estimated reduction in central Jordan Valley surface area with decreased water allocations and increased water prices. (Source: El Naber et al, 2010)

Using these models, the team attempted to estimate the effects on employment in the Jordan Valley of a large decrease in fresh water allocation to agriculture that would cause a large reduction in the surface area farmed. The team made a rough estimate of the number of workers in the agricultural value chains, both upstream and downstream of production. While the team was unable to get a precise number of the population living in the Jordan Valley, estimates ranged from 500,000 to 600,000. The rural population in the three concerned governorates north of the Dead Sea is about 342,000 (Department of Statistics, http://www.dos.gov.jo/dos_home_a/main/index.htm). In addition, the team's visit to the valley suggests that much of the population in Jordan Valley towns is tightly linked to pre-production and post-harvest

goods and service delivery. Using the figure of 2 FTE (Full-Time Equivalent) jobs per household of 6 people, the full reallocation of fresh water to municipal use would require about 83,300 new jobs to be created.

The MOPIC estimate of the investment cost of creating a new sustainable job (1,000 days of employment) in the private sector in Jordan ranges from JD 40,000-JD 50,000 ($60,000-$75,000). If the central Jordan Valley agriculture were shut down to free up municipal water supplies, the investment costs to create new jobs would be 3.33 Billion JD to 4.2 Billion JD, exclusive of retraining programs. Losing jobs in the Jordan Valley would be very likely to translate to increased internal migration to Amman, Irbid, and Highland secondary cities, increasing demand for basic infrastructure and social services. While there is an important element of foreign migratory labor in the Jordan Valley, with two WUA's visited stating that about 50 percent of the labor in their zone was "foreign", the settlement patterns and migratory patterns are difficult to interpret (Van Aken, 2005), and, for GDP purposes the national origin of labor is irrelevant. The team believes that a 50 percent reduction in water allocation to the Valley would lead to reduction in self and direct employment of more than the 41,650 jobs. Creating new jobs to replace economic activity would require 1.7 billion JD to 2.2 billion JD. Failing to create new jobs and putting more people onto social welfare rolls is doubly unattractive, creating a new burden on state finances and reducing the seasonal employment in greenhouses and packing houses for youth and women. The cost of further

The water allocation simulation discussed above assumes that the quantity of water delivered is matched to full crop water needs, i.e., that the water quality in terms of salinity is constant throughout the cropping season, and that the average water quality available doesn't restrict crop selection. If the effect of reductions in water availability reduces farmer ability to leach salts from soils, it would drive the Valley's cropping pattern to a narrower range of more drought and salt tolerant crops, eliminating higher value crops that are currently exported or bring high prices on domestic markets. This concentration of production against a smaller range of crops would reduce the attractiveness of the Valley for continued investment by agribusinesses that currently contract for export and domestic production.

Jordan Valley water allocations depend upon the combination of fresh water flows (variable) and reclaimed waste water flows (higher in the winter than the fall, spring, and summer). Fresh water deliveries for blending with increasingly saline reclaimed wastewater depend upon dam releases, rainfall, and Yarmouk River flows that are increasingly variable. The performance of Jordan Valley Authority infrastructure, especially its ability to maintain good pressure at the main system, varies substantially by zone because of original engineering design assumptions about overall water availability that are no longer valid and because of the deterioration of conveyance infrastructure. In addition, pumping costs for the JVA have increased because of the climb in electricity prices. On-farm pumping costs have also increased for the same reason.

Local market prices are greatly affected by supply concentration, as evidenced by recent protests by farmers over tomato price declines. Export market prices in a recessionary environment in the major EU and Eastern European markets are showing substantial downward pressure. Impact from further major reallocation of existing freshwater flows from the Valley to the Highlands is likely to come at a high economic and social cost.

Two potential points of entry should be considered:

- To set seasonal fresh water allocations and water prices at levels that will maintain per dunum farm profitably to avoid substantial reduction in cropped surface area. It appears that water tariffs could be increased by up to 4 times their current levels as long as current water allocations are maintained.

- Identify the source of the 15 percent conveyance losses quoted by the JVA leadership and design ways to reduce these losses in order to better supply fresh water to valley water users. A corollary investment could be examination of the potential of medium-term 5-10 year development of a fresh water piped conveyance from the North end of the valley above the King Abdullah Canal. This could reduce conveyance losses, reduce the energy needed to pressurize water for delivery to farmers, and reduce the energy needed to pump fresh water up the slope to the Amman municipal supply.

Recommendation:

Current fresh water allocations need to be retained until the effects of flows on the quality of reclaimed water flows to the Valley can be evaluated. USAID may want to consider a relatively small investment to re-activate the JVA sensors used to track flows and water quality in the main and secondary distribution circuits. Reactivated sensors would permit the JVA to capitalize on investments already made in real time management information systems that are cut off from real time data by sensor breakdown and improve the supply of data to the Jordan Water Management Plan's MIS.

WATER QUALITY, ENVIRONMENT AND HEALTH

Surface Water Quality and Industrial Pollution

Jordan's water scarcity issues stem not only from the limited available quantities, but also are becoming increasingly linked to water quality issues. Both are having an impact on Jordan's natural waterways, aquifers and ecosystem health. Industrial pollution from the Zarqa basin in particular, continues to pollute the Zarqa River, the Amman-Zarqa aquifer and eventually downstream the Jordan Valley and Lower Jordan River. Upstream diversions along the Yarmouk have reduced stream flow to 10 percent of the mid-1990s level with associated declines in water quality. The Lower Jordan River flows are predominately sewage effluent and saline springs with some brackish base flow. Salinity levels are on the order of 3,000 – 5,000 ppm (Farber et al, 2005). In short, Jordan's surface water supplies are declining in terms of both quantity and quality.

Given the scarcity issue, it is not surprising that discussions at ministerial levels during the assessment centered on the need to increase supply and expand treatment of sewage effluent so that wastewater could be recycled, effectively adding supply to the water balance. Conventional wastewater treatment options have effectively reduced microbiological contamination of sewage effluent (Table 8) making wastewater reuse more acceptable; however, conventional treatment does not remove salts. Since the 1970s, TDS (salt) levels in the Amman-Zarqa basin have been increasing and effluent at the As-Samra plant are as high as 1,165 ppm TDS (Total Dissolved Solids). The increase in salinity is due primarily to industrial plants that use reverse osmosis and dump brine into the sewer system or natural drainage networks (Jaar, 2009). This topic appears to be one of serious proportions for the continued use of wastewater in the Jordan Valley, and yet discussions at all levels of government and even with projects focusing on industrial pollution did not touch on the salinity issue. Although there is no cheap solution to this problem, further investigation would be merited to determine effective measures that could moderate this problem.

Table 8. Average 5-day BOD (Biological Oxygen Demand) Levels at As-Samra Treatment Plant. Source: Personal communication from Mr. Hassan Abdullah of the As-Samra BOT (Build Operate and Transfer) Company

Pre-Improvements Inlet (mg/l)	Pre-Improvements Outlet (mg/l)	Post-Improvements Inlet (mg/l)	Post-Improvements Outlet (mg/l)
634	130	701	8

Industrial Pollution – Salinity

The wastewater effluent from the As Samra plant has a significant level of Total Dissolved Solids (TDS). Reported levels are in the order of 1,165 mg/l (Jaar, 2009). This has an impact on the TDS levels in the King Talal Reservoir, and therefore on the releases to the Jordan Valley. Since there is limited freshwater available to dilute the effluent because of low flows from the Yarmouk River and Lake Tiberias, this high salinity water enters the Jordan Valley irrigation systems before release for irrigation, leading to lower crop yield and land degradation, and forcing farmers to switch to more salt-tolerant crops.

Our discussions with the Ministry of Environment and MWI indicate that the TDS originates from industrial discharges into the sewer network, predominantly in the Zarqa area. The potable water delivered to Amman has a TDS in the order of 500 mg/l. The treatment process at As-Samra has little or no impact on TDS (i.e., salts in = salts out). Since the TDS does not appear to derive from the domestic discharge, it must derive from industrial flows. As the proportion of industrial flows are believed to be small, on a simple mass balance assessment there must be some very high strength wastes being discharged to sewer. Our discussions suggest that trade effluent control is limited and ineffective, and polluters have little or no incentive to limit their waste streams. Anecdotally, the review team was told that some industries pre-treat and discharge directly to the Zarqa River, also exacerbating the salinity issue in the downstream reservoir.

The review team held discussions with the USAID Water Reuse and Environmental Conservation (WREC) team. They have a wide remit to assist Jordan to deal with industrial discharge issues (solid and liquid waste). One of their initiatives is to develop an industrial wastewater treatment plant near Zarqa (30km east), connected to the Zarqa industrial zone by a dedicated industrial wastewater sewer, and to treat combined wastewater flows there. They anticipate developing a plant with a treatment capacity of 5,000 m^3/day, but they are not yet certain whether the treatment process will include TDS reduction (desalination) and if it does what the disposal route for the brine produced as a waste stream will be. The development of the treatment plant will be combined with coordination with the major dischargers to sewer to attempt to persuade industry to pre-treat wastes, and to adopt re-use, recycling or waste reduction strategies as a means of limiting the quantity and improving the quality of any discharges to sewer.

The review team has a concern that the WREC project does not recognize salinity as a key issue. The focus of the project is on industrial wastewater control, but not necessarily on dealing with the salinity issue. There are some key large industries (e.g., power generation plant, oil refinery, food industries) which were identified in the RIAL project as significant contributors of salinity either to sewer, or directly to the environment, but once again the salinity of these industries' waste effluents does not appear to be a target of the WREC project.

Recommendation:

Incorporate salinity reduction into current and future industrial wastewater treatment programs. The long-term costs to the Jordanian economy of avoiding this issue are likely to be tremendous, whether the undiluted waste water is used in agriculture or industry. USAID is well placed to address this issue given its WREC project.

Drinking Water Quality and Health

Despite the environmental pollution issues, municipal water supplies are being effectively treated and water quality at the household level is within compliance levels. In 2010 for example, 99.96 percent of water samples by the MWI Performance Management Unit were within international World Health Organization drinking water guidelines for microbiological water quality. Despite the reported high quality municipal water, due to non-continuous supply many residents in urban centers routinely rely upon tanker truck water which comes from untreated groundwater wells to meet bulk needs and drinking water is typically purchased from small-scale reverse osmosis operators. The risk of contamination within the tanker truck and in household water storage tanks is high and water quality monitoring of the small RO plants is not strictly regulated. This questionable water quality is likely one factor in the finding that water-borne disease has been found to be the cause of 47 child deaths per year, or about 1 percent of total child deaths (Cervigni and Naber, 2010). Nevertheless, according to the WHO in 2004, the diarrheal disease burden in Jordan as measured in DALYs (Disability Adjusted Life Years) of 282 per 100,000 was on par with other regional countries such as Lebanon (257) and Oman (226) and much better than others such as Yemen (1,545) and Iraq (2,121).

Environmental Services

Absolute scarcity issues for municipal and agricultural use seem to have placed the issue of water availability for environmental services at the bottom of the priority list. The National Water Master Plan only considers water for municipal (residential, commercial and industry) and agricultural use. In the review team's discussions at the ministerial levels, this issue was not considered to be one of major importance given the larger municipal and industrial water supply issues at stake. There are a few civil society groups and the Royal Society for the Conservation of Nature (RSCN) that are trying to bring the issue of environmental services to the attention of the public and the government. The RSCN is responsible for the management and oversight of several national reserves (Azraq Wetland Reserve, Dana Biosphere Reserve, etc.) and is trying to find ways for local communities to gain economic benefit from protection of the natural areas and the water resources that sustain them. Nevertheless, water for environmental services is not a priority issue for the Government of Jordan at this time.

LARGE INFRASTRUCTURE PROJECTS

USAID Projects – Completed or Underway

USAID has supported the water sector in Jordan on a number of large projects listed in Table 10.

Table 10. Summary of USAID Large Infrastructure Projects since 2000

Project	**Brief Description**	**USAID Total Contribution $370 million**
Zara Ma'in water treatment plant (desalination) and conveyance	Water treatment plant to desalinate brackish groundwater and convey to Amman. Capacity 47mcm/yr.	$121 million
Amman water network restructuring and rehabilitation	Improvements to Amman water supply system to improve control and efficiency, reduce technical losses, and move towards 24/7 supply.	$65 million
Aqaba water network improvements	Improvements to Aqaba water supply system to reduce technical losses and improve quality – mainly replacement of GI pipes with plastic pipes.	$20 million

As Samra wastewater treatment plant	Wastewater treatment plant to treat 100 mcm/yr to effluent quality of re-use standard.	$78 million
Aqaba wastewater treatment plant	Wastewater treatment plant to treat 4 mcm/yr to effluent quality of re-use standard.	$38 million
Wadi Mousa wastewater treatment plant	Wastewater treatment plant to treat 0.6 mcm/yr to effluent quality of re-use standard.	$28 million
Mafraq wastewater treatment plant	Wastewater treatment plant to treat 2 mcm/yr to effluent quality of re-use standard.	$20 million

Feedback on all of these projects from all of the institutions and organizations that the review team met during the assessment were unequivocally positive. It is hard to imagine where the water sector in Jordan would be without these key assets, which not only add important infrastructure for the benefit of the sector, but also demonstrate that appropriate international performance standards are attainable. The recent Operations and Maintenance Training Project's wastewater facility survey in December 2011 confirmed that all USAID wastewater facilities had adequate operations and maintenance programs (USAID/OMT). The importance of this aspect of USAID's involvement from the perspective of the institutions met and talked to would be difficult to overstate.

Wastewater Treatment Plants

USAID has provided support and funding for a number of wastewater treatment plants in Jordan over the last 10 years and they deserve special mention here. These have comprised one major project (As Samra), a number of smaller ones (Aqaba, Wadi Mousa, Mafraq) and two small wastewater treatment plants to receive septic tank wastes from numerous small communities.

The As Samra, Wadi Mousa and Aqaba projects are clearly recognized as successful projects that are performing as intended. Mafraq is at the early stages and cannot be judged yet. The two small wastewater projects have been assessed as unsuccessful for a number of reasons primarily based on construction and operating costs (see report "An Assessment of the Effectiveness of USAID Assistance Provided to Jordan's Water Sector over the Past 10 Years – Draft report – May 2011).

The review team believes that the medium size wastewater treatment plants present a good opportunity for USAID's funding over the next 5 years. Our view of the attractiveness of these projects is based on:

- Established need – there are many small to medium communities where current facilities are non-existent or under capacity;
- Multiple benefits – environmental protection, public health, and treated water can be used to reduce demand for scarce groundwater;
- USAID's established track record in project implementation;
- Size of project – project costs are more consistent with the smaller USAID's forecast funding levels for the next 5 years;

The review team understands that some wastewater projects in Jordan have suffered in circumstances where the works were developed without an adequate collection system to deliver sewage to the plant, or where no end use envisaged for the treated effluent.

Recommendation

USAID should continue to undertake wastewater projects and ensure that projects, current and future, incorporate collection and re-use issues as an explicit part of their scope.

Future Mega-Projects

The Government of Jordan and MWI believe that the solution to the water supply conundrum for Jordan is a Red Sea–Dead Sea link combined with desalination. The regional project as proposed would arrest the decline in the Dead Sea level and provide up to 310 MCM/yr of drinking water for Jordan. There is the potential for a further 170 MCM/yr to be shared between Jordan, Israel and Palestine. The most recent World Bank feasibility study (funded in part by USAID) gives indicative costs of $10 - $11 billion capital costs and initial operating costs of $370m/yr. On a parallel track, Jordan has invited tenders for the Jordan Red Sea Project (JRSP). Jordan is viewing the JRSP as Phase 1 of the larger regional project. It is anticipated that the master developers who are bidding on the project will be funded by the gain in real estate and other secondary values derived from the project. Tenders were opened in mid-February 2012 and preliminary negotiations with the leading bidder are expected to be completed by late 2012. Until the completion of those negotiations, any other desalination projects are likely to be of little interest to the Government of Jordan.

Recommendations

USAID has a strong track record in Jordan's infrastructure sector, especially in wastewater treatment for agricultural water use. It is recommended that USAID build upon that record as the need for increased wastewater treatment capacity still exists and USAID is well suited for such endeavors. Future infrastructure projects could provide support to the expansion and development of medium sized wastewater treatment plants in Jordan. Site selection can be based upon the assessment of the following:

- Existing wastewater collection system (i.e., is a collection system in place or would one have to be constructed?)
- Is there a valuable end use for the effluent within a reasonable distance of the facility?
- Would the project reduce groundwater use as a consequence of the availability of high quality effluent?
- Cost/benefit of the project;
- Population benefitting from the project;
- Environmental impact – priority should be given to projects having the maximum impact on reduction of untreated wastewater being discharged to the environment.

COMMUNITY-BASED INITIATIVES

The one project that was reviewed by the assessment team in the rural and peri-urban water sector was USAID's Community Based Initiatives for Water Demand Management (CBI). The CBI model of providing seed capital for revolving funds in selected community based organizations (CBOs) that are active in the field of water demand management seems to be a very successful one. This project has been able to reach households and communities located in the secondary cities and smaller towns of Jordan that may not typically be reached by the larger infrastructure projects funded by USAID. Micro-loans provided by the CBOs were used for a variety of projects (e.g., rainwater harvesting systems, drip irrigation systems, residential maintenance monitoring equipment), and there are still long waiting lists for households who would like to benefit from the micro-loans.

As for the gender aspects, water projects typically provide multiple benefits to the water manager at the household level, predominantly women in the case of Jordan. Intermediate benefits of the larger infrastructure projects accrue to the contractors and engineers responsible for the design and construction of the larger works. While women engineers and water resource experts are becoming more common in Jordan, most of the construction work is carried out by men. The CBI program on the other hand has been able to directly engage women-led CBOs (~30 percent of total) and more than one-quarter of the micro-loans disbursed by the CBOs were made directly to women. This greater engagement from the women of the community likely helps to increase awareness of the need for water conservation and the potential solutions to save water that exist. The second phase of the CBI program targeted awareness raising at the community-level rather than the household-level to build on this experience.

Recommendation

Given the on-going success of CBI, the high payback ratios of the micro-loans, the backlog of interested households for the micro-loans and the unique niche that this space occupies for USAID, the review team recommends that this program be extended and expanded. Although the third stage of the current CBI intends to enter into the more complex issues of IWRM (Integrated Water Resource Management), the continuation of the earlier stages of micro-loans to the household and community level should be maintained in subsequent projects.

CONDITIONS PRECEDENT

The United States Government (USG) provides economic assistance to the Government of Jordan as a cash transfer. The cash transfer is design to achieve three objectives:

1. Retire USG non-military loans and loans from multilateral institutions, e.g., the World Bank and the IMF);
2. Support economic policy reforms;
3. Coordinate Government of Jordan's support to key initiatives.

To achieve the second and third objectives the Government of Jordan deposits an equivalent amount of local currency in an interest bearing account in the Central Bank that may be used by the Government, if they meet certain agreed-upon reform measures or condition precedent (CPs), on-budget or off-budget provided directly to NGOs or other civil society programs.

Findings

The major comments from MWI and the Ministry of Finance (MOF) during the assessment were that:

- USAID should link a project and funding to assist with the achievement of a condition precedent. This would mean that USAID and the Government of Jordan would agree to multi-year objectives, setting forward CPs for the next few years and funding projects to assist in the achievement of the CPs by the target date.
- Considering the weakened financial condition of the Government, USAID should provide more funding for on-budget programs. If this shift is possible, this could provide USAID with a temporary lever (by setting aside a portion of the off-budget funds to be moved on-budget) that could increase the pressure on the government to implemented priority CPs.

The Government of Jordan has received cash payments based on CPs that have been negotiated with USAID. In general, CPs have been an effective means of raising reform issues to the highest level with the Jordanian Government. The MWI and WAJ have fulfilled many of the numerous CPs that were negotiated.

Two problems have reduced the effectiveness of the Cash Payment program in the realm of water resource policy. One is the softening of the language of conditions precedent following negotiations that has resulted in payments being delayed but not refused. This undercuts the value of the CP process. The second problem is that the Government of Jordan has negotiated out of the program water management policy CPs that USAID believes to be very important but that are deemed politically sensitive by the Kingdom, e.g., agricultural water tariffs, import duties that reduce competition from imported products on water inefficient crops, and the closure of illegal wells in the Highlands (USAID/RIG 2011). The increased budgetary costs of maintaining the policy status quo provide more hope today for acceptance of carefully identified and politically well-calibrated and timed CPs.

The process of CP identification, negotiation, monitoring, and management is intensive. USAID/Jordan has considered reducing the number of CPs to a few large ones of great importance to reduce the program's management complexity. The purpose in reducing the number of CPs would be to enforce a

small number of important issues, but it may also reduce USAID's leverage across ministries and stakeholder organizations on the delicate issues of water management policy over a strategy period when direct development assistance through the WRE program may be cut in half.

Recommendations

USAID should consider a Cash Transfer program in WRE that:

- Retains a detailed set of CPs focused on WRE policy objectives;
- Develops CPS using a jointly-developed and agreed multi-year (strategy period) road-map on how the reform will be achieved, with a series of annual CPs designed to move the reforms forward. Repetitive CPs with annual gradation of performance measures sustained from year to year, for example, a CP could require that audited financial statements, or performance measures for the companies, be published by a certain date each year; and,
- Uses project funding to develop the institutional capacity to implement the reform.

SECTION 3. LESSONS LEARNED

Over the past ten years, USAID Jordan and other donor assistance to the water sector has generally tracked well with the broad strategic orientations developed over the past 50 years of water investment, as outlined in USAIDs Blue Revolution Initiative Strategic Framework. Figure 27 provides an overview of the progression of water resource assistance strategies from the perspective of USAID's alignment with the evolution of world-wide trends to the end of the 20th century. Since that time, the first decade of the 21st century could be characterized as the decade of:

- continued focus on transboundary water cooperation in water scarce environments;
- the development of integrated water demand management programs;
- increased emphasis on corporatization of water utilities and public-private partnerships;
- incorporation of the potential impacts of global climate change on water resource scarcity;
- institutional restructuring of water sector institutions to better separate risk assessment, regulation, supply mobilization, and distribution functions;
- strengthening sectoral governance and transparency in water sector utility finance and performance;
- expansion of the use of reclaimed waste water for urban, industrial, and agricultural uses;

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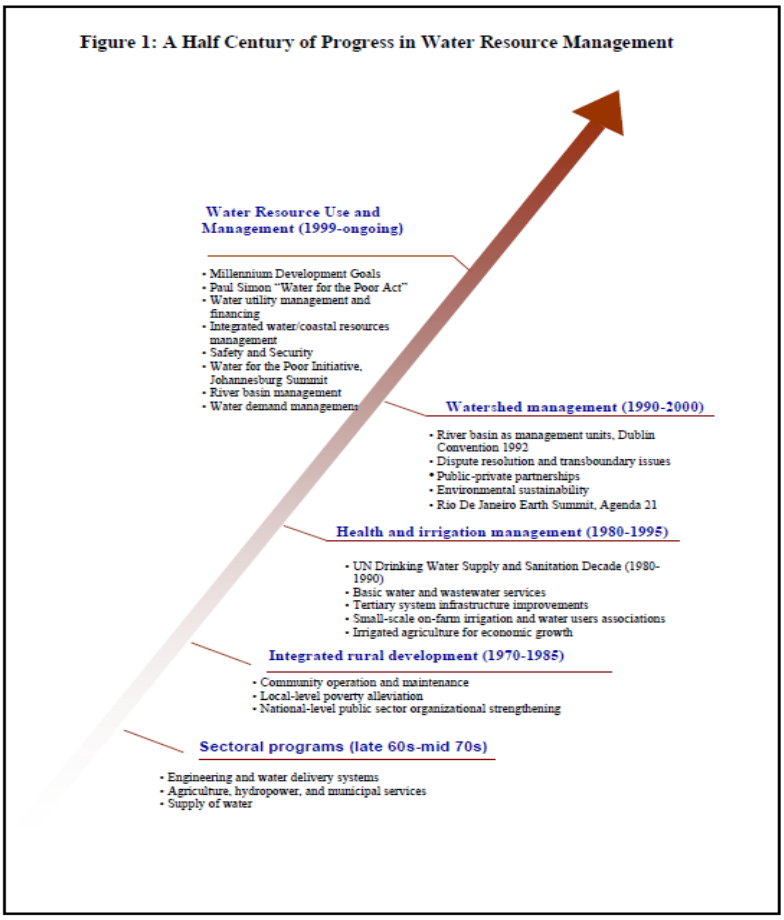

Figure 27. Global Progress in Water Resources Management (Source: Figure 1 from the USAID Blue Revolution Initiative Strategic Framework)

- renewed emphasis on gender roles and innovation in women's roles in water management;
- intense focus on water productivity as more GDP per m3 water as a policy mechanism for allocating water and a potential generator of employment for growing youthful populations; and,
- greater emphasis on the role of water in maintaining environmental health and providing ecosystem services

USAID's WRE portfolio has aligned well with these themes, and is generally recognized by the Jordanian government and citizenry as their historically steadfast and usually largest bi-lateral partner in the development and management of water resources over the past 60 years. USAID's role has been important historically along the continuum from the construction of water capture and conveyance structures through main system operations and management to the development and improvement of large-scale corporatized urban water utilities and small community-based systems addressing underserved areas and populations. It has engaged where possible on environmental issues, a difficult topic in an environment where the Jordan River is essentially a saline and municipal wastewater transboundary sewer and water scarcity is as severe as anywhere in the world.

While the review team enumerated a few dozen lessons learned from review of program and project documents and interviews (please see Annex 5 for the full list), this section focuses on two major lessons that should orient the general framework for the WRE strategy. The first is a lesson on institutional restructuring and the second is on setting benchmarks to measure progress.

Institutional Restructuring

As Jordan's water resources become more and more scarce, the challenges to managing water resources have intensified. Water in Jordan is life and it is also politics. Water tariffs have to be approved by the Cabinet of Ministers and water allocation decisions seem to be the result of complicated consensus building efforts or negotiations that reflect power blocs as much as, too often more than, strategy, policy or even economic necessity. The most glaring cases are the difficulties in enforcing the existing by-law on groundwater extraction in the Highlands and the maintenance of very low tariffs on all types of irrigation water. USAID and other donors have been frustrated by the pace of change to achieve fundamental legal and institutional restructuring along the lines of best international practice. Jordan's already difficult water policy environment now faces more pressure from a severe fiscal squeeze, disruption in regional energy supply that has rapidly escalated energy costs, the revenue impacts of the global recession, and the worries of the Arab Spring as manifested nationally and in neighboring Syria. These elements further complicate the re-working of fundamental water law to enable the top to bottom restructuring of water institutions into a policy-setting ministry and water regulator overseeing bulk supplier(s) and water utilities.

The main lesson that should be learned by donors on institutional restructuring in the water sector in Jordan is that passage of the Water Law is probably the keystone that will hold the arch together rather than the foundation stone on which the improved water sector edifice will be constructed. In water resource institution timelines, the Ministry of Water and Irrigation is relatively young compared to the JVA and WAJ, which both have strong constituencies and strong retail customer identification. Both are still legally autonomous institutions, even though they have been functionally integrated into the MWI. The MWI has water sector policy, planning, and coordination functions, and centralizes the budgets that support these two central water actors and their dependencies (utilities and water user associations) that are in the process of decentralization and corporatization at distinctly different rates (glacially slower in agriculture than in municipal water). There are many, many things that need to happen before a new law becomes implementable. While the fiscal squeeze is tight and tightening rapidly, the social visibility of

water and the relatively smaller cost impact on the national operating budget and national debt, make the sector an attractive field for giving something back to the public or powerful tribes, relative to the bigger ticket items of food, fuel, and electricity. Work on the law shouldn't stop, but perhaps it needs to shift from a drive to establish the legal foundations for best practices to one of finding the "best fit" with the special circumstances of the national environment (van Ginneken and Kingdom, 2008). Corporatization and contractualization of the relationships between the MWI, WAJ, and utilities and MWI, JVA, and eventual irrigation water management districts, WUAs and outsourced service companies are probably the drivers of decentralizing change that will tip the balance in favor of a water law that will have life, rather than languish for lack of implementing bylaws. Steady pressure through projects that embed experienced advisors within the water institutions to improve performance and fiscal management while steadily pushing with CPs for combined and sequenced action will help to reinforce the following characteristics of water institutions that perform well (adapted from van Ginneken and Kingdom):

- Autonomy – independence to manage professionally without arbitrary interference;
- Accountability – being answerable to contractual parties for policy decisions, use of resources, and performance;
- Consumer orientation – reporting to and listening to clients, and working to better meet their needs.

Setting Benchmarks to Measure Progress

There are worldwide best practice benchmarks in the municipal, industrial, and agricultural water subsectors. One of the missing benchmarks is the time required to effect fundamental institutional change and performance. Donors typically evaluate against a quarterly or yearly clock, which is too short for achieving fundamental change. It usually takes more than a decade and sometimes a few decades before fundamental restructuring occurs. There are parts of the United States of America, especially in water scarce regions, where fundamental change in authority and law has been battled in the courts for half a century or more. The review team is not suggesting that Jordan will take that long, because its water crisis is intensifying rapidly, however, adjusting the timelines to better fit the pace of water institutional change -- while expecting good performance on agreed-upon activities annually -- would be a best fit practice.

Non-Revenue Water reduction has a World Best Practice target of 5 percent. Jordan is far above that level, with only Aqaba Water Company with its young infrastructure, high concentration of commercial and industrial clients, and incentivized management and staff operating at 21 percent and shooting for 7 percent NRW. Older, more hybridized systems, such as Amman's, that has a much larger and higher domestic client base, and one that is under constant pressure to add 25,000 new connections a year, will be hard-pressed, even with a better and deeper incentive system, to achieve a steady NRW level of 20 percent. While the review team cannot estimate where the diminishing rate of return is for moving below that 20 percent figure in Jordanian utilities, USAID and other donors should invest in the design and setting of achievable targets for this and other technical and financial benchmarks, rather than measuring against idealized global best practice end-points.

ANNEX 1: SCOPE OF WORK

SCOPE OF WORK FOR A REVIEW OF WATER POLICIES IN JORDAN AND RECOMMENDATIONS FOR STRATEGIC PRIORITIES

November 2, 2011

SUMMARY:

USAID/Jordan is preparing a new five-year Mission strategy. To provide an independent basis for planning new work in the water sector, consultants are to assess the status and recent historical trends in the sector, and recommend the most important and effective interventions for USAID. This review is to build upon a variety of analyses, especially a March 2010 study of USAID/Jordan water projects. The analysis is to determine how water management has changed in the past decade, what role USAID and other donor support played in these changes, and what program approaches will be most effective in the near future.

BACKGROUND:

USAID/Jordan strategic objectives in the water sector have not changed dramatically over the three strategies implemented over the past two decades. General objectives of the Water Resources and Environment (WRE) office have focused on:

- Stronger Water Sector Institutions;
- More Sustainable Policies in the Water Sector;
- Increased Efficiency in Use of Water Resources;
- Improved Wastewater Treatment;
- Improved Water Supply Systems; and
- Protection of Water Resources.

Activities included institutional support, training, technical assistance and construction of significant infrastructure. While USAID has provided support to water development in Jordan for more than a half century, funding levels increased tremendously in the 1990s. The additional funding was used for large infrastructure projects, including the Wadi Mousa Wastewater Treatment Plant, water and wastewater treatment facilities at Aqaba, the Greater Amman Water System Restructuring and Rehabilitation Project, the Wadi Ma'in Zara and Mujib Water Treatment and Conveyance Project, and the As Samra Wastewater Treatment BOT. These facilities represent over $400 million worth of water infrastructure, and over $300 million in USAID assistance.

In parallel with the construction, USAID increased institutional and technical support with projects focused on the Ministry of Water and Irrigation (MWI), and on the establishment of the Aqaba Water Company (AWC) and the Jordan Water Company (Miyahuna) in Amman. USAID has also provided

technical support for projects dealing with water demand management, water reuse, environmental monitoring, and other activities. These projects, in concert with the work of other donors and the Government of Jordan (GoJ), have made Jordan a regional leader in many aspects of water management. However, Jordan's enormous water scarcity, compounded by population growth, economic demands, and the threat of climate change, makes merely good water management unacceptable.

Despite progress and excellent indicators in many areas of water management, Jordan is rapidly depleting its aquifers, failing to recover even operating costs for municipal water outside of Amman and Aqaba, collecting negligible tariffs for irrigation water and failing to control illegal wells, subsidizing low-value and low-employment agriculture, failing to maintain good hydrological records, and generally risking serious economic and social disruption because of unsustainable water management.

USAID/Jordan, including WRE, is preparing a new five-year strategy. Without the large supplemental budgets that powered the infrastructure program in the past decade, work is already shifting to institutional and policy programs rather than infrastructure, while still seeking a balanced program. USAID is also considering options for "sector support" and more direct implementation by the GoJ or its utilities, in keeping with USAID's new management reform agenda (http://forward.usaid.gov/).

WRE has already conducted several other recent assessments of the water sector, all of which will be made available to the team:

- A review of the effectiveness of conditions precedent (CPs) in eliciting policy change (in review). This general evaluation by a Jordanian firm reviewed the long-term success of CPs imposed as preconditions for cash transfers every year since 2000, including 30 in the water sector. The assessment confirmed the widespread perception that the CPs have not effectively promoted policy reform.
- A Regional Inspector General (RIG) audit to address the question "Did USAID/Jordan build sustainability into its water resources program?" This report concluded that despite progress and successes, the GoJ's allocation policies and supply-side solutions are seriously unsustainable.
- An internal USAID "10-year Retrospective" on the results and effectiveness of WRE programs. This programmatic evaluation assessed all of WRE's major projects in the past decade. While comprehensive in its data collection, it did not have the time or resources to establish historical trends and context, nor make detailed strategic recommendations.
- A USGS analysis of trends in Jordan's major aquifers. This desk study of available data was undertaken to determine the immediacy of threats to Jordan's major sources of water in northern basins from depletion ("dewatering") or salinization. A final report due in December will detail and project decreases in groundwater levels, with most basins projected to be 30% depleted by 2030.
- A preliminary new WRE strategy (June 2011) was prepared at the request of the Acting Mission director. The proposed strategy would focus on increasing "water security" through policies and institutions that would improve water demand management and shift allocations to higher-value uses.
- A field analysis of the quality of operations and maintenance at water and wastewater facilities funded by USAID, to be completed in December 2011. This review by the Operations and Maintenance Training Project will assess the sustainability of major water infrastructure, especially those built by USAID, in terms of the quality of O&M.

- A project evaluation of the Water Demand Management Project IDARA in April 2011 found that the project was generally successful and recommended future water demand management projects focusing on non-revenue water and agriculture.
- A project evaluation of the Operations and Maintenance Training Project (planned, January 2012).
- An internal analysis of the contracting capacity of MWI (September 2011) determined that Jordanian water institutions are weak in strategy and planning, acceptably strong at design, procurement, and construction, and quite strong at operations and maintenance.
- A review of the economics of water management by the Water Resources Group and conducted by McKinsey and Company, "Water Transformation in Jordan" (October 2011), which concluded that major savings were available and that water scarcity demands a shift to broader GoJ engagement in the water sector.
- An Institutional Assessment of the Water Sector by the Institutional Support and Strengthening Project (ISSP; July 2011), which selected six sectors for restructuring for greater efficiency, involving consolidation of the ministry, establishment of a national water council, establishment of a national bulk water provider (WAJ), full corporatization of utilities, establishment of a water utility regulator (the PMU), and strengthening water users' associations in the Jordan Valley.
- An analysis of the agricultural business environment, including inputs and subsidies (e.g., water and tariffs) is planned for December 2011.

Despite the quantity of analysis, the focus on performance and specific subsectors has left USAID with no clear understanding how policies and attitudes have evolved over the past decade, what role USAID and other donors played in the change, what approaches were most successful, and what water policy issues are the most important and most attainable in the near future. This study is to answer these questions.

PURPOSE:

USAID/Jordan seeks a programmatic review of the evolution of water management policies in Jordan in the past decade, focusing on the factors that most contributed to positive change and USAID and other donors' role in creating positive changes. On the basis of these facts and conclusions, the Mission seeks recommendations for a new strategy, including key goals and objectives, methodological approaches, the balance infrastructure and institutional work, external constraints to sectoral success, and the objectives of USAID Forward and related USAID policy reforms.

Approach and Issues:

This evaluation should comply with the USAID evaluation policy (http://www.usaid.gov/evaluation/). The assessment should be explicitly historical. It should identify trends in water management and water use, and the role of USAID and other development programs in these trends. The report should identify catalysts and drivers of positive change and activities or sectors that have not seen progress. The report should identify and prioritize areas where USAID has a strategic advantage for providing effective solutions and improvements in the water sector. The strategic trade-offs of different approaches to agricultural water use should be considered.

Deliverables:

- Develop a workplan, to be presented upon arrival in Jordan.
- At least two oral progress reports to USAID.

- A final presentation prior to the team leader's departure.
- A final draft report within four days of the final presentation. USADI will comment within one week.
- A final report within one week of receipt of USAID comments

The final report should explicitly track trends in the water sector in Jordan, both in terms of policies and sector performance. The report should identify possible correlations between policy changes and performance. Performance information should include the overall sector results (number of customers, volume delivered, volume treated…), utility bench-marking standards (cost recovery, non-revenue water, customer service standards...), and agricultural and business efficiency standards (efficiency rates, productivity, employment, cost recovery, reuse…).

Issues to be considered include:

- Quality and capacity of water and wastewater systems
- Technical and management skills in the water sector, especially knowledge, skills and attitudes of government officials, but also including government officials in the other relevant sectors (agriculture, environment, finance, municipalities, energy…). Capacities for strategic planning should be considered.
- Organization and management of key water management institutions
- Knowledge and attitudes of key groups (government officials in different ministries, farmers, householders, civil society organizations…)
- Agricultural water policies and allocation, including water costs, market strategies, and use of treated wastewater
- Industrial water policies and allocation, including reuse and treatment
- Municipal water policies and allocation, including pricing, corporatization, and non-revenue water
- Water Demand Management policies
- Aquifer management and sustainability

Recommendations should be explicitly tied to findings and conclusions, and should inform the following issues:

- General goals that USAID's water strategy could set (with discussion of tradeoffs and risks)
- Water sub-sectors that USAID could productively support Approaches and methods for policy and infrastructure work that USAID should consider, specifically including how the government of Jordan can be motivated to make the water sector sustainable, and how the difficult necessary changes could be implemented.
- Funding and implementing mechanisms for policy and infrastructure work that USAID should consider

The organization of the report need not follow the organization of these lists of topics.

In summary, the report should tell recent the story of Jordan's water sector and suggest how to build on it.

Schedule:

A three week work schedule is anticipated, plus additional preparatory and writing time. Preparations should include collection of performance data from authorities in Jordan. Not all team members are expected to work the full period or the same periods.

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ANNEX 3: WATER RESOURCES AND USES IN JORDAN

TABLE OF CONTENTS

1. INTRODUCTION

Jordan faces severe limitations of water resources availability that have become more acute with time, as population, economic growth and the associated water consumption have grown. Jordan is facing a future of very limited water resources- among the lowest in the world on a per capita basis at 147 m3/capita/year in 2010. If supply remains constant, per capita domestic consumption is projected to fall to approximately 90m3/cap/annum by 2025 , putting Jordan in the category of having an absolute water shortage with all the associated economic and public health problems.

The gap between suppressed demand and available supplies is widening every day with very limited and most likely very expensive options to partially alleviate the water shortages for the domestic and industrial uses.

The majority (64%) of Jordan's water is drawn from groundwater aquifers, both renewable and non-renewable being over pumped at an annual rate as high as 55%. The vulnerability of surface water resources adds to the complication of the issue and in particular the Yarmouk River water and its decreasing flow trends as a result of Syrian upstream abstractions in violation of the 1987 agreement signed between the two countries (Jordan-Syrian Agreement, 1987).

The water crisis of 1998 caused by the failure of Zai Treatment plant to treat pollutants from King Abdullah Canal, a canal that transfers the Yarmouk River water, water from Israel as well as other side small rivers, is a warning on how vulnerable the surface waters of the country and their ability to create social and political crisis in relatively no time and very quickly. This plant was upgraded in the late nineties with USAID support to deal with such unusual pollutants like high organic compounds and microorganisms. The series of water crises in 2006, 2007 and 2010 in Mansheiat Bani Hassan and Sakeb due to water quality issues and in Ajlun due to water supply shortfalls are just the latest manifestations of problems related to the serious water shortage facing the Kingdom.

Renewable water resources have fallen below 130 m3/cap/year and incremental cost of new urban bulk water supply to Amman is expected to exceed USD 1.35 per m3 as is expected in the case of the to Amman Water Conveyance Project.

This situation forced the Government starting in 1999 to issue sector reforms including but not limited to: private sector participation in many forms, reallocation of irrigational water to domestic and industrial uses, restructuring of water tariff, institutional reforms and the establishment of companies for water and wastewater services as the example of As Samra BOT (2002) Aqaba Water Company (2004), Amman (Miyihuna, 2007), BOT (2007) and the Yarmouk Water Company (2011). In addition the Government introduced the IWRM (Integrated Water Resource Management) approach and principles, and a groundwater bylaw in 2002 to regulate abstraction rates and to introduce surcharges in abstraction amount from privately owned well. This bylaw faced tremendous resistance from owners causing farmers demonstrations in many parts of the country during 2001/2002. The debate and dialogue with the concerned parties including Parliament took over a year before government reached agreement with the Farmers Union on introducing surcharges on groundwater use by private owners (Farmers Union and MWI Agreement, 2002).

The development of scarce water resources is extremely expensive since resources close to demand centers have been developed many years ago. The latest project investment cost per cubic meter (to Amman Water Conveyance Project) is about USD11 (MWI, 2008). Increased water supply development projects have added a huge burden to the Kingdom's fiscal budget in terms of new capital and subsidy.

The gap between current tariff levels and full cost recovery is too big to be bridged by tariff increase alone because full cost recovery is too expensive for the majority of the water users (WAJ Annual Reports, 2007, 2008, 2009, 2010).

2. WATER RESOURCES OF JORDAN

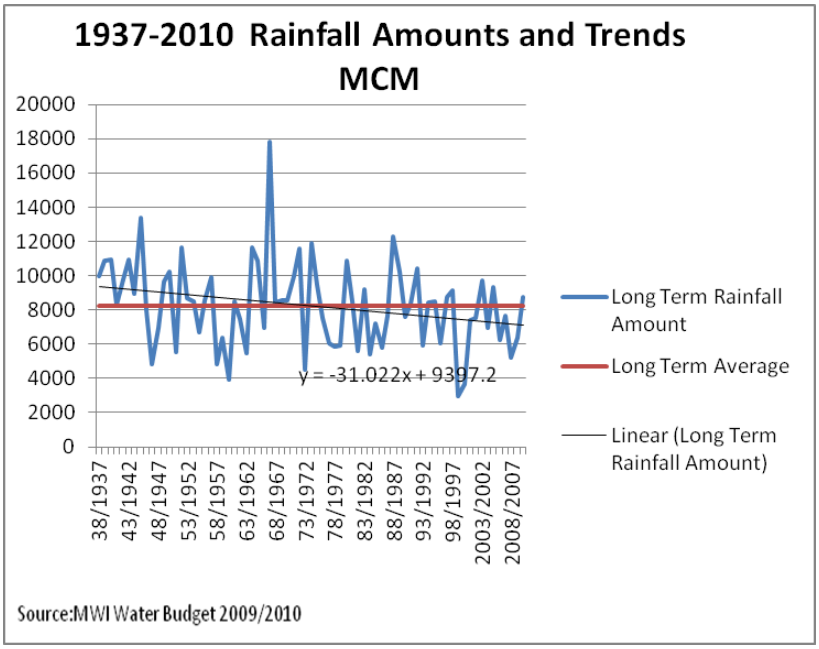
Water resources consist primarily of surface and ground water resources, with treated wastewater being used on an increasing scale for irrigation, mostly in the Jordan Valley.

Renewable water resources are estimated to be about 780 million cubic meters (MCM) per year, including underground water safe yield of 275MCM /yr (distributed among eleven catchment basins) and surface water of 505MCM/yr (distributed among fifteen catchments) These figures have been calculated by many studies like GTZ, 1977 and JRVS, 1993, WAJ Annual Water Budget Report (2011). An additional 143 MCM/ yr are estimated to be available from fossil aquifers (WAJ and Scott Wilson Kirkpatrick, 1994) and about 50 MCM/y from brackish aquifers is accessible after desalination (JICA, 1995). The use of treated wastewater became common for irrigated agriculture mainly in the Jordan Valley with an annual amount of treated wastewater reuse of about 103 MCM as of 2010.

Current use already exceeds renewable supply. The deficit is made up by the unsustainable practice of overdrawing highland aquifers, resulting in lowered water table and water quality deterioration. The additional supplies that became available as a result of the October 1994 Israel/Jordan Peace Treaty have helped alleviating part of the problem with an annual amount of about 45-55 MCM transferred from Lake Tiberias.

Linear trend analysis shows a decrease in rainfall from 1937 to 2010 as shown below in Chart A, which suggests a decline in total rainfall of 2420 MCM (24 percent) over 73 years. Using the generally accepted figure of 95% evapotranspiration losses, this can be very loosely interpreted to mean a reduction in water available for surface flows and groundwater recharge of 115 MCM. Models of climate change for the region suggests that rainfall will decline in the future, and that evapotranspirative losses will increase with higher future temperatures sharply reducing groundwater recharge potential (Jasem and Alraggad, 2009)

CHART A. LONG-TERM RAINFALL IN JORDAN IN MILLION CUBIC METERS (MCM)



2.1 JORDAN'S GROUNDWATER RESOURCES

Groundwater is considered to be the major water supply source for many areas, and is the only water resource in some others. It can be divided into renewable and non-renewable groundwater resources. Twelve groundwater basins have been identified in Jordan and listed in Table 1. Most of the basins comprise of more than one aquifer. Approximately 80% of known groundwater reserves are contained in three main aquifers; Amman-Wadi Es Sir Aquifer System (B2-A7), Basalt Aquifer (Ba) and (D).

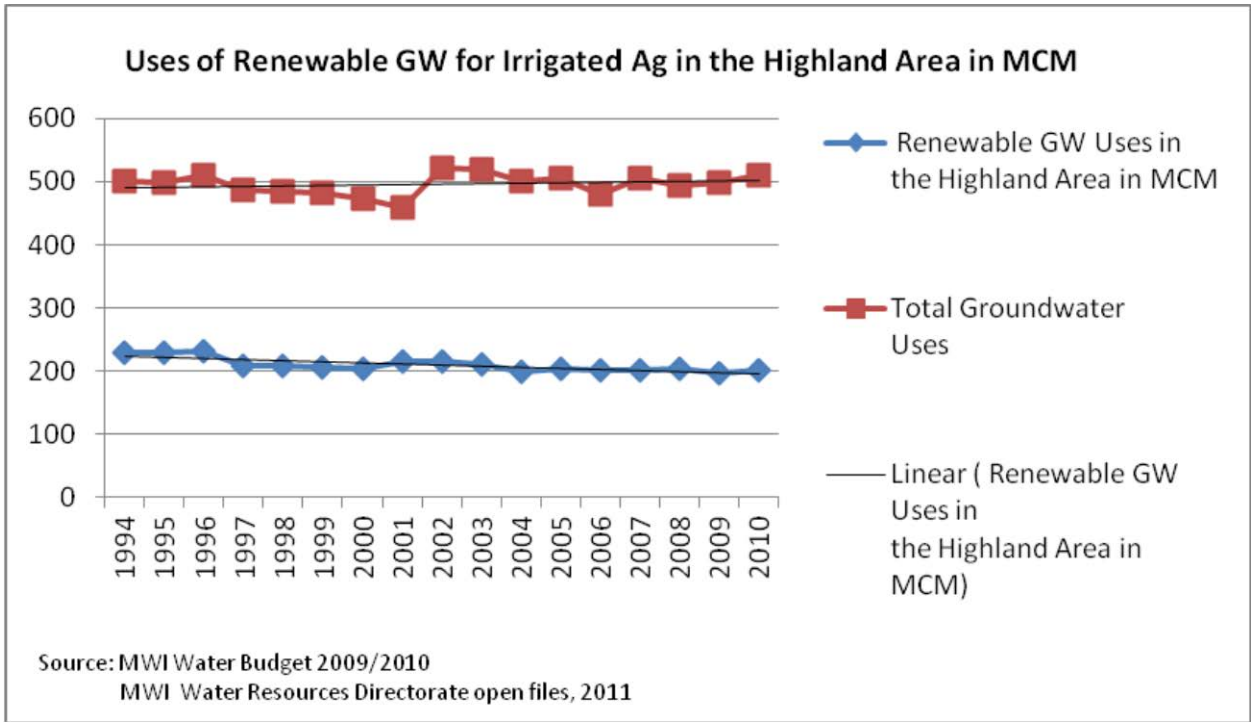
TABLE (1): GROUNDWATER BASINS AND THEIR EXPLOITATION IN 2010 (GTZ, 1977 AND MWI ANNUAL WATER BUDGET, 2011)

Basin	Safe Yield MCM/Yr)	Current Abstraction	Overpumping Rate (%)	No. Of Operating wells*
Yarmouk Basin	40.0	49.9	125.0	166.0
Jordan River Side Wadis	15.0	27.7	185.0	98.0
Jordan Valley Basin	21.0	27.0	128.0	539.0
Amman-Zarqa Basin	87.5	82.1	181.0	867.0
Dead Sea Basin	57.0	90.0	158.0	327.0
	0	63.2	Fossil	85.0
Wadi Araba North Basin	3.5	7.1	205.0	34.0
Red Sea Basin	5.5	6.8	125.0	58.0
Jafer Basin	9.0	32.6	362.0	213.0
Azraq Basin	24.0	53.19	222.0	560.0
Wadi Sirhan Basin	5.0	1.4	29.0	26.0
Hammad Basin	8.0	1.1	15.0	5.0
Total	**275.5**	**510.9**	**185%**	3098

Some of the renewable groundwater resources are currently exploited to maximum capacity, in some cases exceeding the safe yield capacity. Figure (1) shows the geographic location of the major groundwater basins in Jordan.

Chart 1 shows groundwater uses over the last 17 years as well as the quantity used for irrigated agriculture which also shows the declining trend in use for irrigated agriculture, which was due – in part-- to the 2002 groundwater bylaw that imposed surcharges on pumping more than 150,000 m^3 annually. Nevertheless, abstraction rates still exceed safe yield estimates. Ten groundwater basins out of twelve are being over-pumped and exceed the safe yield as can be seen from Table 1. Salinity at localized points has increased as it's the case of Amman-Zarqa Basin, Jafer and Azraq, however, regional salinity trend remain constant as can be seen from Chart 3.

CHART 1. USES OF RENEWABLE GW FOR IRRIGATED AGRICULTURE IN THE HIGHLAND AREA



Source: MWI Water Budget 2009/2010
MWI Water Resources Directorate open files, 2011

FIGURE 1: JORDAN'S GROUNDWATER BASINS (SOURCE: EXACT, 1998)

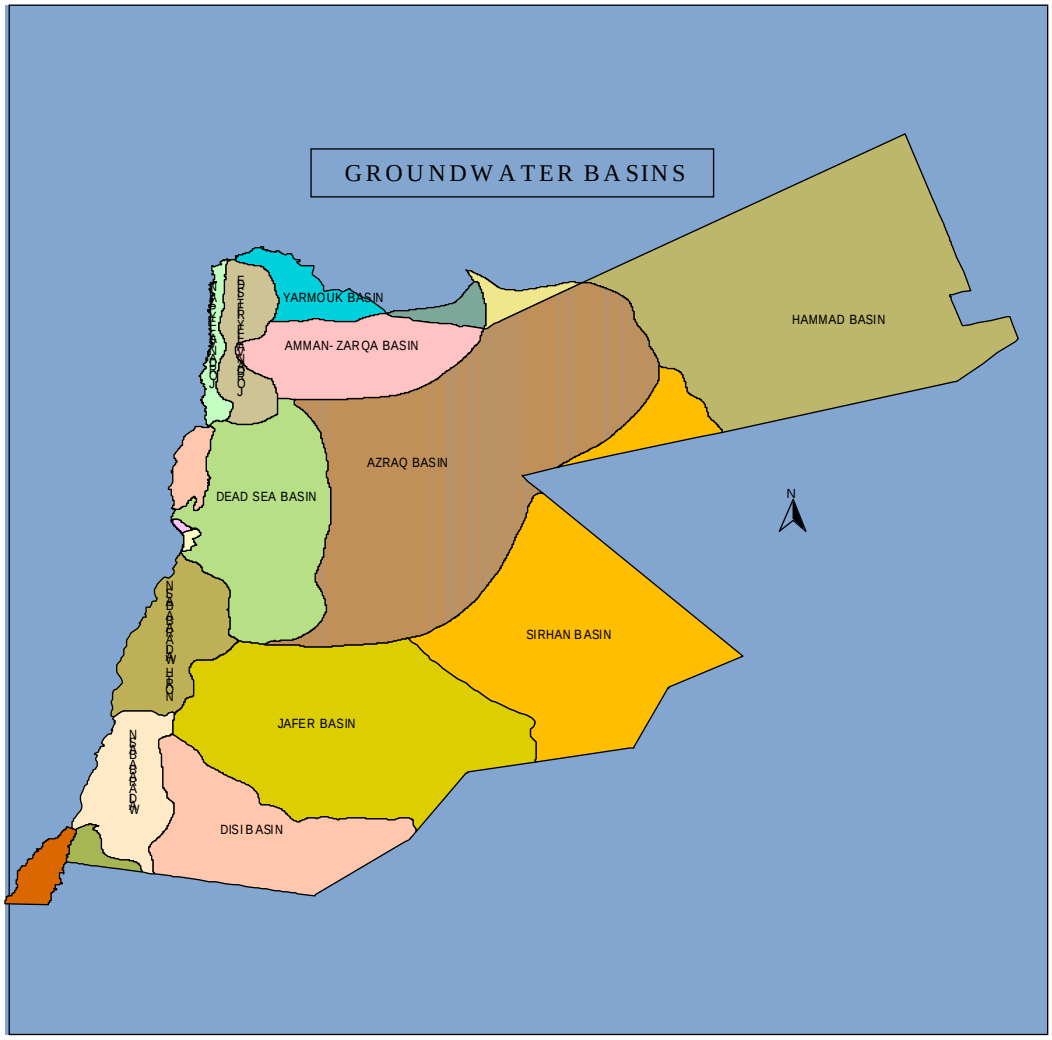


CHART 2 (A). EXAMPLES OF GROUNDWATER OBSERVATION WELLS SHOWING CONTINUOUS DECLINE IN WATER TABLE.

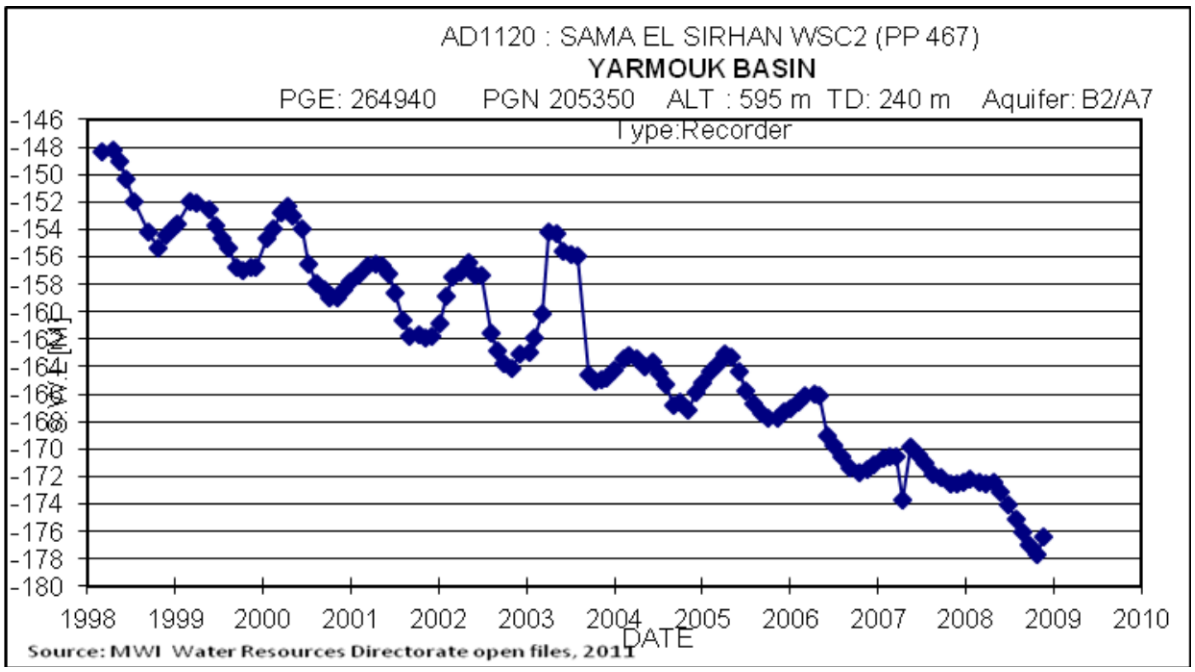


CHART 2 (B). EXAMPLES OF GROUNDWATER OBSERVATION WELLS SHOWING CONTINUOUS DECLINE IN WATER TABLE

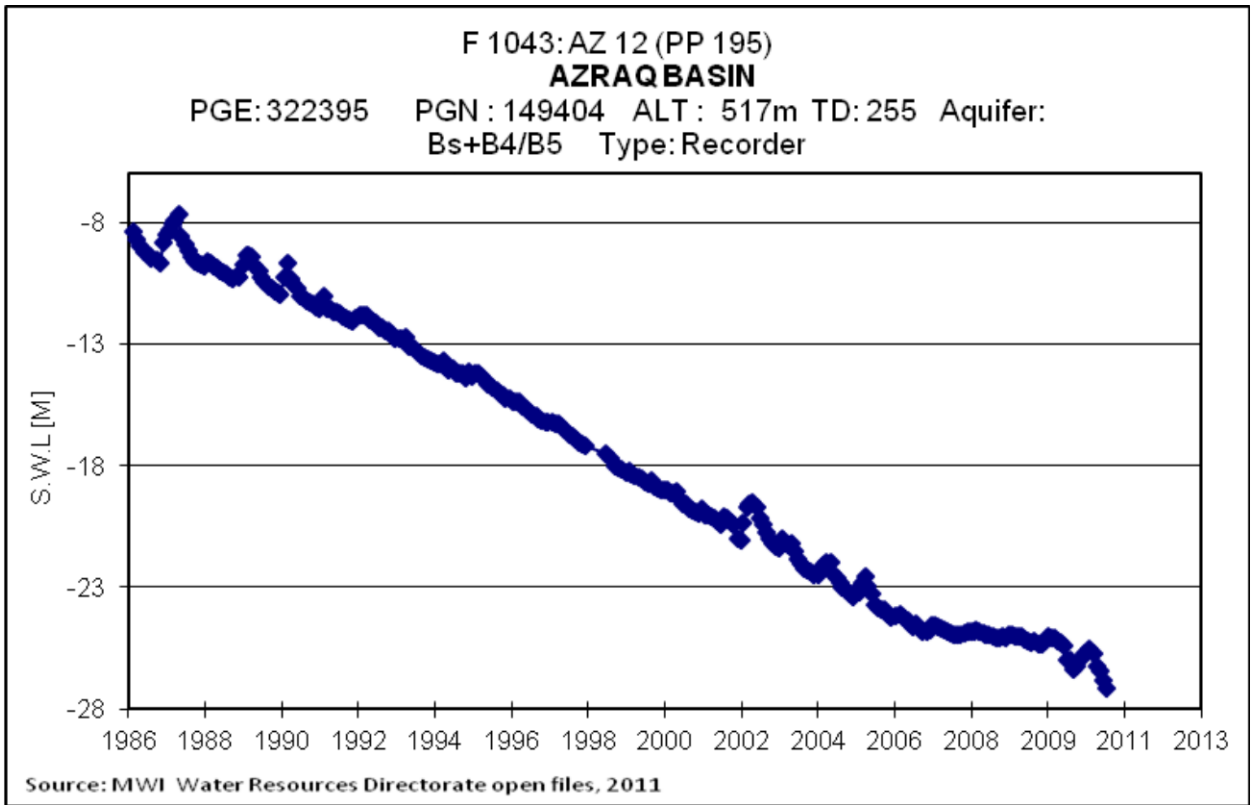


CHART 2(C). EXAMPLES OF GROUNDWATER OBSERVATION WELLS SHOWING CONTINUOUS DECLINE IN WATER TABLE

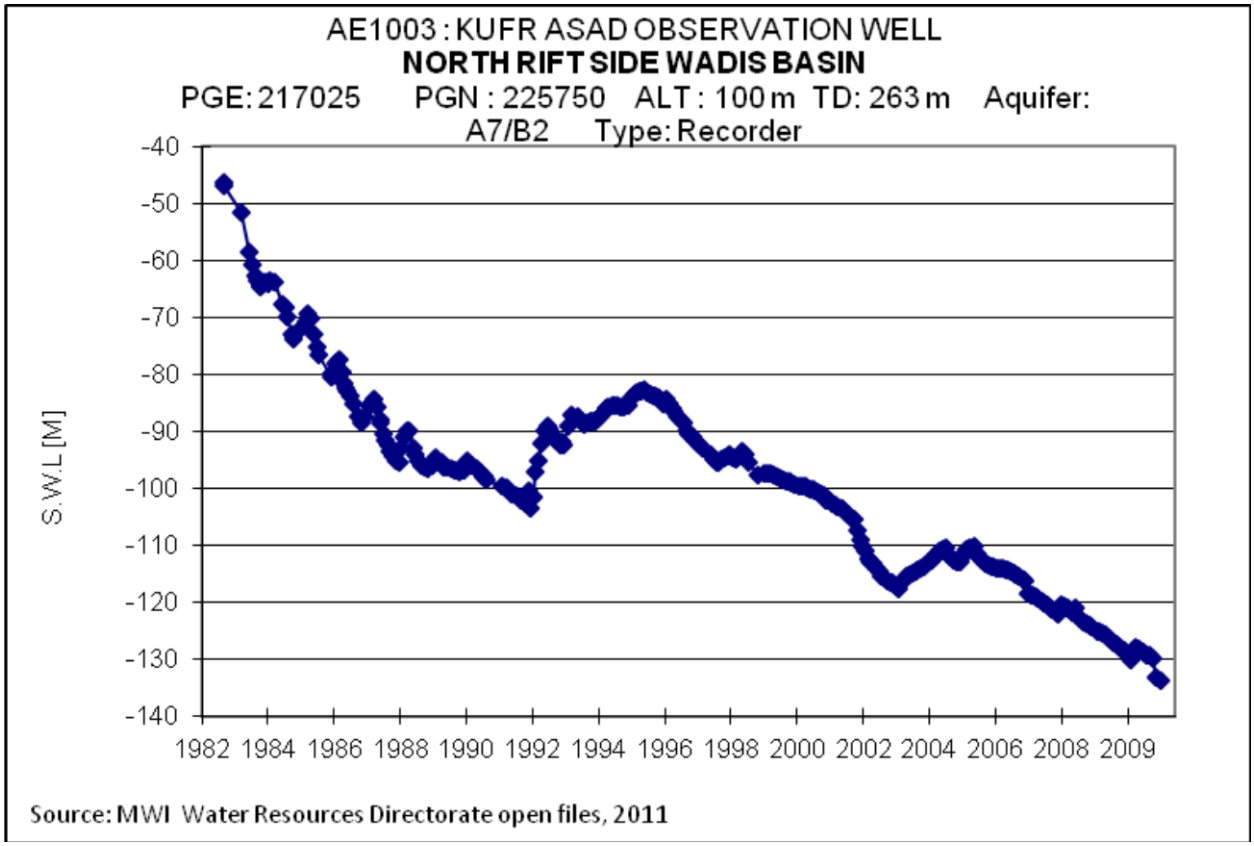


CHART 3 (A). AZRAQ BASIN REGIONAL AQUIFER SALINITY TREND

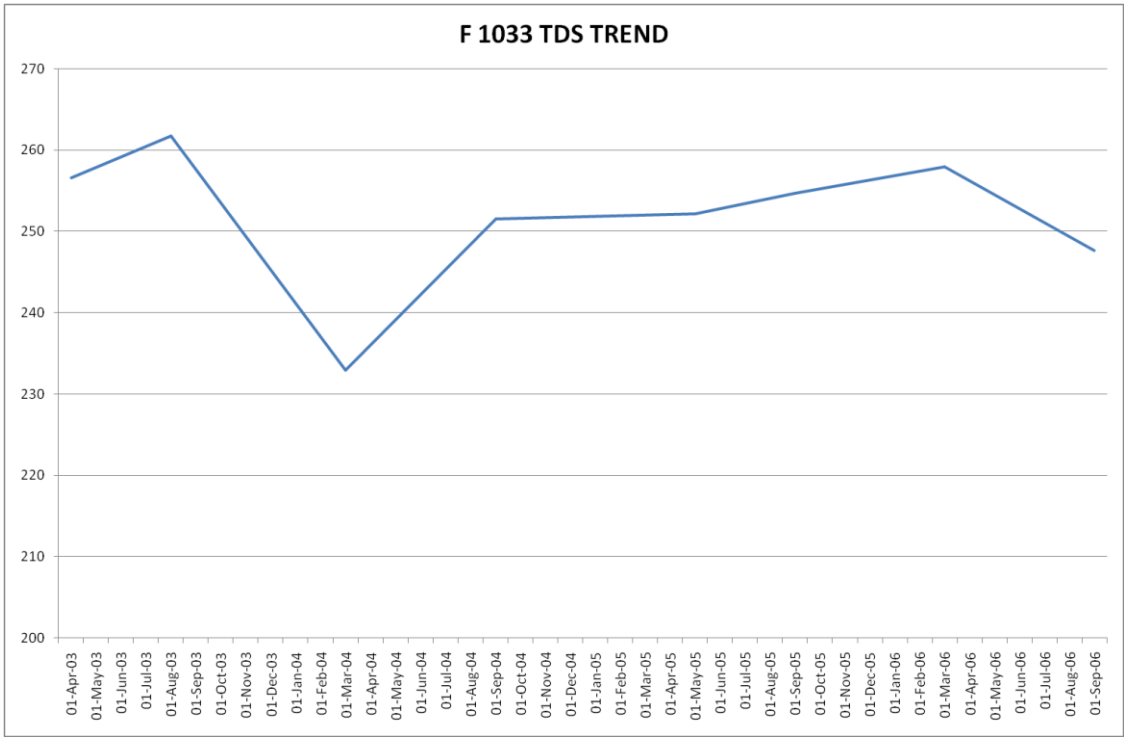
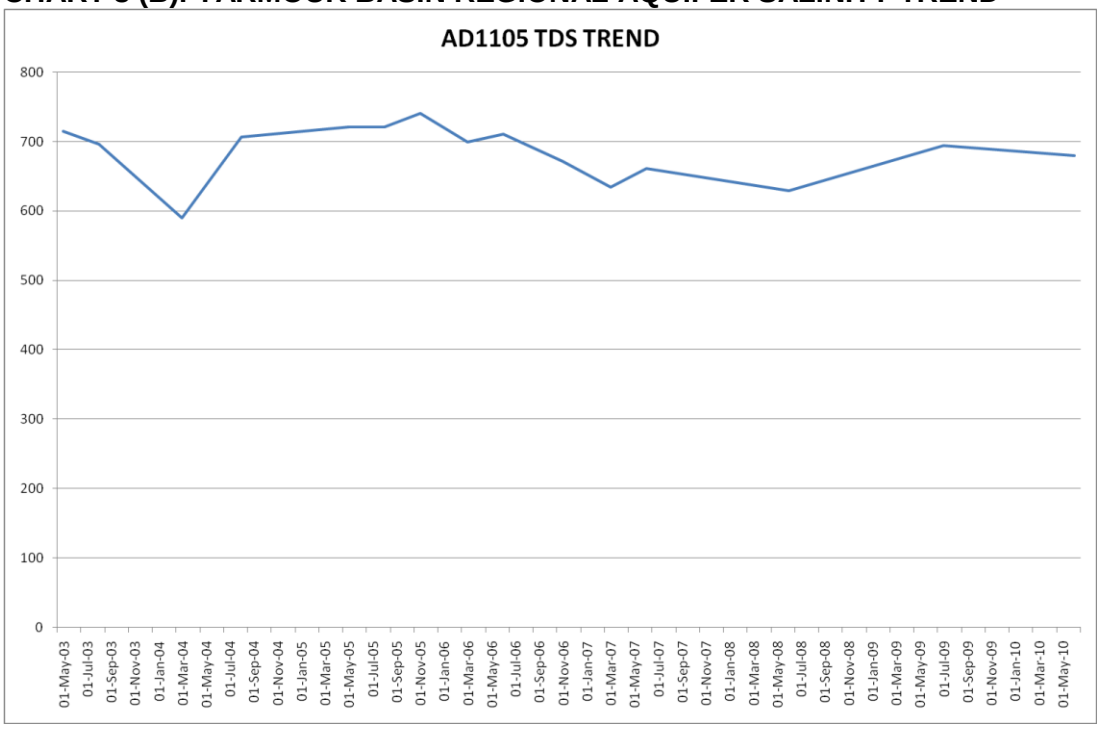


CHART 3 (B). YARMOUK BASIN REGIONAL AQUIFER SALINITY TREND



Rechargeable aquifers receive water from various sources. These include precipitation; base flow and irrigation return flow which percolates to aquifers through pores in the rock matrix in addition to subsurface flow from adjacent groundwater basins. Many studies and estimates have been conducted on groundwater resources in Jordan, and have concluded that the safe yield of the renewable groundwater resources is 275 MCM/yr as shown in Table 1. This estimate however has not been reevaluated since the 1977 GTZ study. Due to groundwater over pumping at high rates from the highland areas, surface flow of the side wadis flowing towards the Jordan Valley has declined, see Chart 4, due to the effect of base flow of shallow-medium aquifers that is connected to highland aquifers, Chart 5.

Non-renewable groundwater resources (fossil water) are derived from stored resources deposited in much earlier times. It has no relation to the current hydrological cycle; the volume of this water depends on the thickness and storage capacity of the ground layer in which it is found, and on the extension of that layer.

The aquifer, part of the Rum Group, outcrops in the southern desert of Jordan and is considered the main non-renewable groundwater resource being exploited. A study conducted by MWI and Scott Wilson Kirkpatrick (1995) concluded that the aquifer system would yield 100-150 MCM/yr over 40 years with an acceptable total drawdown less than 150 m. The water quality of the aquifer is excellent for drinking purposes, being less than 300 mg/l of total dissolved solids (TDS). The MWI is currently constructing a 325 km pipeline and 55 deep wells to pump 100 MCM/yr from the aquifer for potable supply in Amman. Other non-renewable groundwater resources are those of the Jafer basin at Shidyia with an annual yield of 18 MCM over 40 years (GTZ, 1977).

CHART 4. FLOW OF JV SIDE WADIS SHOWING DECREASE TREND

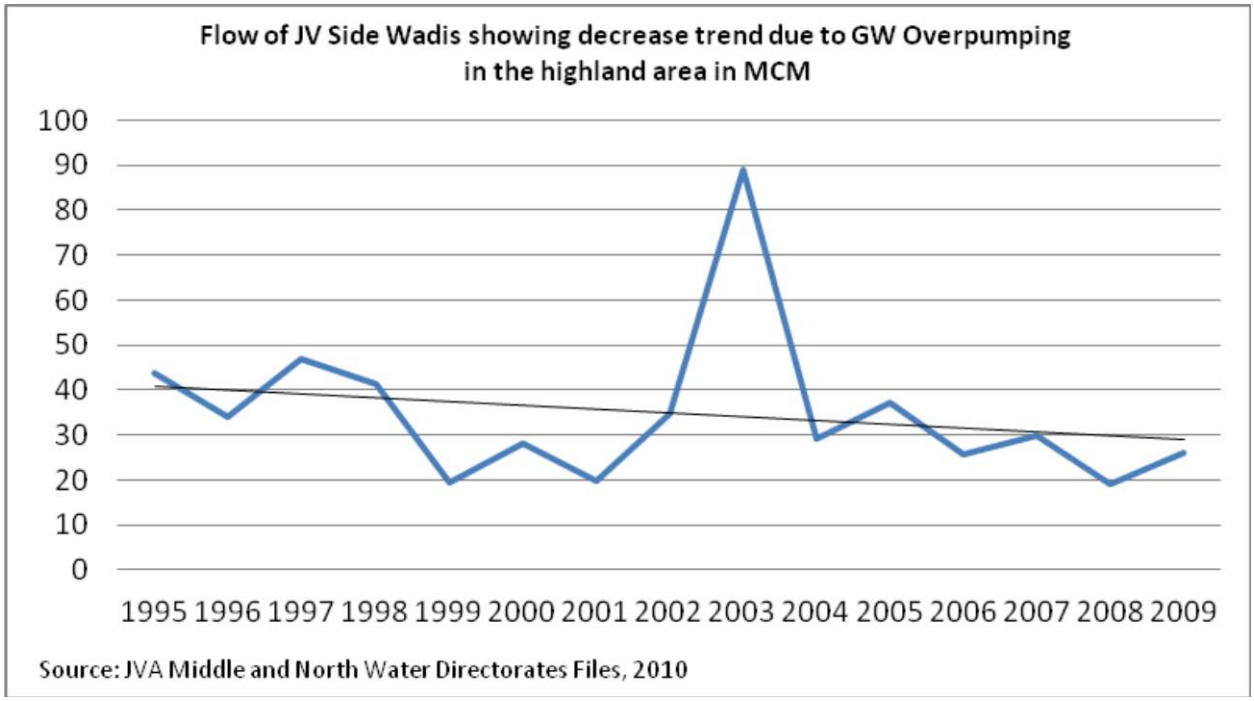
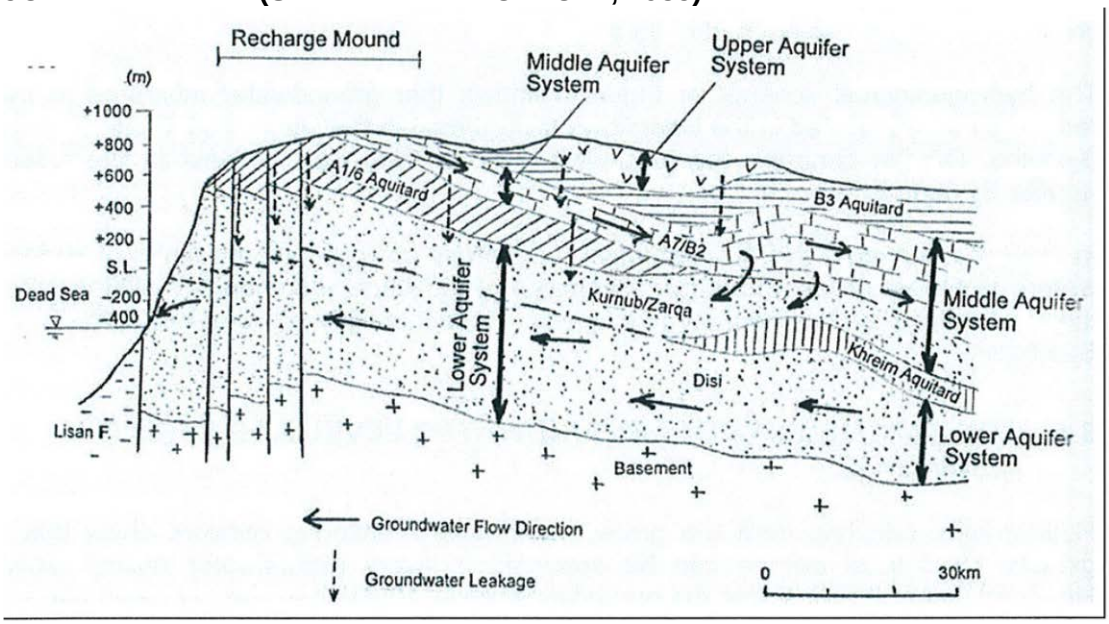


CHART 5: HYDROGEOLOGICAL SCHEMATIC E-W CROSS SECTION SHOWING THE RELATION BETWEEN HIGHLAND AQUIFERS AND AQUIFERS FLOWING TOWARDS THE JORDAN VALLEY (SALAMEH AND UDLUFT, 1985).



2.1.1 Challenges to Groundwater Sustainability

Groundwater is the only reliable drinking water supply source in many areas of Jordan. Overexploitation of aquifers beyond their annual potential recharge has and will continue to contribute significantly to the degradation of groundwater quality in the exploited aquifers, and thereby endanger the sustainability of

these resources for future use. The following issues are considered to be the most critical challenges to address in order to sustain the yield of Jordan's groundwater resources.

1) The ability to protect groundwater resources from pollution (industrial, municipal and agricultural).

2) Groundwater over pumping and the associated problems like depletion and quality deterioration.

3) Irrigation return flows and the associated pollutants from fertilizers and pesticides.

4) Municipal wastewater disposal and the level of treatment.

5) Industrial wastes and the ability to control the effluents from industries.

6) The huge capital investment needed to eliminate groundwater over pumping.

7) Illegal drilling of wells as well as abstraction amounts in excess of the by-law permissible quantities.

8) The technical and political obstacles in controlling water abstraction from wells, in particular the political resistance to additional tariff increases.

9) Lack of trained staff in groundwater studies and management.

10) Saudi abstraction in the case of the aquifer and the Syrian abstraction in the case of the Yarmouk basin.

11) Protection of groundwater resources and the needed mitigation measures is unattractive to policy makers because the relatively long time needed to notice the results.

12) Lack of enforcement of existing regulations related to groundwater abstraction and use, in particular the 2002 Groundwater Bylaw.

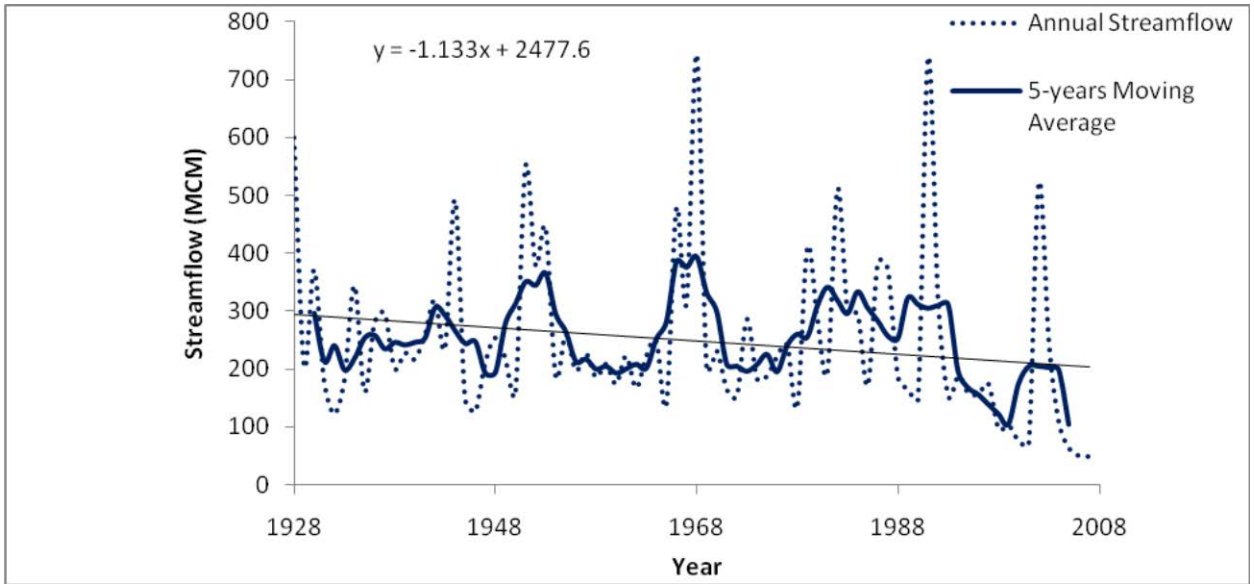
13) Groundwater resources use is considered as the ***default option***, because it is easy to tap in emergency cases by MWI/WAJ as was the case during the 1st Gulf war of 1991 and the 2nd Gulf war of 2003, and easy to tap in some shallow aquifers like the Azraq basin where more than 90% of the illegal wells exist.

14) The needed financial resources to explore deep groundwater aquifers which potentially would be the ultimate resource for long term drinking water supply (El-Naser, 2009).

2.2 SURFACE WATER

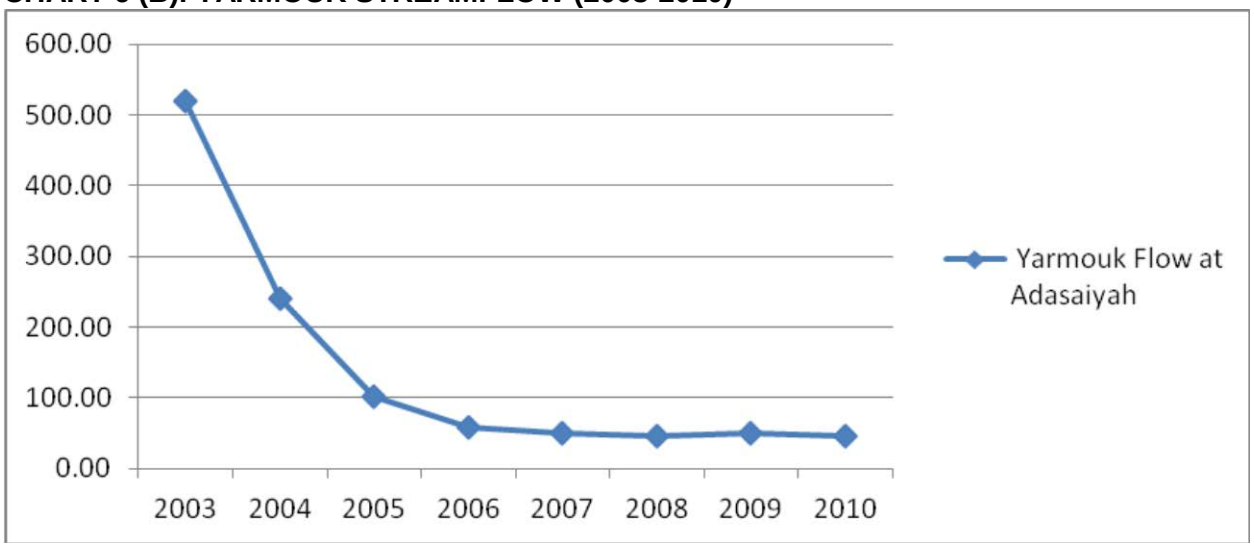
The surface drainage of Jordan consists of fifteen basins. Surface water flows in the country's basins vary greatly between seasons and years. As shown in Table 2, the base flow long term average is about 359 MCM/yr with about 334 MCM of flood flow. A 1993 JRVS study found that on average, out of the total annual surface water resources (693 MCM/yr), only 505 MCM is available for use (JRVS, 1993). However, with groundwater over pumping in 10 out of 12 groundwater basins and decreased flows in the Yarmouk, the 505 MCM/yr is no longer a valid figure for water resources planning purposes. The available surface water resources for the years 2005 and 2010 were 390 MCM and 418 MCM, respectively. This indicates a reduction in the average of about 20%. Chart 6 shows the declining trend of the Yarmouk river especially last 8 years where flow decreased from about 250 MCM in 2004 to less than 50 MCM in 2010 (JVA& ORIENT Eng., 2011). This reduction of flow in the Yarmouk River is mainly due to Syrian upstream abstraction in violation of the 1987 agreement between Jordan and Syria. This is a real threat to drinking water supply in Amman and for irrigation in the Jordan Valley with all associated risks.

CHART 6 (A). YARMOUK STREAMFLOW (1928-2008)



Source: Yarmouk River Basin Water Resources Assessment and Use Study, JVA and ORIENT Engineering, 2011.

CHART 6 (B). YARMOUK STREAMFLOW (2003-2010)



Source: JVA Files, 2011

TABLE (2): LONG TERM AVERAGE OF SURFACE WATER FLOWS

Basin	Base Flow MCM/yr	Flood Flow MCM/yr	Total Flow MCM/yr
Yarmouk	105	155	260
Jordan Valley	19.3	2.4	21.7
North Rift Side Wadis	36.1	13.93	50.0
South Rift Side Wadis	24.8	7.7	32.5
Zarqa River	33.5	25.7	59.2
Dead Sea Side Wadis	54.0	7.2	61.2
Mujib	38.1	45.5	83.6
Hasa	27.4	9.0	36.4
Wadi Araba North	15.6	2.6	18.2
Wadi Araba South	2.4	3.2	5.6
Southern Desert	0.0	2.2	2.2
Azraq	0.6	26.8	27.4
Sirhan	0.0	10.0	10.0
Hammad	0.0	13.0	13.0
Jafer	1.9	10.0	11.9
Total	358.7	334.2	692.9

Source: MWI Water Budget Report, 2011

2.3 WASTEWATER TREATMENT AND REUSE

As a result of Jordan's ambitious campaign since the 1980's, about 65% of the population currently is connected to wastewater collection and treatment systems (WAJ, 2011).

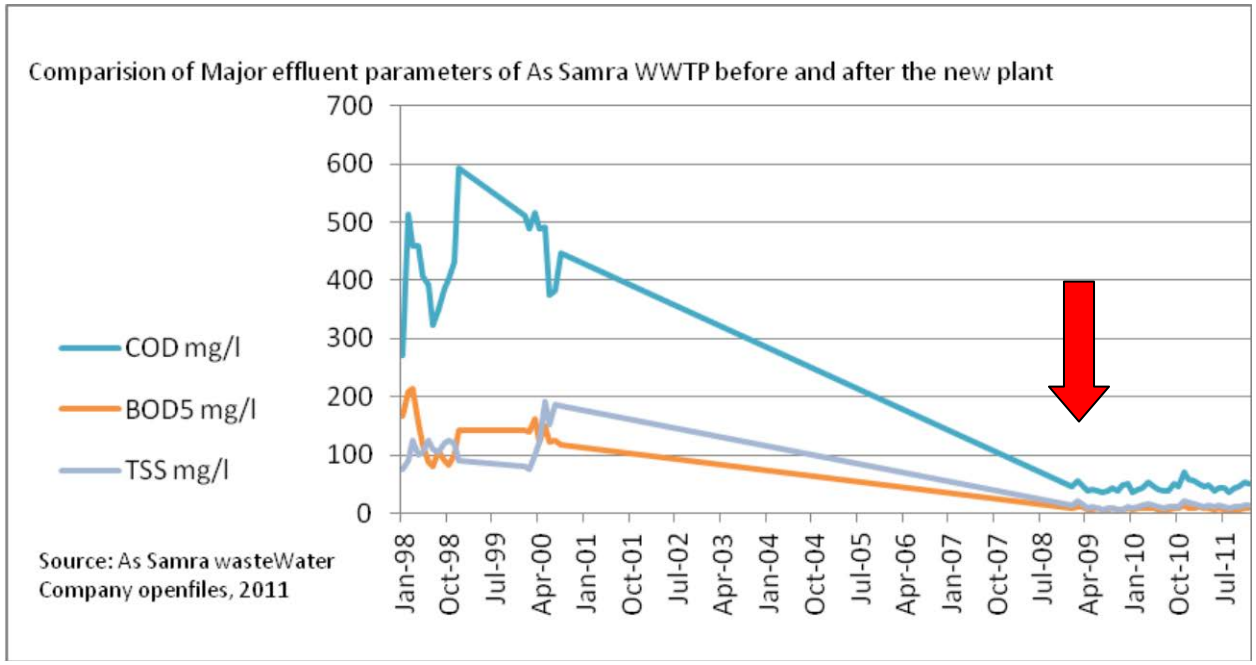
The first wastewater collection network and treatment plant was built in the city of Amman, and was operational in 1968. Presently, there are 27 wastewater plants servicing the country. The number of treatment plants has almost doubled since 1993 (then 14 WWTP) as well as the capacity (then 58 MCM/yr) indicating Government and donor efforts in utilizing the treated wastewater as a new and additional resource (El-Naser and Elias, 1993). These plants produced 103 MCM of effluent usable for irrigated agriculture in 2010.

In order to cope with the growing supply of raw wastewater, two treatment plants are under construction (South Amman and Wadi Al Shallalah) and several are under study, including four that have completed studies available to implement (North Shunah, South Shunah, Dead Sea BOT, Zarqa Industrial Plant BOT). One problem facing all wastewater treatment plants is receiving influent domestic wastewater with high strength in terms of BOD_5 (values range from 500 to 1500 mg/l). This is attributed to the low water consumption due to the national water shortages as well as the type of treatment process technology. Water shortages also impose several operational problems and plants are being biologically overloaded with only a portion of its hydraulic capacity. Chart 7 shows the BOD5, COD and TSS of the largest treatment plant in Jordan (As Samra) before and after the expansion and upgrade of treatment process done by USAID during the period 2003-2006. The effluent quality is well below design value being 30 mg/l for BOD5 and TSS. These improvements have a great impact on the water quality of King Talal Reservoir (KTR) as well as the water quality for irrigation in the Middle and North Jordan Valley. The construction of the new plant makes it technically, politically and socially feasible to expand the use of treated wastewater for irrigation in a trade against reallocation of fresh water for domestic use. Between 2008 and 2009, MWI/JVA expanded its treated wastewater conveyor from KTR to reach almost the boundaries of the Middle and North Jordan valley (Al Mashara area) with a total length of 35 km. The new conveyance is now operational for irrigation of additional Jordan Valley farms with the As Samra

treated wastewater (personnel interview with Eng Qais Oweis of JVA, Director of Middle and North Jordan Valley).

Wastewater treatment plants also prevent surface water pollution problems. In some areas, the quality of water supply improved drastically due to increased sanitation and regulated management. For example, the water quality of Ain Sara spring, having an average discharge of about 579 m^3/hr, has been improved. The nitrate concentration at that site reduced from about 95 mg/l in 1987 to about 41 mg/l in 1993 (WAJ Open files, 2007).

CHART 7. AS SAMRA WASTEWATER TREATMENT PLANT PERFORMANCE BEFORE AND AFTER USAID SUPPORT FOR THE BOT PROJECT.



Treated wastewater is considered as an essential element in the Kingdom's water strategy. Almost 98% of the total treated wastewater is utilized for irrigation (MWI, 2011). The treated effluent of major urban areas is added to the stock of irrigation water and constituted in 2010 about 20% of irrigation water resources. Treated wastewater contributed to nearly 60% of the total water resources used for irrigation in the North and Middle Jordan Valley and this percentage is increasing in annual basis due to the increasing amounts of treated wastewater from As Samra Plant as well as other plants discharging water towards the Jordan Valley like Wadi Al Arab WWTP, Wadi Es Sir, Kufranjah and Salt. By the year 2015 treated wastewater is expected to add additional 76 MCM/yr making total available and usable to be about 180 MCM/yr and mainly allocated for irrigated agriculture within the Jordan valley since more than 60% (46 MCM) will come from As Samra (Water Resources Group 2030)

3. WATER USES

The water budget for all uses in 2010 was about 900 MCM (MWI, 2010) with a rainfall season considered as an average year (Table 3). The supply of Municipal water for the same year amounted to about 351 MCM which is around 39% of the total budget. The average per capita supply for domestic needs in 2010 was approximately 158 liter per capita per day (l/c/d). Considering the unaccounted for refugees (nearly 1 million)and technical losses of up to 20%, the per capita consumption, therefore, was on the order of 90 l/c/d. Compared to domestic use in Europe (250-350 l/c/d), in the Gulf States (280-350

l/c/d) and in Israel (280-300 l/c/d), it is clear that Jordan has a low average, in fact the lowest when it compares to these countries. Only Yemen and PNA compete with Jordan for the lowest per capita availability of water (El-Naser, 2009).

Chart 8 shows the historical trend of Municipal and Industrial (M&I) water uses as well as other sectors together with the population growth. It's worth mentioning that the per capita domestic allocation between 1994 (143 l/capita/d) and 2010 (158 l/capita/d) did not increase, but rather there was an increase in industries connected to the municipal network. This means that efficiency has increased at household level as well as conveyance and distribution system efficiencies in terms of NRW reduction from 55% in 1999 to 30% in 2011 as it is the case in Amman, as shown in Chart 9 (Miyihuna, 2011).

TABLE (3): WATER RESOURCES USES FOR THE YEAR 2010 IN MCM

Source	Domestic	Industrial	Irrigation	Livestock	Total Uses
1. Surface Water	**120**	**6.554**	**256.259**	**7**	**389.813**
North Ghors & KAC	53.64		77.265	0	130.905
South Ghors (Sweimah)	46.54	4.734			51.274
Springs for Drinking Water	19.82	0.32			20.14
Reuse Water	0	0	55.304	0	55.304
Highland Areas					
Springs			37.15	0	37.15
Base flow and flood flow		0	40.35	7	47.35
Reuse Water		1.5	46.19		47.69
2.Ground Water	**231.69**	**33.9**	**245.0**	**0.31**	**510.9**
Renewable	203.878	22.02	200.99	0.3	427.188
Non-renewable	27.812	11.88	44.01	0.01	83.712
Total	**351.69**	**40.454**	**501.259**	**7.31**	**900.713**

CHART 8 (A). HISTORICAL TRENDS OF WATER USES

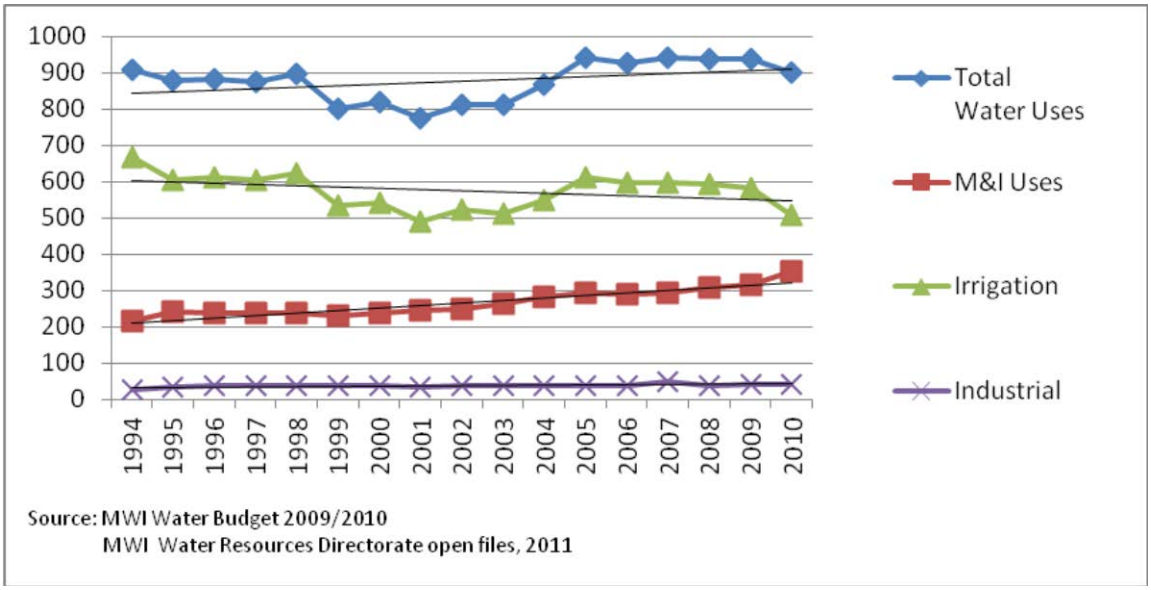


CHART 8 (B). POPULATION INCREASE OVER THE SAME PERIOD FOR COMPARISON WITH THE WATER USES TREND

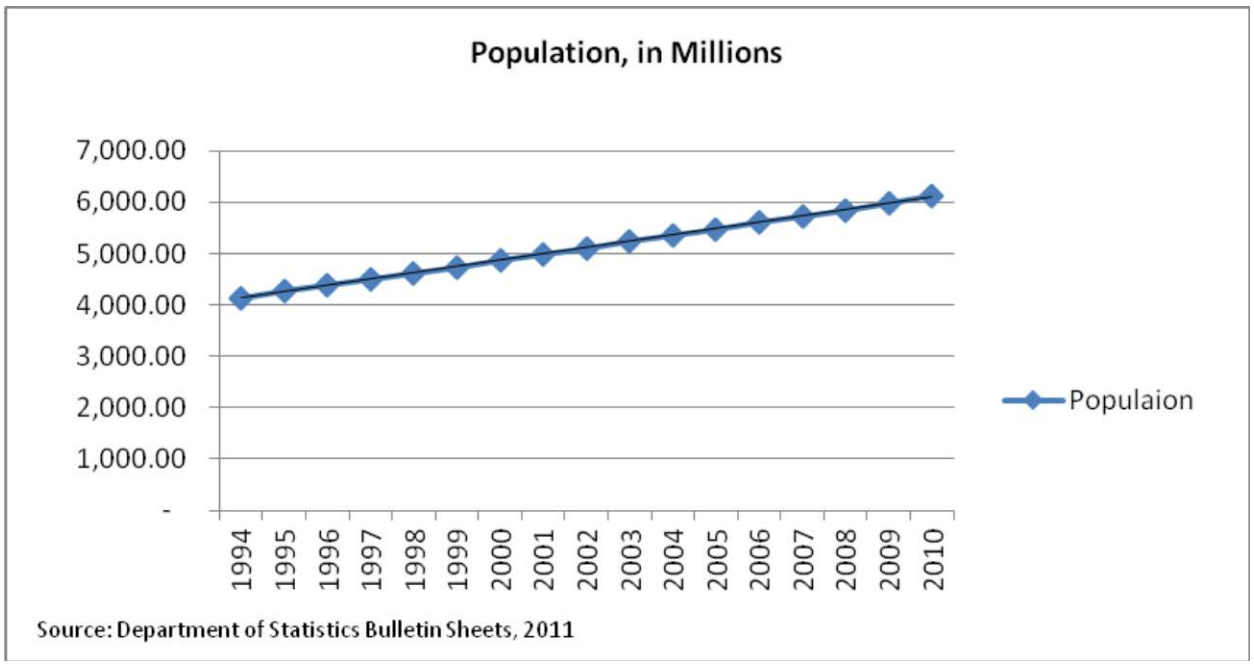
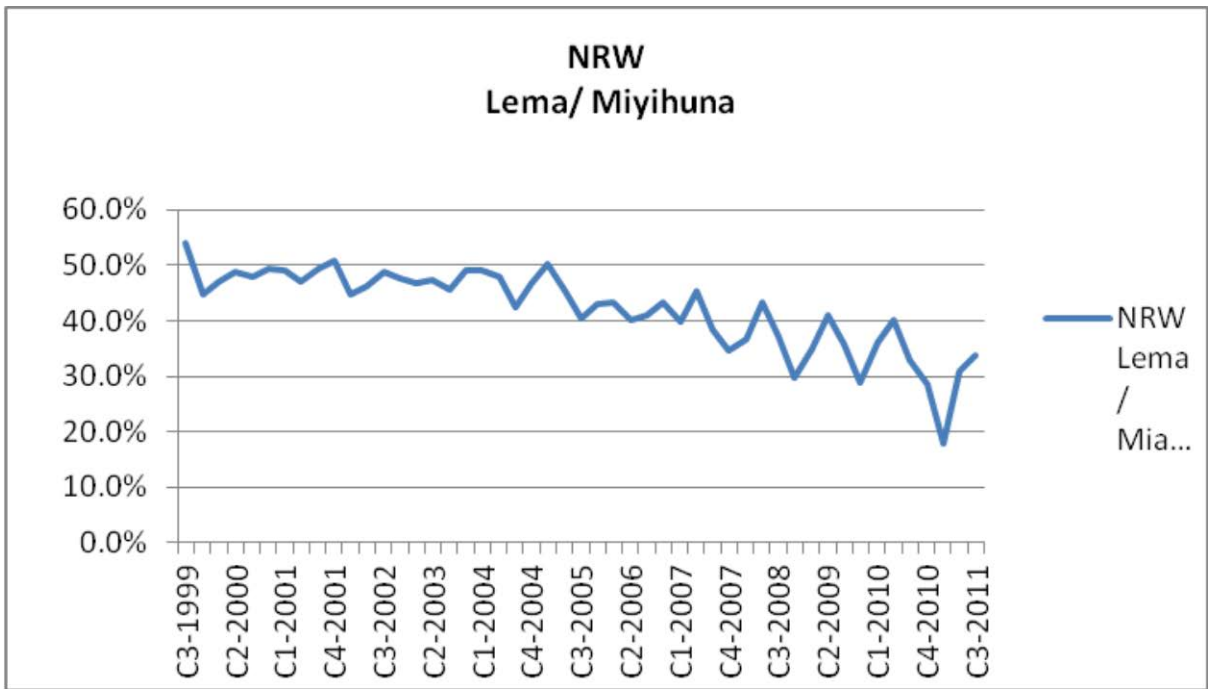


CHART 9: REDUCTION OF NRW IN GREATER AMMAN AREAS AS A RESULT MANAGEMENT CONTRACTS PERFORMANCE, GOVERNMENT AND DONORS SUPPORT FOR NETWORK REHABILITATION



Industrial water requirements in 2010 were 40 MCM. The largest portion of water in the industrial sector is consumed by fertilizer industries (potash, phosphate), the petroleum refinery, thermal power plants, cement factories and various light to medium industries. Most of industries are suffering from water

shortage, and therefore are forced to recycle their processed industrial wastewater, which is in many cases too expensive for small industries hence affecting their competitiveness for export.

Irrigation water uses in 2010 were about 508 MCM including livestock. About 1/3 was used in the Jordan Valley to irrigate around 27,000 ha, while the other 2/3 was used to irrigate about 33,000 ha in the upland Highlands area. Table 3 above lists the uses for the year 2010.

Chart 10 shows that freshwater uses in the JV are decreasing and treated wastewater is increasing as a result of the reallocation policies over the last 10 years. It shows as well that the total amount of water being used in the JV is decreasing while maintain the same size of irrigated land, indicating increase of water use efficiency. Water use efficiency is relatively high being 960 m3/ Dunum/yr (a Dunum is 1000 m2) for a minimum of two cultivation periods and including conveyance and at farm level efficiency. This is mainly due to farmers awareness of water shortages and the water rationing program imposed by the Ministry of Water and Irrigation/ Jordan Valley Authority (MWI/JVA) which forced farmers to use high tech for irrigation like drip, micro sprinklers, green houses, high value crops, etc.

Chart 11 shows development of irrigated land in Jordan where it increases over the last 17 years while total irrigational waters are decreasing with an increasing trend in treated wastewater. This is mainly due to on farm efficiency increase and in particular the effect of more green houses in the Jordan Valley (estimated at 70-80 thousand units according to user association no 55 and GIZ, 2011) as well as the introduction of water users association management program introduced by GIZ and JVA in 2004. According to JVA officials (Mr. Ziad Al Batainah), about70 % of the JV farms are now under management of water users' associations.

Chart 12 shows also the increasing trend of trees and vegetables against field crops due to farmers awareness of the high value cropping patterns like trees and vegetables against filed crops which also contributed to water use efficiency since this change accompanied by the change of the irrigation techniques like drip irrigation and micro sprinklers.

CHART 10. TREND OF FRESH WATER USES AND TREATED WASTEWATER OVER THE LAST 10 YEARS

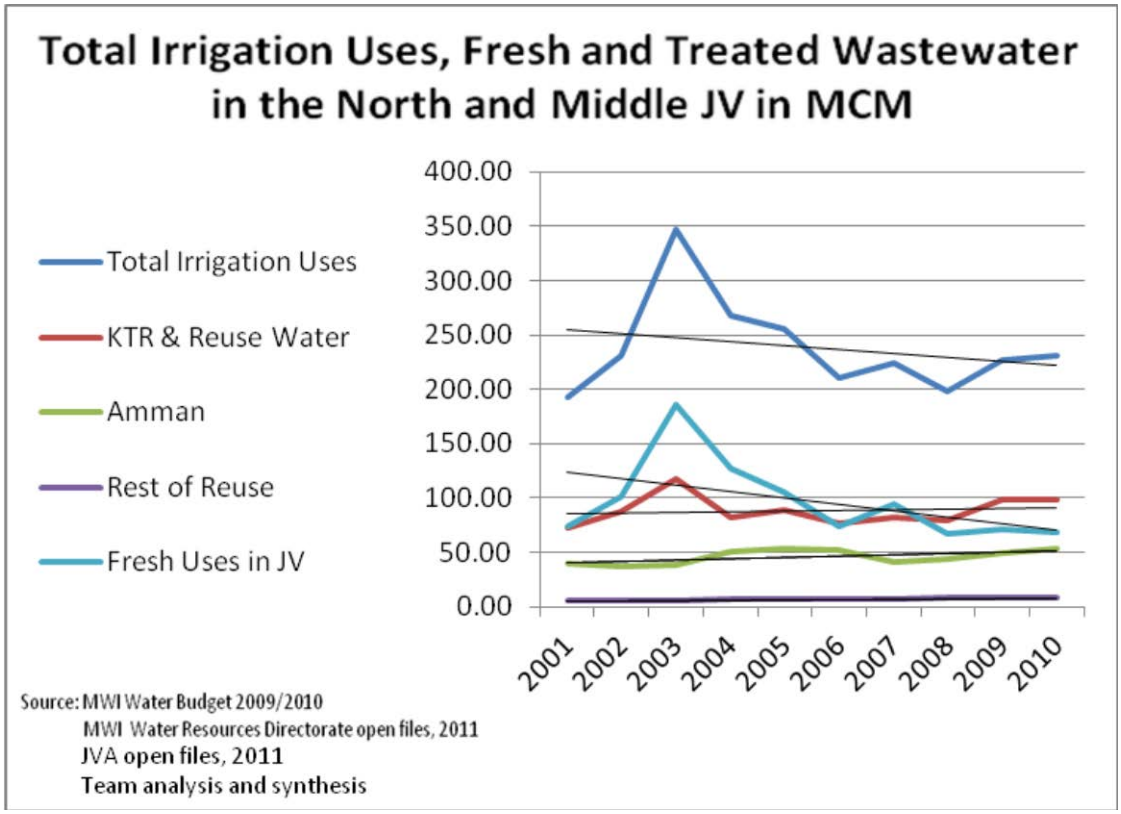


CHART 11. TOTAL WATER USES, IRRIGATION AND TREATED WASTEWATER

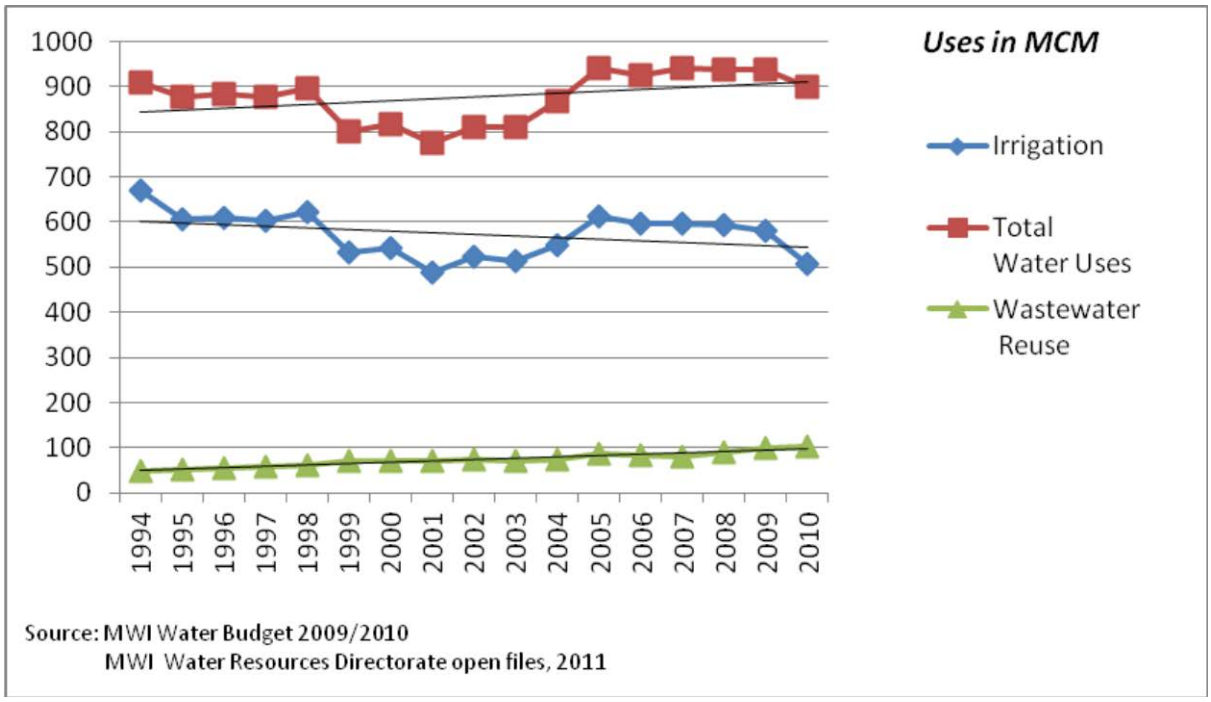
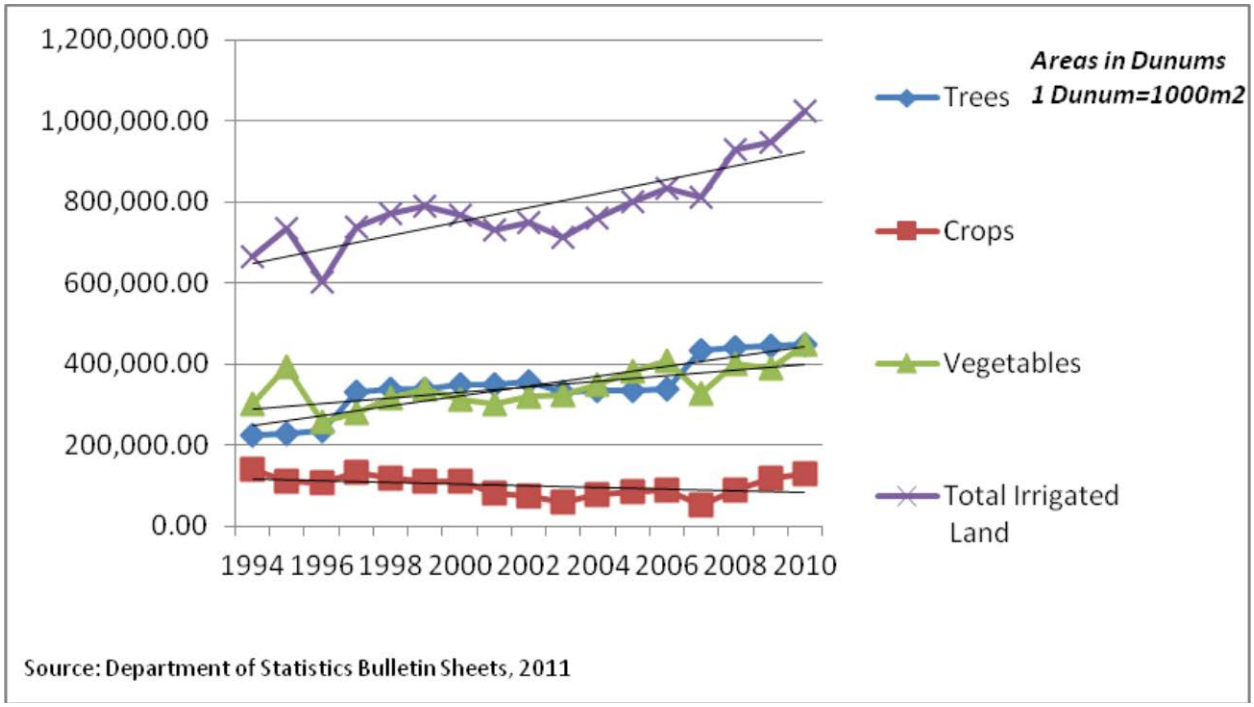


CHART 12. CHANGE OF CROPPING PATTERN, INCREASE IN IRRIGATED LAND AND IRRIGATION WATER.



4. SUPPLY AND DEMAND PROJECTIONS

Projections by MWI Water Sector Planning & Associated Investment Program 2002-2011, Accelerating Water Sector Transformation in Jordan by the 2030 Water Resources Group Study (2011) and MWI Report for Annual Water Budget (2011) as well as many other studies done by MWI and international organizations differ on the amount of future supply and demand for water, but they agree, without exception, that there is a serious gap and that simple, realistic solutions to close it are not apparent. For the purpose of this study, the team analyzed and synthesized the most reasonable and agreeable figures by MWI to have a look on the projected needs for all sectors within the coming years. The following assumptions are important to read before looking into Chart 14 and 15.

1. The amounts of all uses for all sectors for the years 1995 to 2010 have been actualized based on real supply figures as per MWI files.
2. The bases of these figures were taken from the MWI Water Sector Planning & Associated Investment Program 2002-2011 (2011).
3. The Domestic water demand projections were updated as per MWI Annual Water Budget of the year 2009/2010 (MWI open files 2011).
4. The Industrial Water demand projections were updated as per MWI Annual Water Budget of the year 2009/2010 (MWI open files 2011).
5. The irrigation water demand projections were updated using the ceiling of 700 MCM for the years 2015-2025 as per MWI Annual Water Budget of the year 2009/2010 (MWI open files 2011). It is worth clarifying that the increase from the current level of 500 MCM/yr to the 700 MCM is to cater

for the increase in treated wastewater reuse. In this model, demand is predicted to reach 700 MCM by 2015.

6. The future water sources and supplies and their projections used in the figures below were taken from the Accelerating Water Sector Transformation in Jordan by the 2030 Water Resources Group Study (2011). The study used the supply amount of 889 MCM/year as of 2015 or what the study called "Current and Financial Accessible Safe Yield Supply-Sustainable Supply". The 889 MCM/yr figure comply with the historical uses (around 800-900 MCM/yr, see chart 8(a)) and also offsetting future additional supplies on the order of 200-300 MCM with the reduction in available resources quantities like the Yarmouk River.
7. No consideration has been given to the Red Sea – Dead Sea Project due to uncertainty of completion at least within the projected planning horizon (2020-2025).
8. These figures are intended for regional planning use and policy formulation and in no way to be used for master planning or project design purposes.

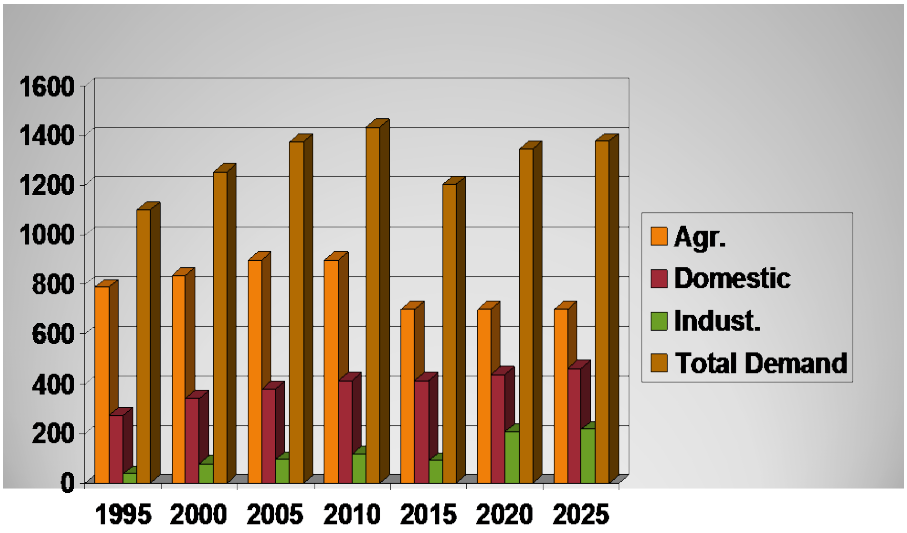
Projected future water supply availability from all sources shows that water deficit is increasing with time (Chart 15). Despite the huge investments planned by the MWI in the water sector until the year 2025, considerable water deficit will be facing Jordan. For example, the water deficit for all uses will grow from about 314 MCM in 2015 to 490 MCM by the year 2025. Suppressed demand and rationing distribution programs for domestic uses as well as irrigated agriculture can help to close the gap. Other options such as desalination of Red Sea water under any local, bilateral or regional option or maybe through a swap agreement with some of the regional partners can also help Jordan meet future demands.

Currently, the deficits are being covered by mining groundwater beyond their safe yields, and by exploitation of non renewable groundwater. In the near future, where additional naturally occurring fresh water is not available, domestic and industrial needs must eventually be met by desalinating the brackish and saline groundwater or sea water from Aqaba in particular.

The practical implications of permanent water deficit, a likely future scenario for Jordan, are twofold: on the one hand, activity in most water dependent sectors would have to adjust present behavior patterns of use to conserve and to use water more efficiently, and on the other, large and growing imports of food grains and energy would be needed to maintain an effective balance in the supply and demand for water. An important example of where important adjustments will be needed is found in the present practice of allocating available water mostly to agriculture without incentives to use it efficiently or to increase its productivity as it is the case with the precious groundwater resources of the highland areas. The current trend of decreasing per capita availability of low-cost, naturally occurring renewable supplies of water thus carries with it economic and social threats that Jordan must cope with.

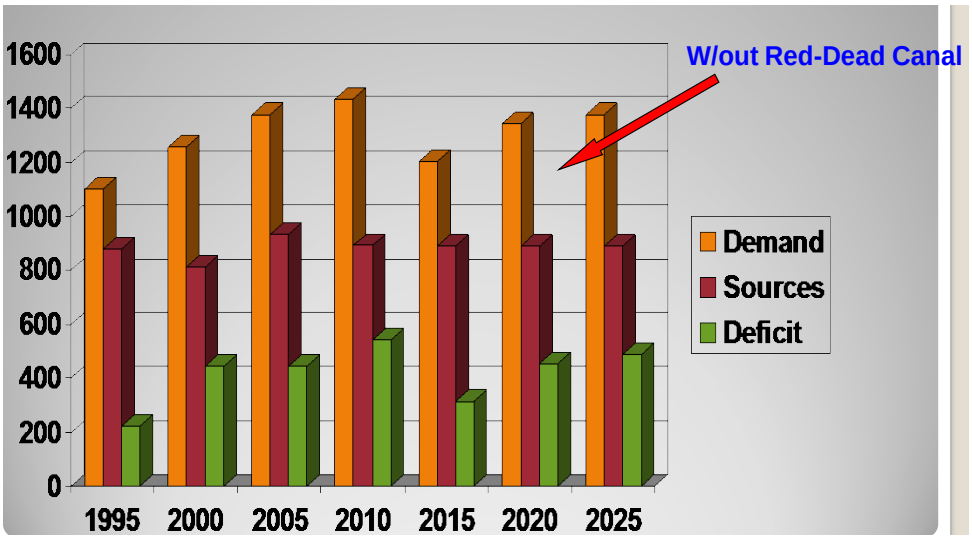
CHART 14. DEMAND PROJECTIONS FOR ALL SECTORS

Source: MWI Water Sector Planning & Associated Investment Program 2002-2011, MWI Water Budget Report



2009/2010, Water Resources Group 2030 Report (2011) and Team Analysis and synthesis

CHART 15. TOTAL DEMAND, SOURCES AND DEFICIT PROJECTIONS



Source: MWI Water Sector Planning & Associated Investment Program 2002-2011, MWI Water Budget Report
2009/2010, Water Resources Group 2030 Report (2011) and Team Analysis and synthesis

5. INSTITUTIONAL SET UP

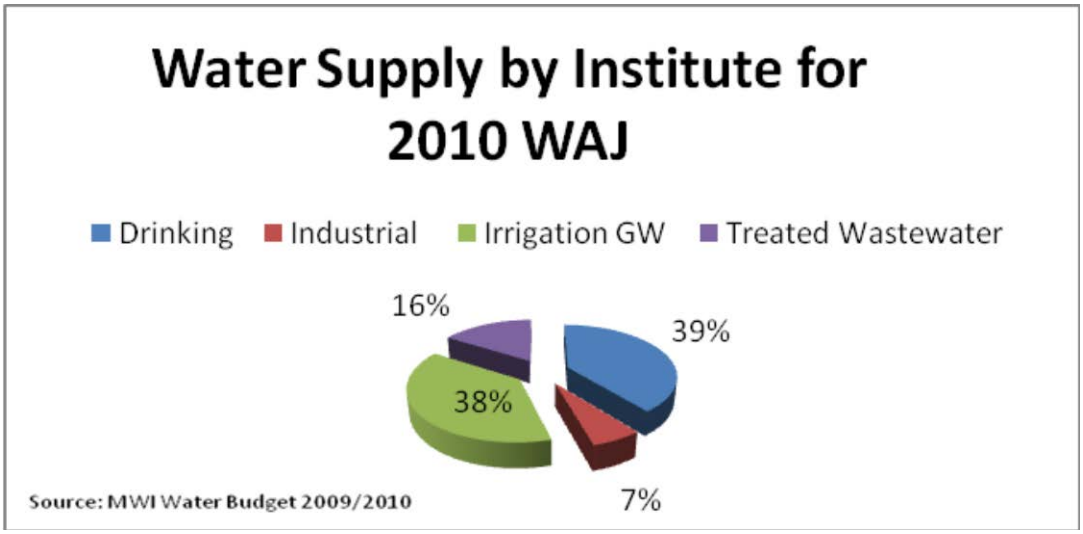
The main government agency entrusted with water resources responsibilities and with drinking water supply and wastewater services is Ministry of Water and Irrigation (MWI) which was created in 1992 to manage the country's water resources. MWI is responsible for the formulation and implementation of water and wastewater development programs and for recommending water sector policies and tariff revisions to the Council of Ministers.

The Water Authority of Jordan (WAJ) which was established by law in 1988 is an autonomous entity with financial and administrative independence beholden to government and civil service regulations. WAJ is governed by a Board of Directors chaired by the Minister for Water and Irrigation, representatives

of the Ministries of Planning, Agriculture and Health, as well as the Secretary General of WAJ and the Secretary General of the Jordan Valley Authority (JVA).

WAJ is in charge of the implementation of policies related to the provision of domestic and municipal water and wastewater disposal services. Its responsibilities include the design, construction, and operation of these services, as well as the supervision and regulation of construction of public and private wells, licensing well drilling rigs and drillers, as well as issuing permits to engineers and licensed professionals to perform water and wastewater related activities. Chart 16 shows the percentage allocation of water WAJ supplied to all sectors in 2010.

CHART 16. WATER SUPPLY BY WAJ FOR VARIOUS USES IN %



WAJ's Law was amended in 2001 under Article (28) in order to allow for private sector participation (PSP) in the water and wastewater service delivery through the assignment of any of WAJ's duties or projects to any other body from the public or private sector or to a company owned totally or partially by WAJ.

Out of the need to introduce private sector to water and wastewater operations, MWI/WAJ hired a Management Contractor (MC) to run water and wastewater facilities including water supply, sanitation services, metering and billing. The MC was converted in 2007 to a public company owned by WAJ (Miyihuna) and providing since then services for Greater Amman Area. A similar set up was done for Aqaba by creating Aqaba Water Company (AWC) to run all services related to water and sanitation within Aqaba Governorate. The Aqaba experience seems to be a successful one in terms of cost recovery and financial viability.

A series of micro PSP options were introduced to raise efficiency in metering and billing in more than one Governorate, namely: Madaba, Karak and Balqa.

In 2010/2011 WAJ created the Yarmouk Water Company (YWC) for the Northern Governorates including Irbid, Jarash, Ajlun and Irbid, to provide water and sanitation services to all these Governorates. Chart 17 (a) and (b) shows the amount of water supplied by all utilities under WAJ as well as WAJ itself.

CHART 17 (A). DRINKING WATER SUPPLY BY UTILITIES UNDER WAJ AND WAJ IN %

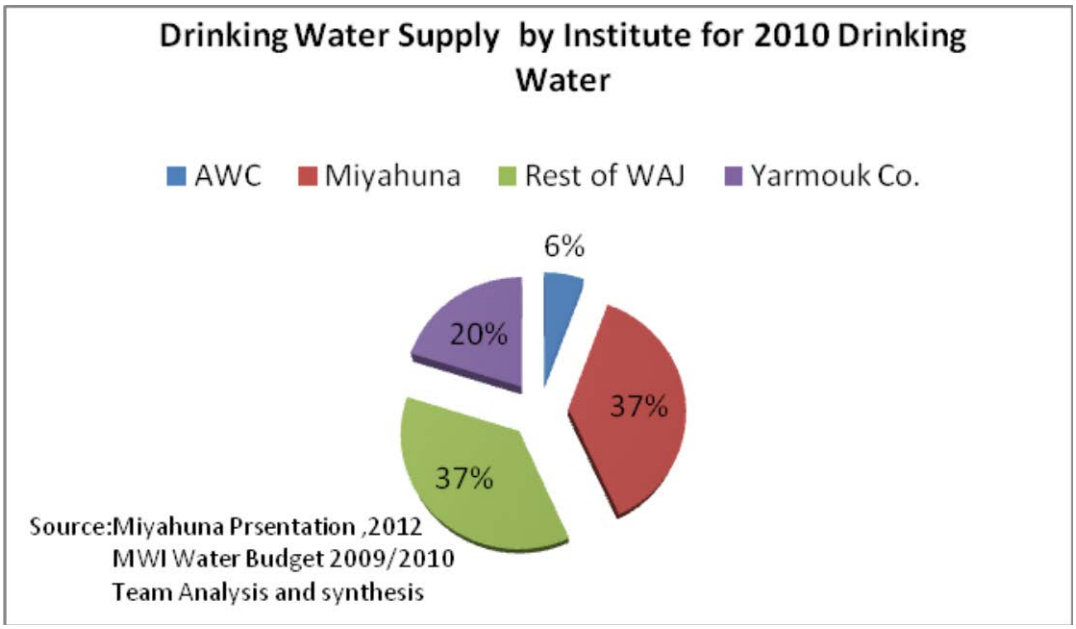
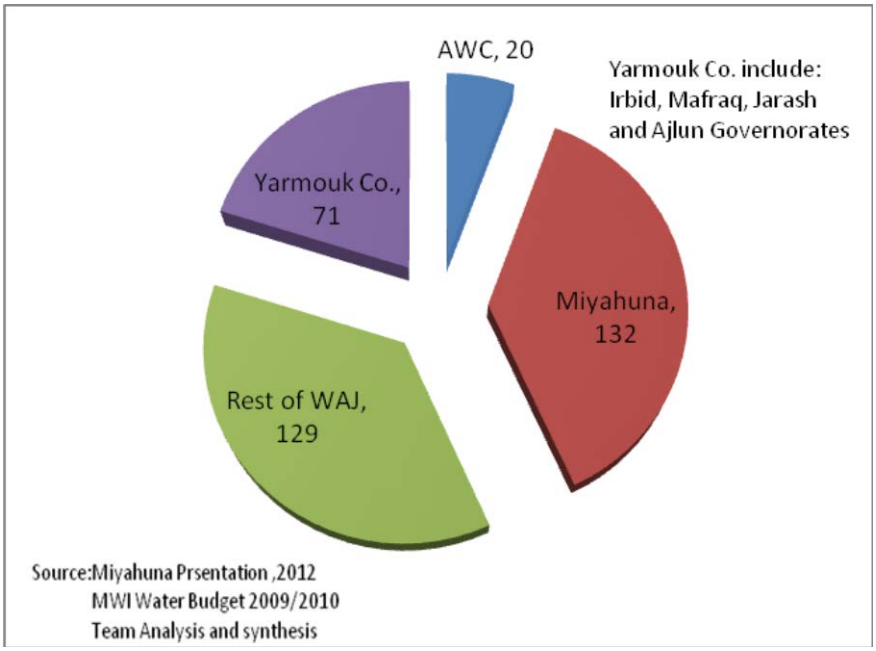


CHART 17 (B). DRINKING WATER SUPPLY BY UTILITIES UNDER WAJ AND WAJ IN MCM



In addition, the Program Management Unit (PMU) was established in 1997 to coordinate and monitor the first Management Contract (MC), to oversee the capital investment program for Amman, and prepare the other governorates for commercialization and PSP (El-Naser, 2009).

The Jordan Valley Authority (JVA) was created in 1977 and given the mandate to develop the Jordan Valley and the area south of the Dead Sea. Other responsibilities include: the development of water

resources (irrigation, domestic, industrial and municipal), development of towns and villages; design and construction of road networks, domestic water supply, electricity, telecommunications and provision of tourist facilities.

Other Government Ministries and organizations involved in the water sector include Ministry of Finance which oversees budgets and project financing; Ministry of Planning which involved mainly in Donor's affairs; Ministry of Agriculture involved at Farm Level Management including collection and communication of relevant data with regard to irrigated agriculture; and Ministry of Health which monitors the suitability of drinking water that is supplied by WAJ as well as effluents from public and private wastewater facilities.

Non-Governmental Organizations (NGO's) are mainly involved in public awareness towards national environmental issues, education, problem identification and proposed actions towards protection (e.g., Jordan Environmental Society and Royal Society for the Conservation of Nature). Other NGO's are involved in measurements, testing, training, education and monitoring work as a third party independent inspector mainly for water quality and material testing (e.g., Royal Scientific Society and Water and Environment Research Center at the Univ. of Jordan).

Table 4 below summarizes institutional responsibilities of all involved institutions in Jordan's water sector.

TABLE (4): SUMMARY OF INSTITUTIONAL RESPONSIBILITIES

Sector policy	Sector policy developed by MWI and adopted by Council of Ministers
Service provision	WAJ and private operators where responsibility has been delegated by the Council of Ministers e.g., Miyihuna, AWC, YWC, As Samra BOT Company
Regulation of prices, water resources and customer service standards	Prices: WAJ Board of Directors / Council of Ministers Water resources: Water Authority of Jordan Service standards: no regulation of service standards
Drinking water policy, monitoring and enforcement	Policy: Ministry of Health Monitoring: Water Authority of Jordan / Ministry of Health Enforcement: Ministry of Health
Environmental policy, monitoring and enforcement (with respect to water resources)	Policy: Water Authority of Jordan (as per Art.6b WAJ law) Corporation for Environmental Protection (as per Art.5f Law of Environmental Protection) Monitoring: Water Authority of Jordan, Corporation for Environmental Protection (as per Art.5e and Art.17 of the Law of Environmental Protection) Enforcement: Corporation for Environmental Protection and the courts (as per Art.22 Law of Environmental Protection)
Contracting for private investment	MWI: contract development WAJ: contract counterpart and contract monitoring
Public Awareness and Education	Campaigning and outreach: NGO's (Jordan Environmental Society, RSCN, etc.)
Measurements and testing	Third party inspector on water quality: Royal Scientific Society

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ANNEX 4: INSTITUTIONAL INVOLVEMENT IN THE WATER SECTOR

Institution	Functional Involvement														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Other Government Organizations															
Ministry of Planning	√										√			√	
Ministry of Municipal and Rural Affairs	√	√									√				√
Ministry of Finance	√										√				
Ministry of Agriculture	√	√		√				√						√	√
Ministry of Environment	√	√									√				√
Ministry of Health		√	√	√	√		√								√
Ministry of Public Works and Housing		√			√		√								
Ministry of Education				√						√					
Ministry of Industry and Trade		√	√												√
Ministry of Energy and Mineral Resources														√	
Ministry of interior		√													√
Ministry of Information and Communication Technology				√											
The Dept of Statistics	√														
Non Government Organizations															
Royal Scientific Society				√						√				√	√
Royal Society for the Conservation of Nature				√										√	
Environment and water NGO's				√					√					√	
Universities and Research Centers				√										√	√
Community Based Organizations				√					√						
National Farmers Union	√			√								√	√		
Jordan Valley Farmers Union	√			√								√	√		
Chambers of Industry and Commerce	√			√								√	√		

Legend

Sector Governance
1. Policy & Strategy Management
2. Legislation Development
3. Regulation Development
4. Sector communication

Sector Service Delivery
5. Planning Development and Construction (Nat)
6. Operational Management (Nat)
7. Planning Development and Construction (Loc)
8. Operational Management (Loc)
9. Customer Management

Sector Support
10. Human Resources Management
11. Finance and Administration
12. Information and System Management
13. Water Data Collection & Analysis
14. Research & Development
15. Monitoring & Enforcement

ANNEX 5. INVENTORY OF LESSONS LEARNED

This Annex provides an inventory of lessons learned identified in water strategy frameworks, water sector assessments, and project documents.

GENERAL:

-Infrastructure investments are perceived as having higher and longer -lasting benefits than TA contracts. USAID will need to maintain some balance between infrastructure and TA to retain credibility. USAID is capable of leading Middle East innovation (As Samra BOT WWT Plant) in infrastructure development that also shifts attitudes and practices (e.g., wastewater reuse). (Jordan Water Sector Assessment - JWSA)

- CPs raise awareness across GOJ of key issues but the most beneficial conditions (in terms of water allocation, tariffs, and sustainability) are among the most difficult to implement because of political and social constraints. Also, cash transfers linked to Conditions Precedent have raised general awareness across the GOJ of key water issues, but payments have historically been made even when CPs have not been fully met because of political considerations. (JWSA)

- Water policy reform and implementation requires coordinated action by at least 3 (MWI, MOPIC, MOF) ministries and the Royal Court. USAID has not yet learned how to successfully structure such coordinated programs (JWSA), and there are no models to follow.

- Champions are necessary but not sufficient to achieve policy and regulatory change (too much turnover in senior positions and the different constituencies have different interests – geographic, refugees, tribal, political, economic, and religious). (JWSA)

-Reduction in illegal wells and groundwater over-abstraction are a public policy minefield that is difficult to change through regulations that provide little or no compensation to illegal and over-abstractors (GMED)

-More likely than large-scale “violent conflict is the gradual degradation of water quality and/or quantity that over time can affect the internal stability of a nation or region and act as an irritant between ethnic groups, water sectors or states/provinces.” (Blue Revolution Initiative (BRI) Strategic Framework)

SUSTAINABILITY:

- Water resource sustainability requires environmental management plans and action; financial sustainability requires effective and equitable tariffs, transfers from taxes, and international transfers from donors and private foundations; investment and asset sustainability requires innovative financing (sovereign buy-downs, private sector mobilization of capital for BOT, BOO, BOOTs etc). (BRI)

-Commercialization models have the desired effects on management and operations capacity, with larger effects on newer facilities with BOT financing structures enhanced by capital cost buy downs (RIAL, AQABA)

-Government company ownership (Miyahuna and Aqaba Water Company -AWC) improves public and political acceptability, but can induce large potential constraints to financial sustainability from application of public accounting standards (cash-based accounting with zero reserves on a monthly basis). (JWSA)

-Wastewater treatment plants for small communities require careful attention and management to avoid basic design and construction flaws, over-optimistic operating assumptions, and failure to examine implicit assumptions about financial sustainability (WWMT)

- Pursuing sustainability through increased tariffs on agricultural water or municipal supply is unlikely to result in the coverage of current water subsidies or their continuing increase as new sources of fresh water double or triple bulk water supply costs. USAID's financial sustainability model is too simple. (JWSA)

-Embedding staff in water sector policy institutions and greater field presence by projects improves policy change planning and implementation, but USAID has resisted an approach that would embed its own staff and require contractors to co-locate with key partners). (JWSA)

- Infrastructure projects have helped to protect the environment, made wastewater available for reuse, and improved efficiencies. Sustainability could be improved by placing greater emphasis on full life-cycle costs and the long term sustainability of projects. (JWSA)

-Resource planning needs to consider the rights of established water users, balanced with the obligation to deliver similar water services to new generations of water users (GTZ WMP).

-Broad stakeholder involvement in water demand management program design improves the likelihood of public sector institutionalization and private adoption of sub-sector wide demand management activities (IDARA)

-Political support and a disciplined approach are needed. High level committees need to anticipate opposition and plan to engage and respond, discipline is needed to plan and execute the plan with daily contact, transition planning from old to new structures is needed, and consultants should be in the field throughout. (Segura/IP3).

-Education and information transmission on water use efficiency that ignores systemic problems in water delivery (e.g., pressurization and water quality in the JVA), will have lower financial benefits to users and less than expected results. (Kaa'fa)

DONOR AND STAKEHOLDER ROLES:

-RIAL provides two major lessons learned. First, USAID has the ability to affect policy changes, through prolonged and sustained engagement. Policy changes do not happen quickly. Second, projects targeted at institutional development and policy can have a multiplier effect on the returns of infrastructure projects. In this case, RIAL successfully linked Wadi Musa, a previous USAID project, with demand markets, while at the same time building the capacity of the corporatized AWC, and providing AWC a new means

of cost recovery. Coordinated efforts to assist the GoJ with amending legislation regarding reuse has paved the way for today's use, and valuation, of treated wastewater. (RIAL)

-Donors can act successfully on both the demand and supply side (AWC, Miyahuna utility financing innovation). (Segura/IP3)

-Political support and a disciplined approach are needed to achieve policy and institutional change. High level committees need to anticipate opposition and plan to engage and respond, discipline is needed to plan and execute the plan with daily contact, transition planning from old to new structures is needed, and consultants should be in the field throughout. (Segura/IP3).

-Feedback loops need to be established with stakeholders to signal needed change and measure its achievement as real world pressures affect the designed changes (Segura/IP3)

GENDER:

-Women are central to household water management and hygiene and need to be included in water management and in feedback as customers to water supplier and utilities (BRI Strategic framework).

-Waste management is gender-centered and the starting point is at the household. Changing hygiene behavior is the key complement to necessary infrastructure construction, with government facilitation of e good decision-making at the household level (standards, codes, community participation in design to increase acceptance, cost recovery, and effective O&M). (ABRI)

MONITORING AND EVALUATION:

-Lessons should be learned from other arid, water-short regions of the world (WRE 2007-2011 Strategy Statement). The corollary is that benchmarks comparisons should be made with countries with similar situations and not from more humid, well-supplied water environments. (JWSA)

- USAID needs to set time-to-impact measures that align better with business and household acquisition of water demand management knowledge, the time needed to shift attitudes, and the time and mechanisms need to support behavior change (WEPIA), for example, through social marketing programs linked to policy change (building and plumbing codes) that result in financial savings at the household and business levels. (JWSA)

-USAID M&E efforts are fragmented, too distant from partner experience, and too focused on minor bureaucratic indicators rather than key drivers of policy change, regulatory enforcement, and improved financial management of subsidies and sectoral investments. (JWSA)

- USAID has the ability to influence Jordanian policy through long engagement (privatization, treated wastewater reuse through various projects) but may expect too much change too quickly. Water allocation among sectoral users is highly politicized and resistant to change for a range of social, political, and economic reasons that may require broader analysis, action, and longer timelines than USAID may be willing to lead and finance. (JWSA)

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