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COMPREHENSIVE SECTOR ANALYSIS REPORT

FINAL REPORT

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COMPREHENSIVE ANALYSIS REPORT

WATER AND WASTEWATER SECTOR

LEBANON

Prepared under Task Order # 01/AID-OAA-TO-10-00018 under the WATER II Indefinite Quantity Contract, #EPP-I-00-05-00010-00.

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LIST OF ABBREVIATIONS

AUB	American University of Beirut
AFD	French Aid (Agence Française pour le Développement)
AFIA	Association of the Friends of Ibrahim Abdelal
BAH	Booz Allen Hamilton
BCM	Billion Cubic Meters
BKWE	Bekaa Water Establishment
BMLWE	Beirut and Mount Lebanon Water Establishment
BOD	Biochemical oxygen demand
BREEAM	Environmental Assessment Method (European equivalent of LEED)
BRE	Environmental Assessment Method
BWE	Baalbek Water Establishment
CAPEX	Capital Expenditure
CAS	Central Administration of Statistics
CDL	Community Based Livelihoods
CDM	Camp Dresser and McKee
CDR	Lebanon Council for Development and Reconstruction
CHF	Cooperative Housing Foundation
CIDA	Canadian International Development Agency
CNEWA	Catholic Near East Welfare Association/ Pontifical Mission
COD	Chemical Oxidation Demand
COTR	Contracting Officer's Technical Representative
CSIS	Center for Strategic and International Studies
CSM	Colorado School of Mines
DAI	Development Alternatives, Inc.
DBO	Design, build, operate
DG	Director General
DIFID	United Kingdom Department for International Development
EA	Environmental Assessment
EDL	Electricite du Liban, Lebanon's electric power company
EGAT	Economic Growth Agriculture and Trade Bureau
EIB	European Investment Bank
EPIQ	Strengthening Indefinite Quantity Contract
EU	European Union
EXBS	U.S. Department of Commerce and Trade's Export Control and Related Security Program
FAO	Food and Agricultural Organization of the United Nations
FAS	Financial accounting system
GAAP	Generally Acceptable Accounting Principles
GDP	Gross Domestic Product
GIZ	German International Cooperation Agency

GMAO	Gestion de la Maintenance Assistée par Ordinateur (French: Computer Maintenance Management System)
GTZ	German Agency for Technical Cooperation (incorporated into GIZ as of 1 January 2011)
GW	Gigawatt
HA	Hectare
ICARDA	International Center for Agriculture in Dry Areas, Aleppo, Syria
ICLEI	International Council for Local Environmental Initiatives
IMG	International Management Group (consulting company managing EU programs in Lebanon)
IQC	Indefinite Quantity Contract
IRD	International Red Cross
IDRC	International Development Research Center
IRG	International Resources Group
KW	Kilowatt
KM	Kilometer
LAIS	Liberal Arts & International Studies Department
LEED	Leadership in Energy and Environmental Design (US-equivalent of BREEAM)
LRA	Litani River Authority
LRBMS	Litani River Basin Management Support Program
LWPP	Lebanon Water Policy Program
LWWSA	Lebanon Water and Wastewater Sector Assessment
LWWSS	Lebanon Water and Wastewater Sector Support
MCC	Millennium Challenge Corporation
MCI	Mercy Corps International
MCM	Million Cubic Meters
MDA	Municipalities Development Association
ME&A	Mendez England and Associates
MEDRC	Middle East Desalination Research Center, Oman
MENA	Middle East and North Africa
MIPER	Master of International Political Economy of Resources Program
MoE	Lebanon Ministry of the Environment
MEW	Lebanon Ministry of Energy and Water
MoI	Lebanon Ministry of Interior
NCSR	Lebanon National Council for Scientific Research
NGO	Non-Governmental Organization
NIWAR	New Zealand National Institute of Water and Atmospheric Research
NLWE	North Lebanon Water Establishment
NWSS	Lebanon National Water Sector Strategy
O&M	Operations and Maintenance
OMEP	Office of Middle East Programs
OORTP	Olive Oil Residue Treatment Plant
OPEX	Operational Expenditure
PIP	Performance Implementation Program
PPM	Promote Preventive Maintenance
POC	Point-of-contact
PPP	Public Private Participation
PSP	Private Sector Participation

QRTA	Quick Response Technical Assistance
RFTOP	Request For Task Order Proposal
RWE	Lebanon Regional Water Establishment
SADC	Swiss Agency for Development and Cooperation
SJU	Saint Joseph University (USJ in French)
SLWE	South Lebanon Water Establishment
SO	Strategic Objective
SOW	Scope of Work
SEPP	Sustainable Environmental Practices and Policies
SFG	Strategic Forecast Group
SIDCA	Swedish International Development Cooperation Agency
SVWWTPS	Small Village Wastewater Treatment Plant Support
TBD	To Be Determined
TDS	Total Dissolved Solids
TOC	Total Organic Compounds
TOR	Terms of Reference
UNICEF	United Nations Children's Fund
UNRWA	United Nations Relief and Works Agency
USAID	United States Agency for International Development
WASH	Water, Sanitation and Health
WB	World Bank
WE	Water Establishment
WRS	Water Resources Sustainability
WSS	Water Supply and Sanitation
WT	Water Treatment
WUA	Water User Association
WW	Wastewater
WWT	Wastewater Treatment
WWTP	Wastewater Treatment Plant
YMCA	Young Men's Christian Association

EXECUTIVE SUMMARY

This Comprehensive Sector Analysis Report is one of several work products under the Lebanon Water and Wastewater Sector Assessment (LWWSA). The report is prepared for the U.S. Agency for International Development (USAID) Lebanon by Mendez England & Associates (ME&A), under the Quick Response Technical Assistance through the Water II Indefinite Quantity Contract. The report provides an assessment of the current situation of the water and wastewater sector in Lebanon.

The three-person Assessment Team prepared this report with technical support from Washington, DC, over a seven-week period. The Team compiled and reviewed over 200 documents, interviewed over 100 people, conducted ten site visits, evaluated the water and wastewater sector in the country, and held many discussions.

During the assessment, the Team identified the strengths and weaknesses of the sector.

The Team found that the public water sector management, implementation, and efficiency in Lebanon are weak and non-sustainable without donor funds and extensive outsourcing to the private sector. The reasons for this are: 1) institutional and political constraints; 2) sectarian proportionality and confessionalism; 3) appointments not based on competency; 4) heavily centralized decision making; 5) corruption and cronyism; 6) unavailability of trained, experienced and motivated personnel; 7) inadequate capital/operations/maintenance capacity; 8) old or failing and incomplete physical infrastructure; and 9) poor financial practices.

The Team also found a number of strengths in the sector, coming from: 1) relatively abundant water resources; 2) a growing economy and educated population; 3) awareness of challenges among public sector operators; generous international donors; 4) savvy academics, researchers and private sector advisors, consultants, and engineering firms; 5) successful non-governmental organizations; and 6) reportedly highly successful private sector water and beverage bottling companies.

Based on the findings of the assessment, the Team arrived on a number of key conclusions, which are listed below. For convenience, these conclusions are grouped by the following categories:

1) General;
2) Institutional - Legislative;
3) Institutional – Water Establishments;
4) Potable Water;
5) Wastewater;
6) Agriculture;
7) Other;
8) Support; and
9) USAID/Lebanon.

General

1. On a regional level, Lebanon has relatively abundant renewable and stored fresh water resources, which are available for development but are not well assessed, quantified, or efficiently exploited. Lebanon's water resources are positioned to increase in importance; therefore, efficient water exploitation and integrated water resources management (or sequencing) would benefit the country's economy and stability. Currently, neither of these is practiced.

2. Lebanon could become a water exporter if integrated water resources management (IWRM) was applied efficiently and its water resources were well managed. However, water exporting is also a political issue. Lebanon already exports bottled drinking water from natural mountain springs to the Gulf States.

3. Much of Lebanon's fresh water is not captured and stored; it is discharged to the Mediterranean Sea during the wet winter, spring, and summer by streamflow, sea springs, and sub-marine springs. These water resources are generally not available to water users. They are not quantified and do not contribute to the economy.

4. Available natural water resources are under threat from: a) coastal seawater intrusion; b) pollution from agricultural wastes, solid wastes, untreated sewage, and industrial and medical wastes; c) summer droughts leading to over-pumping of groundwater; and d) un-met water demands due to weak resources management and regional conflicts related to shared water resources.

5. Significant amounts of fresh water from rivers help support the natural Eastern Mediterranean Sea ecosystem and refresh Lebanese coasts and beaches.

6. Because Lebanon's water supply, quality, demands, uses, economic worth, and balance (water budget) are unmeasured and poorly assessed, water scarcity, deficits and inefficiencies are not quantifiable.

7. Recent wars and conflicts have destroyed much of Lebanon's infrastructure, which continues to challenge its limitedly staffed institutions to operate efficiently, including its water utilities (or WEs).

8. There is an anticipated water deficit in Lebanon - based on population projections and estimated renewable fresh water resources - which is not quantified at present but is generally assumed to be true by sector experts. With the apparent decline in rainfall in recent and projected years - as reported by observes in the Bekaa, announced by the Ministry of Energy and Water (MEW) to Parliament, and frequently commented upon in the Daily Star articles - and increasing population and demands on readily available fresh water resources, the deficit will be exasperated without efficient IWRM and increased significant water sector efficiencies.

Table 1: Needs of Lebanese Organizations in the Water Sector

Needs of Lebanese Organizations in the Water Sector
Information. Appropriate and accurate water resources and water use information, well-managed and readily available so that better management decisions may be made
Reform. Institutional reform to depoliticize the Water Establishments (WEs) and the municipalities to give them authority to operate their sectors and to make and implement significant decisions in staffing, budgeting, fee setting and income, contracting and outsourcing to manage the sector professionally and free of the currently imposed bureaucracy, sectarian and confessional elements
Human capacity. Public sector human resources capacity in administration, business, finance, management, engineering, and facilities operations and maintenance
IWRM. Knowledge and understanding of the benefits of IWRM (water sequencing, demand management, water reuse and recycling) to improve water management and to include IWRM concepts in their planning activities and policy development
Policy. Shift Lebanese water policy from obtaining more fresh water resources to manage its entire water resources efficiently and sustainably

9. Lebanon's water sector is highly dependent on water resources, use information and data, skilled resource management, dependable energy, trained professional and technical personnel, adequate spare parts, ongoing maintenance, sufficient cash flows, and other conditions and inputs. However, these resources are generally not readily available.

Institutional-Legislative

1. Lebanon lacks an approved national water law or code (the code, modeled after the French *Code de l'Eau*, has been pending since 2005). In addition, there are neither agricultural, nor other water user associations (WUA), a national agricultural management plan or integrated water management plan, or agency to regulate environmental pollution. A national plan for solid waste management is being drafted but has not yet been completed or approved. Law 221 delegates water authorities but is poorly designed.

2. Lebanon has a proposed draft National Water Strategy (NWS) which favors large infrastructure projects and has numerous plans for dams and other sector infrastructure requirements. However, it has not yet been approved by the Council of Ministries and may be superseded by future Councils. (Note: at the time of this draft, Lebanon does not

have a government due to disputes among the major parties and its parliament has not passed a national budget since 2004; most of its plans remain unimplemented.)

3. Lebanon has a highly qualified cadre of water academics, government officials, and private-sector engineering consultants who could be called upon to re-establish Lebanon's preeminence in Middle Eastern water management. However, Lebanon lacks a comprehensive master plan and implementation strategy. MEW has recently prepared a draft NWS.

4. Lebanese water management authorities, from ministries to WEs and municipalities, know well their water sector needs and what is needed to improve the sector through their experience and donor-imposed planning. However, they do not know quantitative information on the national water balance, as it is not measured. The union of municipalities, and municipalities themselves, know where the water demands and pollution sources are in their jurisdictions, as they issue some environmental and construction permits (pollution sources: bottomless septic tanks, industrial polluters, solid waste dumps).

5. Lebanon's Government, the Council for Development and Reconstruction (CDR), ministries, and institutional water sector authorities - MEW, WEs, Litani River Authority (LRA), and municipalities - are highly politicized, mixed with sectarian proportionality and confessionalism, centralized, fractionated, sometimes conflicted, and generally bureaucratic. All these create inefficiency in the sector and stifle water utilities services. Water sector appointments and employment, which are not competency-based but politically or socially based, cannot be expected to produce sound technical decisions and actions.

6. Reforming the water sector structure to empower the four WEs, enact the draft Decree relative to the re-structuring of the MEW after reviewing and improving it, clarifying the roles of the various administrations - WEs, LRA, municipalities, MEW, Ministry of Environment (MoE) - playing a role in the water sector so that their prerogatives don't overlap, establishing and empowering river basin authorities (noting that a reformed LRA could become one of those basin authorities), and establishing agricultural WUAs (noting that a Draft Law for the establishment of such associations is presently being prepared) would lead to better and more efficient water services, according to many stakeholders interviewed.

Institutional – Water Establishments

1. Several interviewees indicated that public private partnerships and outsourcing to the private sector would lead to better and more efficient water and wastewater services if the public sector has the capacity to oversee contracts. All the WEs outsource extensive unskilled and some professional services and engineering support, which is commonly their second largest budget item after energy costs. They could use training in contract and outsource management.

2. Current law mandates WEs to take on functions (which they are ill equipped to perform) in potable water supply production and distribution, wastewater collection and treatment, and agricultural bulk water supply. The WEs indicated that their expertise is in potable water supply and not in wastewater treatment or agriculture. Typically, the first priority of WEs is supplying potable water.

3. The four WEs - ranked by the Assessment Team's perceived best to worse performance based on financial strength and provision of water services, area served, and level of service - would be: 1) Beirut and Mount Lebanon Water Establishment (BMLWE) and 2) North Lebanon Water Establishment (NLWE), then a large jump down to 3) Bekaa Water Establishment (BKWE) and 4) South Lebanon Water Establishment (SLWE). BKWE and SLWE are the most in need of support. BMLWE, the largest in population served and in potable water revenues, is the most advanced WE.

Potable Water

1. Although Lebanon's potable water supply is relatively abundant for the Middle East, there is no generally recognized interest or initiatives in IWRM (sequencing), artificial groundwater recharge, roof top or street water harvesting, or grey water reuse. Water is generally very low priced (or nearly free) and unmetered.

2. Lebanese citizens who receive potable water service pay at least three times for water and twice for energy, both of which sectors are undependable. Residents pay for WE-delivered potable water, vendor-supplied potable water, and store-bought bottled drinking water. Some Lebanese pay again for water for their back-up water wells and water treatment facilities. Concerning energy, Lebanese pay for both utility-supplied electricity and for on-site back-up generators. Lebanese have high expectations of their water utilities (WEs), which cannot be met. Multiple payments are an economic burden and detract from economic growth. Surveys indicate that the public is willing to pay more for good service and quality water.

3. Potable water utility collection payments are poor; payments are reportedly less than 20% in BKWE but as high as nearly 100 % in the Northern part of the LRA agricultural user area. The low payments may be improved if water agencies provide reliable, sustainable, high-quality water, as people say they are willing to pay even more if they have reliable service.

4. Potable water utility distribution is generally weak, especially outside Lebanon's major cities (Beirut, Tripoli, Saida, and Zahle). Even so, other than in narrow areas of Tripoli, potable water distribution is less than 24 hours/day, often only a few hours a day and maybe less in the summer. Approximately 25% of the Lebanese population in both rural and urban areas have no delivered water service, but presumably obtain their water from local wells, springs, vendors, concessions or unauthorized and illegal connections to water distribution networks.

5. Potable urban water distribution networks, reportedly, have high water losses and suffer from leakage and unauthorized (illegal) connections and taps, on the order of 40 to 60%.

Wastewater

1. Lebanon's wastewater is generally not treated or is improperly treated according to international standards; there is little if any water sequencing or reuse of treated wastewater to substitute for fresh water demands in agriculture, industry, or energy. However, as a widespread practice, farmers frequently use sewage and other polluted waters for irrigation, including raw sewage in the summer when other water sources are unavailable. Most of the country is not connected to a Wastewater Treatment Plant (WWTP), and wastewater is disposed of directly to groundwater, rivers, or the sea. Septic tanks generally need to be pumped out but disposal of pumped-out sewage is to rivers or the sea. Some septic tanks have several chambers, the last of which directs liquid effluent to a dry well for groundwater recharge. Septic tank leaching fields are generally unknown.

2. Much of Lebanon's shallow groundwater, summer, or low-flow surface water resources and valley lakes suffer from contamination by municipal, domestic, industrial, commercial, and agricultural wastes as well as solid, hazardous, and in some places, medical and olive oil-residue wastes.

Agriculture

1. The agriculture sector is the largest water user in Lebanon and should be a focus of efficient water management, as it comprises approximately 70% or more of water use in general and over 80% of water use in the summer, although exact figures are unknown. Small improvements in agricultural water efficiency would make large amounts of fresh water available for other uses or expanded agriculture. Moreover, use of recycle water from wastewater treatment effluent could free fresh water for other uses.

2. Lebanon has the potential to become more self-sufficient in food production and a larger exporter of some high value crops (fruits, vegetables, flowers) than what it is currently. Thus, Lebanon could become a water-enhanced value chain producer and exporter if it managed its arable land and water more efficiently.

3. Water is owned (as in the French tradition) by the national government, but by tradition and lore there are vested riparian water rights tied to land ownership and traditional water usage. Conflicts over water are generally resolved through negotiations and informal agreements rather than by adjudication and contracts.

Other

1. Lebanon has the potential to generate substantial, sustainable wind energy from mountain towers, hydropower through mountain tunnels, and waste-to-energy from its wastewater, wastewater sludge (biosolids), and agricultural and municipal solid waste. However,

these alternative energies warrant further study. Solar energy is also feasible on some levels such as household water heating, which would free up energy for other uses. Heat exchangers for waste-heat recovery and energy co-generation are also feasible.

2. Lebanon's water resources, particularly its mountain and sea springs and watery caverns and karsts, could be framed for eco-tourism, which could tie-in with the country's several UNESCO World Heritage Sites, such as the world-famous Geita Grotto. However, eco-tourism in water is challenged by water pollution, such as the corniche or river walk in Zahle.

Support

1. The water sector suffers from weak or unavailable public sector professional and technical staff capable of operating and maintaining infrastructure, as well as a lack of cash-flow for operations and maintenance and capital improvements, and weak partners authorized and capable to manage the sector.

2. There are many donors willing and able to contribute to Lebanon's water sector; however, their effectiveness would improve through better coordination, communication and project planning. Although this is challenging, better coordination is needed to avoid the missteps of partially completed and ill or unconnected programmatic pieces such as WWTPs awaiting collector sewers, as in Tripoli and the Bekaa, and, more broadly, Water Treatment Plants (WTPs) and potable water stations awaiting connections to households and taps.

3. Collaboration with and empowering of water authorities, after mutual agreement on goals, objectives and levels of funding, has been successful and should be continued and increased. The WEs and LRA expressed satisfaction with USAID/Lebanon's current collaborative Litani River Basin Management Support (LRBMS), Lebanon Water and Wastewater Sector Support (LWWSS), and Small Village Wastewater Treatment Plant Support (SVWWTPS) programs.

4. There is a lack of accurate water resources data and comprehensive studies on the water sector; some recent studies are available but they are not readily available. Many interviewees expressed frustration regarding unavailable or poor-quality of water resources, water quality, and water uses data. For example, there is no ongoing data collection of snow fall and mountain rainfall (rainfall stations are typically located at airports), nor are there ongoing stream flow and groundwater level measurement programs, natural resources water quality sampling and analysis programs, or water consumer use measurement programs.

5. Supporting and empowering shared water resources in Lebanon may have high value and impacts. This reflects the paradigm of IWRM (or water sequencing), which is not yet applied in Lebanon but is quite successful in the region.

USAID/Lebanon

Table 2. Impact of the USAID/Lebanon Assistance in the Water and Wastewater Sector

Impact of the Assistance of USAID/Lebanon in the Sector
USAID/Lebanon is making progress towards reaching its goals of making water resources more valuable, manageable and improving water management.
USAID/Lebanon's current programs are successful and well received by stakeholders and beneficiaries, though recipients say they have more unmet needs yet to be filled. Their successes depend largely on close collaboration with their stakeholders.
USAID/Lebanon's positive impacts and benefits from its current technical assistance through the LWWSS, LRBMS, SVWWTPs programs are likely to be sustainable beyond the intervention.
USAID/Lebanon's positive impacts and benefits from its current pollution control (via wastewater treatment through the SVWWTPS program) are challenged by the uncertainty of which organizations will operate the plants beyond the intervention. If appropriate arrangements are made beyond the intervention, its impacts and benefits would be sustainable.
USAID/Lebanon's previously funded small-scale, community-based, WWTPs in South Lebanon and Mount Lebanon are not sustainable without the support of the WEs, which is mandated by Lebanese law to have that responsibility. Where the Beirut and Mount Lebanon Water Establishment (BMLWE) has taken over the cluster WWTPs of Chouf, there are successes with likely sustainability.

USAID/Lebanon's current implementing partners - Camp Dresser and McKee (CDM), Development Alternatives, Inc. (DAI), International Resources Group (IRG) - are doing good work under the difficult circumstances caused by institutional constraints and challenges. Their efforts could be easily scaled up, replicated, and expanded with little risk. However, five to ten years of effort would more likely lead to sustained results and impacts; their current time-frame is too short to be sustainable. In addition, those programs which design, build, and operate physical infrastructure, such as WWTPs, are likely only to have short-term impacts if there is no municipal or WE champion.

1.0 INTRODUCTION

In the preparation of this report, the Assessment Team followed the guidelines presented in the Scope of Work (SOW) of the Request for Task Order Proposal (RFTOP).

1.1 Key Issues and Threats

Lebanon faces several pressing issues and threats - declining water quality, rising prices, environmental degradation, inadequate electrical supplies, corruption, and severe development disparities across the country - which are all well-known in the country and publicized routinely in its daily newspapers.

The scope for this sector assessment is very broad but does not include issues relating to the Palestinian camps, in which perhaps 425,000 people (10% of the population) live and work. The responsibility to provide water, wastewater, sanitation and other basic services for these refugees is borne by international humanitarian organizations, especially by the United Nations Relief and Works Agency (UNRWA).

The Lebanon water sector (and the energy sector, which is required for a strong water sector) is in disarray and non-functional in several ways as it does not know its water supply, water quality, or water uses in detail, and cannot provide potable water to fully meet demands all the time, nor does it sufficiently collect and treat its wastewater.

Although Lebanon has the most rainfall and the some of the highest educated people in the Arab Middle East, it has been challenged by years of civil war (1975-1990), unfavorable border-water allocations, unresolved border conflicts, extremely limited institutional human resources capacity, massive emigrations and massive refugee immigrations, an inefficient public sector, and arguably declining rainfall. The public sector is built on an old administrative French model of red tape and centralization, which is complicated by Lebanese sectarian particulars, which require that decision-making be made on a socio-politico-sectarian basis.

There are several big issues or big-issue components to keep in mind when evaluating water resources, quality, and uses, as well as the fate and transport of the stocks and flows in the water sector. They may be considered in terms of three major challenges:

1. State challenges: inadequate governance, leadership, vision, and continuity
2. Institutional challenges: failure of institutional framework in allocating responsibilities and authority to the water utilities
3. Financial: lack of capacity to invest in the energy and water sector

2.0 BACKGROUND

This section presents information on Lebanon's physical, geo-political, and socio-economic backgrounds; water resource – water balances; institutions, structure, laws and regulations; conservation activities; and donor, NGO, and USAID/Lebanon activities.

2.1 Lebanon's Physical Background – Geography, Climate, and General Setting

Location and size. Lebanon borders the Mediterranean Sea to the west and lies between Israel to the south and Syria to the northeast and east. Lebanon's total land area is 10,400 square kilometers, of which only 170 square kilometers (less than 2%) is surface water. Its total land border is 454 kilometers, bordering 79 kilometers with Israel and 375 kilometers with Syria. Its Mediterranean Sea coastline is 225 kilometers, and its maritime claims extend 12 nautical miles as territorial sea.

Please see Annex E for its physical characteristics and climate, and a more detailed information on Lebanon's morphology, climatology, hydrology, vegetation and environment.

Figure 1. Map of Lebanon

Organization. Lebanon is divided into eight governorates or provinces (*mohaafazaat*; singular *mohafazah*), which are further subdivided into 25 districts (*aqdya*; singular *qadaa*; *caza*). The districts are also divided into several municipalities, each enclosing a group of cities or villages. Listing clockwise from the top of the map next page (see Figure 2), the eight governorates are: 1) Akkar; 2) Baalbek-Hermel; 3) Beqaa (Bekaa); 4) Nabatiah (Nabatiye); 5) South; 6) Beirut; 7) Mount Lebanon (Jabal Lebnan); and 8) North (Al Chemal), with the Mediterranean Sea to the left or west.

The Nabatiah and South Governorates are often discussed together geographically as South (Al Jounoub), Akkar and North as the North, and Baalbek-Hermel and Bekaa as The Bekaa. The WEs are structured to cover the country, using the old divisions of North Lebanon, Bekaa, South Lebanon, and Beirut/ Mount Lebanon.

Climate and terrain. Lebanon has a Mediterranean climate, with mild to cool wet winters and dry summers. Its mountain ranges experience winter snow and spring thaws. Its terrain is a narrow coastal plain to the west, and the Bekaa valley between its northeast-south west trending Lebanon and Anti-Lebanon mountains. Its lowest point is sea level at the Mediterranean and its highest point is 3,088 meters above sea level at Qornet es Saouda.

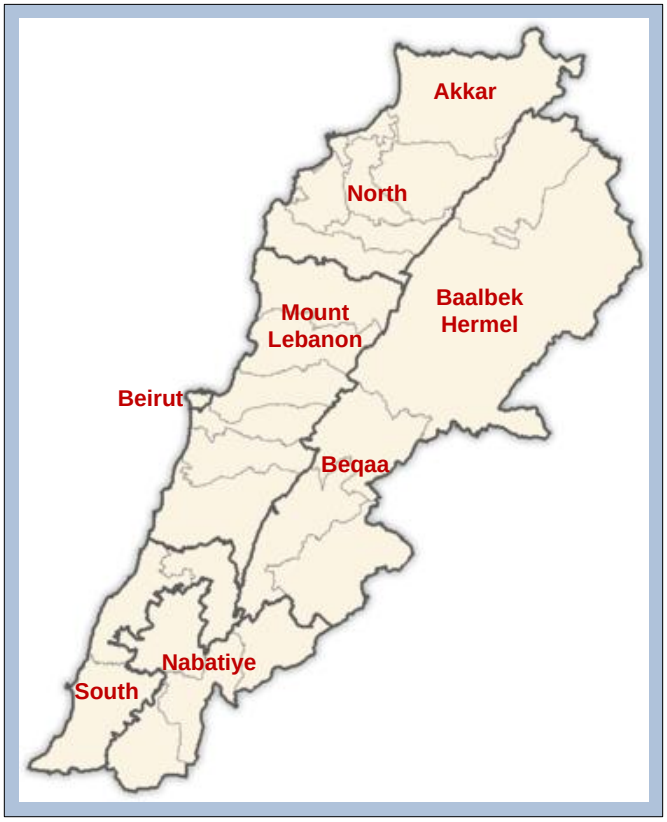

Figure 2. Governorates of Lebanon

Natural resources. Lebanon's natural resources include limestone, iron ore, salt, water surplus in a water-deficit region, and arable land. Recent surveys have identified possible offshore natural gas reserves. Its 2005 land uses were 16.25% arable land, 13.75% permanent crops, and 69.9% other land uses. Natural hazards in Lebanon include dust storms, sandstorms, and occasional earthquakes and flooding. Its environmental challenges include deforestation, soil erosion, desertification, air pollution (in Beirut, from vehicular traffic and burning of industrial wastes), and pollution of coastal waters from raw sewage and oil spills. There is also significant surface water and groundwater pollution from raw sewage, industrial waste, solid waste or trash, and agricultural runoff or tail-waters. The Litani River and Aammiq Wetlands (the largest remaining freshwater lake area in the country) as well as Lake Qaraoun (a man-made lake) in the southern region of the Bekaa Valley are unfortunately polluted from several anthropogenic sources.

Hydrology and treaties. Lebanon is hydrologically unique in the region because its natural fresh water supply originates within the country. Lebanon has two trans-boundary rivers between Lebanon and Syria in the north, with which it has water treaties, and one river with Israel to the south, with which has *de facto* status and contention of its southern groundwater resources. Nahr el Litani is the only major river in Near East not crossing an international border.

Water pollution issues. There are several sources of water pollution in Lebanon. For example:

- Seawater intrusion along the coast, contaminating fresh groundwater. This situation continues to worsen from over-pumping of coastal water wells, and will worsen if sea levels rise in the Mediterranean due to climate change
- Direct disposal of untreated or raw sewage to rivers, lakes, and wells
- Leachate from disposal of household and other wastes into dump sites and landfills that are not properly engineered, impacting both surface water and groundwater
- Agricultural return flows or tail-water runoff (containing pesticides and fertilizers, especially nitrogen and phosphates) to both surface waters and groundwater
- Uncontrolled dumping of agricultural, energy, industrial, commercial, and medical wastes, impacting both surface water and groundwater

Sources of uncontrolled dumping impacting both surface water and groundwater
Untreated or raw sewage; household wastes; agricultural wastes and return flows; other solid or liquid wastes from agricultural crop production and processing, energy, industrial, commercial and medical facilities including dairy farms, wineries, chicken farms, and slaughter houses; petroleum service stations and generator sites; cement plants, rock quarries and materials sorting facilities, building stones, ceramics, product manufactures, and hospitals and clinics, pharmaceuticals, cemeteries.

Impact of terrain. The country's rugged terrain historically helped isolate, protect, and develop numerous factional groups based on religion, clan, and ethnicity, all of which play significant roles in governance, institutional challenges, and water and energy allocation.

2.2 Lebanon Geo-Political Background

Lebanon water and regional peace: Politics, conflicts, competition for water resources, and short-term interests more likely dominate the will towards cooperation. Otherwise, many of these conflicts would have moved further towards resolution rather than continued conflict and stalemate at best, and there would already be water pipelines from Turkey and Syria to Lebanon and Jordan, and perhaps the Red Sea-Dead Sea canal or even the Mediterranean Sea-Dead Sea canal.

2.3 Lebanon Socio-Economic Background

Contributions from agriculture to the economy and employment are reportedly in decline, while industry and tourism are growing, especially in the Beirut and Mount Lebanon Governorates.

Figure 3. Akkar agricultural irrigation canal and repairs, Bared River in mid-February 2011

Associated with this, a unit of water used in agricultural production, as estimated in terms of GDP, is very low, while a unit of water used in industry or tourism is very high. However, high-value cash-crop vegetables and flowers are growing in importance, especially from greenhouse and plastic row production.

Figure 4. Greenhouse farming in North and South Lebanon are wise irrigation water uses

Complicating factors for governance and national decision-making. A complicating factor in Lebanese society is its sectarian or religious balance to equity and fairness in its diverse society. It is the Lebanese way to apportion government and other sector opportunities, benefits, and employment through a confessional and non-competency based system, recognizing the contributions from its components.

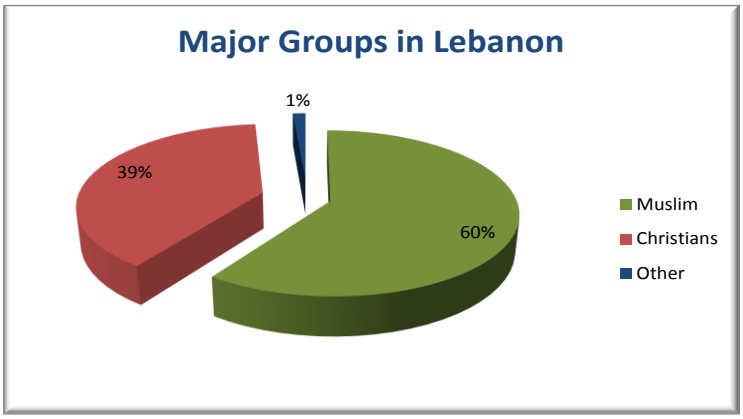

Figure 5. Major Groups in Lebanon

The CIA (2011) estimates that there are three major groups in-country: Muslim 60%, Christian 39% and other 1%. Nineteen religious sects are recognized in Lebanon. In addition to sectarian balance, allocated from a 1932 population census and later agreements and guarantees, it is Lebanese tradition to seek unanimous consent (rather than consensus, majority, plurality) in major decision-taking. The combination of sectarianism in representation and appointments, coupled with unanimous consent in decision-making, makes governance challenging and often ineffective.

Trade, commerce, and incomes. Historically, Lebanon has been the trade and cultural center and connection from Europe to the Middle East because of its strategic location, diverse culture, and ease of regional trade. It has a high level of education and health, and the highest estimated gross domestic product (GDP) per capita (pp) in the Arab Fertile Crescent (Levant and Mesopotamia), or from 2.5 to early 2.75 times that of the GDP-pp for Jordan and Syria, twice that of Egypt, and approximately equal to that of Turkey.

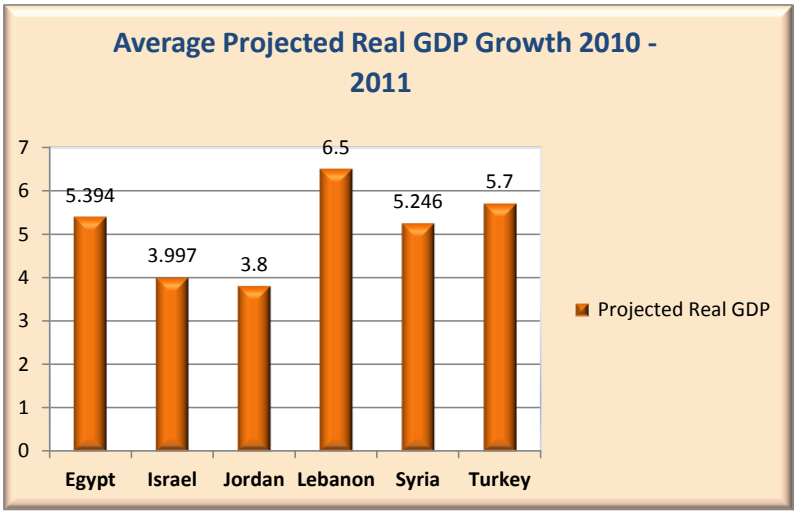

Figure 6. Average Projected Real GDP Growth. Source: IMF 2011

Products. Lebanon produces several agricultural products, including citrus, grapes, tomatoes, apples, vegetables, potatoes, olives, tobacco, sheep, and goats. Its major industries are banking, tourism, food processing, wine, jewelry, cement, textiles, mineral and chemical products, pharmaceuticals, electrical equipment, wood and furniture products, oil refining, and metal fabricating. Lebanon imports petroleum products, cars, medicinal products, clothing, meat and live animals, consumer goods, paper, textile fabrics, tobacco, electrical machinery and equipment, and chemicals; it exports jewelry, base metals, chemicals, miscellaneous consumer goods, packaged food and beverages, fruit and vegetables, tobacco, construction materials, electric power machinery and switchgear, textile fibers, and paper.

Market economy. Lebanon's economy is service-oriented, with services and trade sectors accounting for 60% of Lebanon's GDP and 73% of Lebanese jobs, both of which have significant growth potential[1]. Financial services, especially banking and tourism services are important pillars in Lebanon's economy, as a significant portion of Lebanon's GDP is from foreign capital inflows and financial transfers. However, the World Bank's "Doing Business" Economy Rankings placed Lebanon 113th of 183 global economies for "Ease of Doing Business" in 2010.

2.4 Lebanon Water Resources – Water Balance

Lebanon's water budgets. Water resources, water quality, and water use monitoring services in Lebanon are limited to a few special areas and short-term projects, rather than a sustained, professional, ongoing commitment to resources and use monitoring. Water resources supply and use data, as well as water-quality and pollution data, are sparse and non-systematically collected, and generally are not readily accessible in Lebanon. There are rainfall records at major airports, some building records to help manage buildings, and some agricultural records taken to assist farmers. There are some stream gaging stations on the Litani River. One can find some groundwater level measurements collected locally. There are also water use estimates from bulk water providers. But there is no central entity or entities which collect, compile, validate, and evaluate the water supply and use data for the country. Annex K shows several estimated water balances (the annual relationship between precipitation, evaporation and transpiration, and surface water and groundwater flow and stocks) for Lebanon. . It has been reported in several interviews that there is general consensus that water data is politically sensitive because in part it

[1] Lebanon Country Brief, The World Bank, Sept. 2010

Figure 7. Lebanon's detailed water balance from snowfall, rainfall, runoff, river and spring flows, groundwater flow, surface and groundwater storage, and water demands and use are non-measured and unknown

is a jewel which might be captured by unfriendly neighbors if exhibited. Annex F-1 discussed the sometimes perceived water scarcity in Lebanon.

The new Lebanese Center for Water Conservation and Management in the MEW, the Union for Mediterranean Center for Water Resources, MEW, WEs, universities, and others, have or intend to have relevant water supply and water use data. The only national groundwater study was performed in 1970.

If there is seasonal or operational scarcity of water in Lebanon, there is no scarcity of Lebanon water budgets[2]. Estimated current and future water balances show a deficit in renewable fresh water resources in relation to water demand, but there are significant gaps and uncertainties in the data.

Reportedly, annual precipitation in Lebanon is on the decline[3] by 12–16%. In addition, "water sources in Lebanon... under the impact of human activities like rivers and groundwater showed a 23 to 29 % decrease in the amounts of water since the last four decades. However, in both cases, the status is quite alarming and needs immediate water management plans to conserve water resources in Lebanon." This is confirmed by interviews with several long-term residents in the Bekaa, and the reported MEW announcement to Parliament that in 50 years Lebanon will have half its current rainfall and will be a desert.

Lebanon's natural water resources and supply, water quality, untapped water resources, water rights and water distribution systems. Lebanon's natural water resources are controlled by its Mediterranean-driven rainfall and mountain snowmelt. Its precipitation is the highest in the Middle East at approximately 32.5 inches per year (including snowpack) but is reportedly declining in recent years. Its rainfall and snowmelt generate surface water (streamflow and storage in few lakes), recharge groundwater (flows and storage in mostly fractured and karstic limestones and dolomites) and springs, and flow as surface water to the Mediterranean Sea, to the west.

Its potable water supply consists of its surface water and groundwater supplies. Both surface water and shallow groundwater are generally low in total dissolved solids or salts, although groundwater is often "hard" due to natural dissolution of minerals from its carbonate aquifers.

[2] Bassil, September 2010. National Water Strategy; Comair, April 2007. Water Sector Management in Lebanon: An Operational Framework for Undertaking Legislative and Institutional Reforms; Amery, 2000. Assessing Lebanon's Water Balance

[3] Shaban, 2009. Indicators and aspects of hydrologic drought in Lebanon

Figure 8. River flow at Tripoli and raw wastewater discharge directly to the sea

Potable water contamination. Lebanon's potable water resources are contaminated from several sources. These include: agricultural runoff or tail water (pesticides, fertilizers, sediment, turbidity), municipal and domestic wastewater (organic matter, bacteria, sediment, turbidity), solid and other wastes (petroleum products, industrial and commercial organic compounds, dissolved heavy metals, sediment, turbidity) to surface waters; and disposal and recharge of contaminated surface water and coastal seawater intrusion, with naturally high totally dissolved solids (TDS), to groundwater.

Figure 9. Examples of pollution from Tripoli solid waste mountain at coast and Bidneen canal in Accra village

Water rights. Water rights and water ownership are complex; they are divided by urban, rural, and sectarian issues. All water in Lebanon is owned by the nation, but in practice there are landed tenures, which hold both surface water and groundwater. The national government has little actual control of its water resources; in practice, villages, cities, and municipalities are more likely to control surface water.

Water distribution. Water distribution systems are composed of urban, rural, historical, and riparian issues. Most agricultural and potable water is derived from groundwater and is distributed by pumps, pumping stations, and urban pipelines or agricultural canals. Surface water is generally not controlled or stored, though there is some limited agricultural surface-water storage for irrigation.

Figure 10. Long-term ongoing construction of massive coastal connector sewer to donor-built, non-operational large WWTP awaiting connections for several years

Lebanon's major cities have complex and unmetered water-distribution pumping and piping systems. These do not supply sustainable full-time water, but generally ration water depending on available energy, water, and pumping capabilities. Higher floors in multi-story buildings often are not as well served by the urban systems because pumping pressure is inadequate and supplies are limited, especially during low-rainfall periods which limit groundwater recharge. As much as 50% or more of potable piped water and agricultural canal water is lost from productivity because of pipeline and canal leakage, as reported in several interviews.

Water losses. Estimates vary widely on water losses, but typically, agricultural irrigation can lose 50 to 70% of its supplied water from the water source to the field in developing countries. Water losses are on the order of 30% in developed countries which applied water-conservation methods due to pricing and scarcity. In addition, agricultural water is even more unproductive when crop losses from drought, flood, pests, diseases, and harvesting, processing, and delivery from farm to fork are considered, and may account for another loss of crop to food by over 50%. Thus, the amount of water that agriculture extracts but loses is over 15 times the volume of water that domestic and industrial users use, on a global basis. Therefore, small improvements in agricultural water use efficiency could make vast amounts of fresh water available for domestic and industrial uses, if appropriate incentives and infrastructure would allow. In addition, water losses in Lebanon, including illegal connections, from potable water distribution networks are reportedly on the order of 20 to 60%, though they are not measured.

2.5 Lebanon water sector institutions, structure, laws, responsibilities: CDR, GoL/MEW, WEs, LRA, municipalities, water associations

Legal, institutional and regulatory issues. Water conflicts and disputes are settled by negotiations or in the courts; there are no water rights to adjudicate. In addition, Lebanon is party to a variety of environmental and international agreements. Lebanon has two trans-boundary rivers: discharging to Syria to the north, with which Lebanon has water treaties, and to Israel to the south, with which Lebanon has *de facto* status and contention of its southern groundwater resources. Annex G further describes the legal, institutional and regulatory setting for the water sector in Lebanon.

Laws are passed by the Parliament (Legislature) and are binding to all branches of the executive and judiciary branches. The Council of Ministers (Cabinet) applies and details the laws through decrees. It also governs through decrees that are binding to the executive branches (executive orders such as appointments, regulations, etc.). Ministers run their ministries through decisions that apply, clarify, and detail the decrees and laws that they are subject to. Decisions can be overturned by new ministers.

Decrees can only be overturned by the Council of Ministers, and laws can be amended only through Parliament, which is elected directly by the people. The President of the Republic of Lebanon is elected by the Parliament. The Prime Minister is selected by the President after binding consultations with Parliament. The President and Prime Minister form a Council of Ministers (Cabinet) that is subject to approval of Parliament as a vote of confidence. The several Ministries (Agriculture, Defense, Energy and Water, Environment, Finance, Foreign Affairs, Health, Interior, etc.) may overlap in their function and ministerial decisions.

Table 3. Organizational Roles and Responsibilities in the Water Sector

Organizational Roles and Responsibilities in the Water Sector
International Treaties – highest level of responsibilities, have precedence over Lebanese law
Government of Lebanon – overall national authority for all sectors
Council for Development and Reconstruction – negotiates donor contributions and allocated funds
Ministry of Energy and Water – sets national water strategies and policies, approves WE budgets
Water Establishments – provide potable water, wastewater treatment, and bulk agricultural water within their jurisdictions or service areas: North Lebanon, Bekaa, South Lebanon, Beirut/Mount Lebanon
Litani River Authority – provides bulk agricultural water within the Litani River Basin and hydropower as well
Municipalities – provide building and related permits and enforce laws, such as protecting human health, nuisance laws, ordinance (but generally have no police and depend on the Ministry of Interior for enforcement through the Interior's internal security)

2.6 Lebanon Water Conservation Activities

Promotional campaigns to encourage water conservation, demand reduction, and creation of more efficient water practices are reportedly low- key and ineffective. Several campaigns include those organized by the Ministry of Agriculture (Beirut), Ministry of Agriculture's Regional Office in Zahle, MEW, *Corniche du Fleuve* (Beirut), and Lebanese Water Establishment, Bekaa, outreach with FAO support, to promote the use of treated wastewater for irrigation and wastewater treatment plant sludge (biosolids) in agriculture.

Other campaigns include: 1) USAID/Lebanon Water Use awareness campaign on water conservation carried out as part of the LWWSS Project and targeting public and private schools as well as the general public; 2) USAID/Lebanon, LRBMS Program Managing Water Wisely for All; and 3) USAID/Lebanon's outreach water conservation program under the Lebanon Water

Policy Program – featuring the American Water Works Association's "Willing Water" caricature, saying "Keep Your Eye on Water, Every Drop Counts."

2.7 Donor Activities

International donors play an important role in the water sector for technical assistance and physical infrastructure.

Figure 11. Foursol WWTP: Well designed, constructed, and operated WWTP funded by USAID/Lebanon at Foursol in the Bekaa allows honey-wagon drop-offs and disinfects effluent with liquid chlorine, but there is no Lebanese public sector entity which can afford to operate and maintain it.

There are several donors (Annex H) working in Lebanon on water and related issues. GIZ (formerly GTZ) funded its Technical Assistance in the Water Sector Reform with $5 M over past few years, and plans an additional $3M for the next two years before leaving Lebanon as it considers it to be developed sufficiently to support the sector. The Kuwait Fund for Arab Economic Development's activities in Lebanon (related to the water) sector is about $199 M in soft loans. The Italian Cooperation supported water sector and related interventions with 100 million Euros in soft loans and grants, or $136 M.

Donor assistance in the water sector exceeds $800 M, from contributions from Arab Banks, GIZ, European Investment Bank, the European Union, French and Italian Aid, Kuwait Fund, USAID/Lebanon, and the World Bank as grants, loans, and direct project interventions.

Conclusions on current shortcomings of donor support. Donor support is essential in the water sector, but often the support has been disconnected and overly optimistic in coordination. For example, the Water Code, sponsored by French Donors, remains to be approved after several years. The large Italian-funded WWTP at Tripoli is not functioning, and has been waiting several years for large sewer collectors. Many of the USAID/Lebanon-funded WWTPs through NGOs are inoperable due for some to poor design, construction, lack of connection to sewer lines, lack of skilled labor and energy to operate them, insufficient cash flows for operations and maintenance, and non-ownership by the appropriate authorities (WEs). Better donor coordination and leadership is needed to avoid the mis-steps and delays from partially completed and ill or not-connected programmatic pieces, such as WWTPs awaiting collector sewers (as in Tripoli and The Bekaa), and, broadly, WTPs and potable water stations awaiting connections to households and taps.

2.8 USAID/Lebanon-Funded Non-Governmental Organization Activities

There are several active non-governmental organizations relevant to the water sector in Lebanon (Annex I). Among them, Community-Habitat Finance International, Catholic Near East Welfare Association, Catholic Relief Services (CRS), Mercy Corps International (MCI) and the Young Men's Christian Association (YMCA) have had recent influence and projects. Cooperative Housing Foundation (CHF), Catholic Near East Welfare Association/ Pontifical Mission (CNEWA), CRS, MCI, and YMCA completed several projects for USAID/Lebanon in solid waste management and wastewater treatment plant construction.

USAID began its assistance to the Lebanese water sector by working directly with NGOs, such as CHF, CNEWA, MCI, and YMCA to improve solid waste management and wastewater treatment on the small village or village cluster level. During this period, the NGO-constructed WWTPs were challenged, in general, by several factors, including:

- Experimental treatment designs, which depend on careful control of wastewater influent and hydraulic loads, and sustained energy
- Designs unable to become operational at low and high influent flow rates; lack of ability to accept "honey-wagon" waste from septic tanks, use of acutely hazardous materials (gaseous chlorine)
- Procurement by procurement personnel without engineering experience
- Lack of quality control during procurement, design, materials arrival, and construction
- Limited budget

However, those projects, which were taken over by the BMLWE, are operational.

2.9 USAID/Lebanon More Recent Activities

USAID has intervened in Lebanon's water sector through several programs. USAID's international, regional, and local water sector programs are widespread and dispersed through several mechanisms. Water interventions come through various pillar and regional bureaus, as well as through the Mission itself. Interventions may come through Democracy Conflict and

Humanitarian Assistance, Economic Growth Agriculture and Trade, Global Health, or Middle East Bureaus. Interventions may also be charted through various strategic objectives under agriculture, economic, education, environment, health, and others, or be charted through specific initiatives, such as Advancing the Blue Revolution Initiative (ABRI) by DAI (April 2009 climate change workshop, May 2009 conference, AUB collaboration), Office of Middle East Programs, and The Paul Simon Water for the Poor Act.

The Paul Simon Water for the Poor Act 2010 Report to Congress indicates an upward trend in funding for drinking water supply, sanitation and hygiene (WASH), with a corresponding decrease in funding for water resources management and water productivity. WASH obligations increased from 40% of the total water budget in 2003 to 80% in 2009, water productivity decreased from 29% in 2003 to 8% in 2009, and water resources management obligations decreased from 26% in 2003 to 5% in 2009.

USAID/Lebanon interventions in the water sector in Lebanon are summarized in Annex O. Annex O-1 illustrates the Small Village Wastewater Treatment Systems project for the Upper Litani River Basin, and Annex O-2 shows many highlighted USAID/Lebanon activities from its story archive, emphasizing the diversity of its water sector projects.

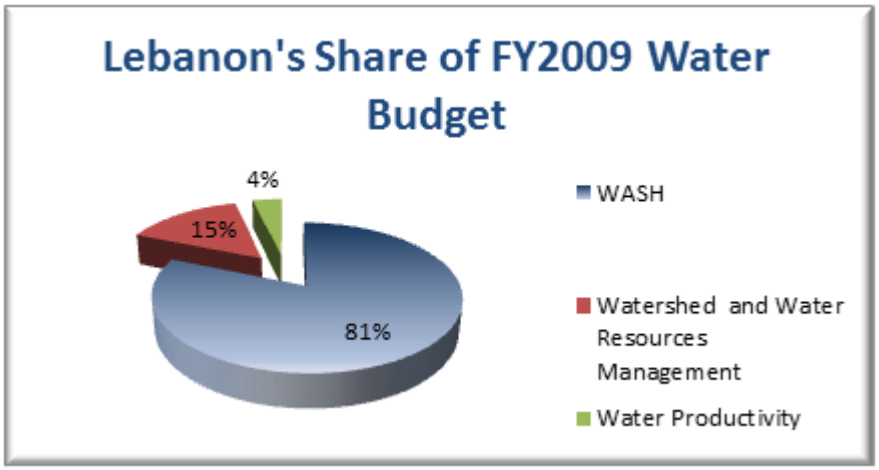

Figure 12. Lebanon's Share of FY2009 Water Budget

USAID/Lebanon is currently working with American contractors such as CDM, DAI, and IRG, who are providing technical assistance to WEs, building and operating WWTPs, and providing advice to the LRA. These contractors are challenged by indecision over who should be trained to take-over the WWTPs, remembering how the NGO-implemented WWTPs frequently had no owner or manager after project completion. A potential short-term solution would be for USAID to continue operating the plants through contractors and using them as a training center for operators, e.g. a Wastewater Management Academy. Otherwise, the challenges facing potential owner/ operators are:

a) Municipalities which have interest and are locally accountable, but have no national authority;

or

b) WEs which have little or no interest, staff, experience, or budget, but have legal authority and a national mandate without national autonomy.

Currently, the agency is seeking to re-evaluate its strategies on WWTPs.

3.0 CURRENT SECTOR SITUATION AND NEEDS

This section discusses water information, water management, agricultural water, potable water, wastewater, industrial and commercial water, water resources protection and pollution, cross-border water, hydropower, energy, integrated water resources management, and water sequencing.

Potable water supplied by Water Establishments is inadequate to meet full service, and generally is not drinkable. Commercial entities must treat their water for potable use. Commercial vendors fill the gap for potable water; shops sell bottled drinking water. Typically, Lebanese pay at least three times for water; many pay four or five times when factoring in their own supporting wells and potable water treatments.

Lebanon's water-demands, user sectors, sector contributions to wealth both direct and indirect thorough "water-exports" as exported goods. Although there are many estimates, Lebanon is scarce in dependable water-use information. For example, Lebanon reportedly uses about 1.38 cubic kilometers of fresh water annually or 385 cubic meters per capita (2000). This usage is distributed as 32% for domestic use, 1% for industrial use, and 67% for agricultural use. Agricultural use is primarily to irrigate 1,040 square kilometers of land, or ten percent of the country. Some reports estimate the total renewable fresh water resources to be 4.8 cubic kilometers per year, but this is a dynamic figure, and it has been widely reported that rainfall has been in decline in since the 1960s.

3.1 Water Resources Information and Management

Because water resources information and management generally do not exist in Lebanon, an accurate water balance or budget cannot be made. In addition, IWRM and water sequencing are not generally practiced in the country, although it is in the MEW National Water Strategy. Annex N provides information on IWRM in Lebanon. The MEW has recently engaged a national dialogue on IWRM under the EU Water Initiative and as such, most key stakeholders in the Lebanese water sector have been introduced to the possibilities and need for IWRM.

Two small pilot studies using modeling software and IWRM principles have been conducted under international funding for the Damour River and the Dog River, but the basic elements for an integrated sector approach are still absent.

The traditional management paradigms that prevailed some decades ago are still very much ingrained in the operators of the sector. Segmentation of the responsibility between different institutions and conflicting agendas stand in the way of progress. In order to meet the water needs of both sprawling urban areas and economic development, the only response has been to bring online additional supplies, which require large financial investments in infrastructure. The CDR, the MEW, and the WEs' financial and development plans reflect strongly this approach. Demand management and optimization of resources usage have not received equal attention.

Figure 13. Water Supplies in Lebanon. Top left, a tanker making a routine fill-up at a home. Top right, a water-pumping station. Bottom left, bottled water is a routine source for drinking wate, especially among the poor. Bottom right example of a polishing system that might be used at an upscale apartment building or hotel.

The new water strategy prepared by the MEW has recognized the need to balance water supply and water demand by acting on both sides concurrently, which would allow for a management paradigm shift, and thus enable an economically and environmentally sustainable water resources management policy in Lebanon.

Table 4. IWRM Examples

IWRM Examples
Villagers and building managers.
✓ If 50,000 villagers captured 1 meter of annual rainfall on 30 square meters of roof each, and 50,000 building managers captured 1 meter of annual rainfall on 1,000 square meters of roof each, they could treat the water by sand and/or carbon filtration and store it in tanks or as recharge to their wells, and have 1.5 million cubic meters/ year and 50 million cubic meters/ year (less losses). This would reduce their otherwise fresh water demand at low initial cost and in a sustainable manner.
✓ If grey water were captured with appropriate plumbing and then filtered, it could substitute for other potable water demands, which would reduce fresh water demand by 40% or more and would be under their own control, at moderate to high initial cost.

IWRM Examples
Irrigation farmers. ✓ If farmers captured locally available treated wastewater for irrigation purposes, they could treat it by sand and/or vegetation filtration and store it in surface ponds, tanks or as recharge to wells, which would extend their irrigation season and/or their irrigated lands, and reduce their otherwise fresh water irrigation demand under their own control, at low to moderate cost, in a sustainable manner.

3.2 Agricultural Water

Although agriculture is responsible for approximately 60% of Lebanon's water withdrawal (FAO 2005), agriculture only produces 5.3% of the country's gross domestic product (World Bank 2008). According to several interviewees, during summer months, agricultural water use can jump to 80% or more. Of course, many people work in the agricultural sector, and nearly every nation's historic and cultural base comes from and is supported largely through agriculture, which has benefits beyond those captured by GDP figures.

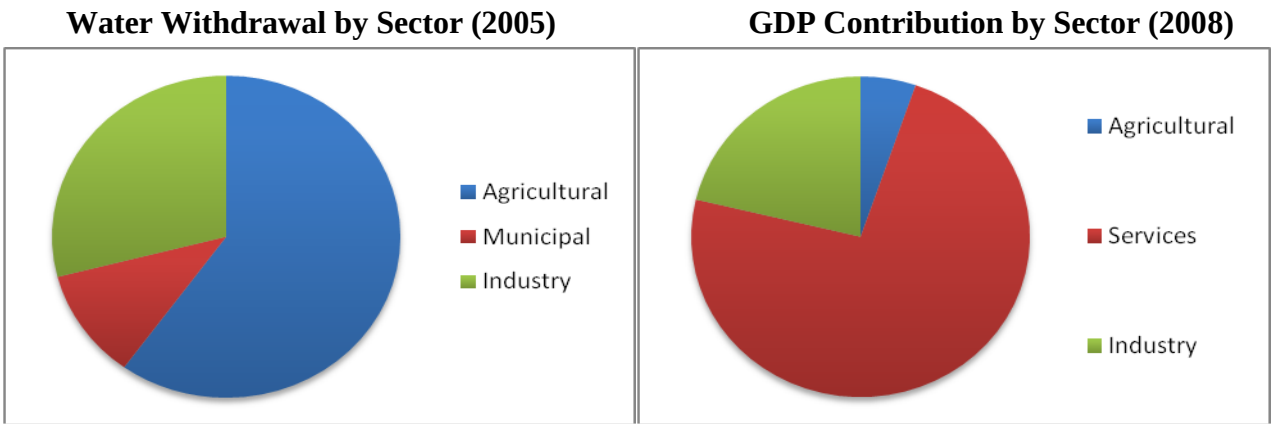

Figure 14: Contribution of Agriculture, Industry and Services to Lebanon Gross Domestic Product Sources: (World Bank, 2009; FAO Water Report 34, 2009).

As Lebanon's biggest water user at 60%, agriculture is a prime sector target for water efficiency improvement.

The agricultural sector has historically suffered from institutional neglect, with minimal budgets allocated to the Ministry of Agriculture (less than 1% of the total governmental budget) albeit the livelihoods of more than 10% of the population are directly affected by it. Poor farmers rely heavily on government subsidies and support. Limited irrigation infrastructure improvement projects have been implemented under funding from the World Bank during the 1990s, through CDR. Canal 800, by far the largest irrigation development project (from Qaraoun Lake to the south), has been in planning for decades and is slated for execution soon. The larger part of agricultural sector suffers from archaic agricultural practices, traditional crops, and heavy

partitioning of land. Cash crops such as fresh produce and export crops such as fruits have benefited from improved practices such as green houses and drip irrigation, but they have suffered from excessive fertilizer and pesticide use to the point of rejection of exports at points of entry. Stand- alone in the agricultural sector is the wine industry, which has developed highly prized wine products while relying solely on private resources.

The BKWE, NLWE and LRA supply unmetered irrigation water to farmers through networks of channels they own on the basis of a flat fee calculated proportionally to the irrigated surface and the type of crop. The remaining agricultural lands are irrigated using pumped water from unmetered legal and illegal groundwater wells.

Agricultural water is not charged in general; however, farmers bear the cost of installing and operating their irrigation wells and distribution systems. Water subsidies or, freely or nominally charged water fees, inadvertently encourage water wastage and promote scarcity.

3.3 Potable Water

The WEs of Lebanon are responsible for delivery of potable water at a yearly, flat connection fee which corresponds to a theoretical total volume to be delivered daily (e.g. 1 cubic meter per day per connection). The fees cover part of the costs of wells, pumps, pumping stations, and delivery systems. Initially, that unit volume amount came from Beirut where flow restrictors assured no more than that amount would be delivered for water to be stored in a suitable tank and distributed in-house by gravity or pumps as needed. Because these fees are not based on water usage, there is no pricing signal to reflect scarcity or encourage conservation. Moreover, urban water consumers generally bear the cost of water filtering to remove sediment and turbidity, and water softening to reduce hardness and high soap demand for washing, cleaning, and laundry.

Figure 15. Simple shallow, hand-dug water well in rural area, Akkar

Moreover, these supplied potable waters can become contaminated by agricultural crop production and processing, wastewater infiltration, and other pollution sources. Lebanese have high rates of water-borne disease according to water, environment, sanitation and health reports[4]. Many Lebanese purchase open-market priced bottled drinking water, which is of good quality, but is expensive at $5 per 18 liters. Urban consumers of drinking water therefore generally are inconvenienced and financially burdened by obtaining water from three supplies: urban supplied water supplied by utilities that, while "potable" is too salty to be drinkable without treatment, supplemental private-purveyor supplied potable water, and bottled drinking water. As many urban apartments are small, and supplied potable water is typically "hard," there is generally no

[4] UNICEF, October and September 2007

room for water-softening tanks, so urban water consumers must use hard water for cooking, bathing, and washing.

Potable water networks suffer from heavy leakage and illegal connections. Water sources suffer from summer drought, and pumping stations suffer from power shortages and scarcity of spare parts.

Discontent over potable water. There is significant discontent over potable water distribution in Lebanon. Dozens of interviews and small focus group discussions with everyday Lebanese men and women in Hamra District, Beirut, give this consistent story (see Annex O). Water supply is discontinuous and often of low quality.

A DAI 2010 consumer survey of 1,230 WE residential subscribers indicated over half of the respondents were unsatisfied with the quality and quantity of water provided. The survey further indicated that only half of the respondents said they would pay a higher fee for continuous water service at 24 hours/ day, and 63% stated they were willing to pay more if the bill was consumption-based as well. These results, although indicative, might not be completely representative and should be validated through additional surveys in due course. The World Bank[5] estimates that 75% of expenditures on potable water in Lebanon go to private sector operators, while 25% is spent on WEs.

In Beirut and other large cities, apartments, hotels, restaurants, office buildings, and other large buildings have rooftop tanks for storage of potable water for domestic use. In summer months, it may take a week or more to accumulate potable water in the rooftop tanks because of high demand and low supply. These tanks are often supplemented with potable water from street vendors during summer months. Many of these buildings pay for several potable water connections and have several water storage tanks but this method is not sufficient to insure a sustainable potable supply. Thus, they typically drill unauthorized water wells, and then dispose of their wastewater to urban sewers. It is very possible that in some sewered urban areas, some buildings contribute more wastewater than they consume in potable water supplied by WEs.

3.4 Wastewater

Both wastewater and storm water flow directly from coastal cities to the Mediterranean Sea without treatment or reuse. Rooftop or grey water (household water from showers, sinks, bathtubs, dishwashers, clothes washers but not from commodes, bidets, or swat toilets) is not harvested, but private-sector potable water and bottled drinking water are used carefully because they are expensive. There are no significant problems with urban flooding in coastal cities; however, spring thaws often flood the valleys, especially in the Bekaa.

Through infiltration, storm water often contributes to sewers during rainy or wet months. Moreover, the 12 Palestinian camps likely take no potable water from the WE (except for Dbaye in the Beirut/ Mount Lebanon WE) but reportedly connect their wastewater and drainage water to the sewer network where available, as in Beirut, through illegal connections.

[5] 2010 Public Expenditure Review

Wastewater collection and treatment has been assigned by law to the four regional water establishments, but they lack the capacity to intervene at any level in this field. Major wastewater collection and treatment schemes are being implemented and have reached different completion levels by the CDR through international donor funding. These projects follow a general master plan developed in the 1980s (and updated in the 1990s) that addresses wastewater flow from the major urban centers along the coast and inland. Most of the remaining villages and smaller cities have small schemes planned for them, but lack governmental funding. International donors have stepped in to provide for these small schemes. USAID/Lebanon has intervened at two levels through NGOs for very small villages, and through CDM for localities around the Litani River.

3.5 Industrial and Commercial Water

Large industries and commercial interests have developed their own water production, mostly from unmetered wells or from neighboring small streams, treating the waters to their required level of performance and then returning the effluent either to the urban wastewater system or back to the stream. Treatment of effluent water is still very uncommon and unregulated. Large business interests and political cronyism intervene in some cases to secure water resources away from less powerful users.

3.6 Water Resources Protection and Pollution

Lebanon's environmental challenges include pollution of coastal waters from raw sewage and oil spills. There is also significant surface water and groundwater pollution from raw sewage, industrial waste, solid waste, and agricultural runoff or tail-waters. The Litani River and Aammiq Wetlands (the largest remaining freshwater lake area in the country) and Lake Qaraoun (a man-made lake) in the southern region of the Bekaa Valley are known to be polluted from several anthropogenic sources. There are no environmental protection laws or agencies, although mayors may enforce nuisance or public offence regulations at their discretion.

3.7 Cross-Border Water – Syria, Jordan, Israel

The term "*nahr*" is Arabic for river. Two perennial rivers (Nahr al-Kabir and Orontes) originating in North Lebanon near the Syrian border flow into Syria. The Orontes is the bigger of the two rivers, and it is also bigger than the Nahr El-Wazzani Hasbani, which flows to Israel in the south. Lebanon-Syrian water agreements are in place; however, many Lebanese feel that the agreements were coerced, as they came about during the time of Syrian control of Lebanon. There is agreement to allow Lebanon to build some dams on these rivers for Lebanese reservoirs and use, such as on the Nahr al-Kabir River.

There is some Lebanese-Syrian dispute over land boundaries in the east, particularly where the disputed areas and temporary borders are within the Serghaya water basin, as opposed to water divides. Lebanon and Syria share or compete for groundwater in these areas. The small watershed on Serghaya feeds a tributary of the important Litani River in the East Bekaa. A small dam is planned by the LRA on the lower reach fully controlled by Lebanon.

Table 5: Main Rivers in Lebanon

River	Length in (km)	Catchment Area in Lebanon (km^2)	Origin	Flows To	Major Exploitation
Nahr Al-Kabir	60	295	Lebanon and Syria	Syria, Mediterranean	65% Syria
Orontes (Nahr El-Assi)	65	1,900	Lebanon	Syria, Turkey	Syria, Turkey
Nahr El-Wazzani-Hasbani (Snir Stream within Israel), a tributary to the Jordan River)	75	625	Lebanon	Israel	Israel

Figure 16. Lebanese public awareness of water issues

In the south, there are two basins at higher elevation than the neighbor to the south. These areas illicit edginess amount some Lebanese, as the neighbor is Israel with whom there have been several conflicts and no formal treaties. The Wazzani basin is largely abandoned, while another has villages with at least 5,000 people served by unauthorized water wells and pumping stations.

The water balance across the borders of Lebanon shows a net outflow of surface waters towards Syria in the North and Israel in the South. Lebanon controls all the water sources of the rivers that flow on its territory. The main rivers are:

- The Aassi (or Orontes) originating in the North Bekaa and flowing north towards Syria through Homs, Hama, and then emptying in the Mediterranean through Antioch in Turkey. Its average yearly flow at the Lebanese- Syrian border is 370 to 420 million cubic meters.
- The Litani (or Leontes) originating in central Bekaa and flowing south then bending west towards the Mediterranean. At over 140km in length, it is the largest river in Lebanon. Its basin is within the boundaries of Lebanon, and has an estimated average yearly flow of 700 to 920 million cubic meters.
- The Hasbani River, originating in Hasbaya in south Lebanon and flowing south towards Israel. It is the first tributary of the Jordan river, and has an estimated yearly flow of 140 million cubic meters, 20% of which is contributed by the Wazzani spring and rivulet very close to the point where it crosses to Israel. Partition of the waters between Lebanon, Syria, Jordan, and Israel has been a contentious issue and is considered sufficient reason for warfare.
- The Nahr Al Kabir al Janoubi forms the border between North Lebanon and Syria. Its basin lies across the border of the two countries and the partition of its waters has been agreed upon by treaty between Lebanon and Syria. A large common dam is slated to be built on its lower reach.

The flows of most of the other Lebanese rivers are variable and have different watershed sizes; most of them have dams planned some of which are also amenable to hydroelectric production. Large irrigation schemes development for the Bared, Ibrahim, and Awali rivers are in the planning stages.

3.8 Hydropower

As IWRM approaches are used, it is important to integrate hydropower production in the analysis, especially since most of the waters used may have to be released to the sea in the absence of control reservoirs downstream. Developing hydropower may in the future compete for other water demands.

Operating hydropower capacity is above 220 MW, most of which on the Litani River through tunnels is operated by the LRA and sold to the national grid (*Electricite du Liban*, EDL). The rest of the production is located mainly in small plants on the Qadisha, Nahr Ibrahim, and Rechmaia rivers. Many small hydropower plants installed before the civil war have been stopped due to their need of either a major overhaul or a willing operator. Hydropower contributes more than five% of total power production and may be potentially doubled. Power generation can be integrated with IWRM or treated as a separate field of intervention.

3.9 Energy

Unreliable electrical power adversely impacts water, from water pumping, boosting and distribution, to wastewater treatment systems throughout the country, as well as other sectors. For example, common electrical power surges, downtimes, and blackouts reduce energy and hydraulic efficiencies, which is an event all Lebanese experience in their daily lives at home, at work, and during recreation. Electrical power uncertainties slow down and stop pumped potable-water, irrigation-water flows and distribution, wastewater-influent flows and treatment, and effluent discharges. Power uncertainties also overburden and burn out electrical equipment. Although Lebanon could benefit from several potential energy improvements, including hydropower, solar, and especially wind, investors are stifled because they cannot sell excess electricity back to the utility, nor can they reasonably get a license to compete with it at this time. However, the UNDP-sponsored Lebanese Center for Energy Conservation (LCEC) was established in 2002 through the Global Environment Facility (GEF) in the MWE to promote conservation practices.

Where feasible, water and energy consumers generally pay for back-up water and energy supplies through private-sector water purveyors and electrical diesel-energy suppliers. Reportedly, during low-rainfall seasons and droughts, pumped piped potable water along coastal cities is slightly saline (due to seawater intrusion in wells), while purveyor-delivered tanked or drummed potable waters are reportedly contaminated from un-cleaned tanks and drums. Beirut-supplied water is often salty, requiring householders to clean salt off washed dishes with expensive drinking water. Beirut has many small water shops which sell and deliver drinking water and water jugs. Energy is taxed in several forms to improve the development and reconstruction effort after the wars. These high taxes encourage a new trend of roof-top photovoltaic cells to collect solar energy with inverters to supply energy to Beirut buildings for hot-water heating, which reduces the otherwise energy demand, according to the LCEC. There could be other energy incentives, for example: energy surveys, insulation, and co-generation from waste heat.

3.10 IWRM and Water Sequencing

IWRM and water sequencing are not practiced in Lebanon but are within the NWR. Refer to Annex N for a discussion on IWRM and water sequencing. Large entities, such as the WEs and LWA, do not do these but they are likely practiced pragmatically in smaller basins and villages, where roof-top water harvesting and wastewater irrigation are practiced. Roof-top water can easily be treated by filtration and used through onsite cisterns for potable or garden use, or for recharging groundwater through shallow wells. Treated wastewater is commonly used throughout dry or water-short climates, usually by gravel rows or subsurface irrigation with care to keep the water from contacting the fruit, nut, or vegetable. Unfortunately, some springs and many irrigation wells are contaminated with untreated wastewater, which is routinely used for irrigation in the Bekaa.

4.0 CHALLENGES AND BARRIERS IN THE WATER SECTOR

This section discusses water sector challenges and barriers related to the Government of Lebanon, CDR, MEW, WEs, municipalities, river basin authorities, WAUs, human capacity, and finances. The table below summarizes the status of the sector.

Table 6. Summary of Water Sector Infrastructure Status in Lebanon

Water Sector Infrastructure Status in Lebanon
Potable Water
• The potable water infrastructure of Lebanon is a patchwork of treatment and pumping facilities, transmission lines, storage reservoirs, and distribution networks, ranging in age from before the 1950's in older urban areas to recently renovated systems. • About 78% of the mostly urban Lebanese population is connected to a public water network. Service quality is highly unreliable. Severe shortages and insufficient supply has a negative effect on Lebanon's economy and growth. At the national level, supply averages less than eight hours/day in summer to 13 hours/day in winter, with extremes such as three hours/day in Beirut in summer time contrasted to 24hrs/day in Tripoli year long. • During the period spanning from the end of the Lebanese civil war in 1990 and until the effective merger of the different water offices and committees into four regional establishments in 2005, development of potable water infrastructure was carried out (without coordination) by different governmental agencies. CDR carried out large rehabilitation projects and concentrated on the main cities and supply sources, as well as remote area networks and supply investing (close to $700 million up to 2009). The Ministry of Hydraulic and Electrical Resources (predecessor of the MEW) designed and implemented projects ranging from drilling single wells or spring catchment structures at remote villages, to complete systems with reservoirs and distribution networks. The Central Fund for the Displaced rehabilitated water networks in mountain villages with displaced populations, and the Council for the South built and commissioned whole systems in South Lebanon. • The World Bank estimates that the public investment in water infrastructure falls short of the level adequate to meet the country's development needs. • The North Lebanon Water Establishment (NLWE), South Lebanon Water Establishment (SLWE) and the BKWE do not have the financial resources to implement network rehabilitation or development projects; they still rely on the projects developed by the CDR, funded by international donors. The BMLWE has started developing and funding its own projects in addition to those which are funded through the CDR. • Due to the topography, many systems around villages and groups of villages in the mountains operate independently, with supply secured from local water sources. Some of

Water Sector Infrastructure Status in Lebanon

these systems are not yet under the full control of the regional establishments.

- Many systems rely on wells for water supply, whereas surface waters go untapped and undeveloped.
- Large gaps corresponding to areas without service remain, such as 75 villages in the extreme North of the country.
- Leaking old potable water distribution networks represent the most important operational problem of WE, such as the network in Zahle (BKWE).
- Securing new water supply sources and upgrading treatment and pumping capacities represent the most important strategic planning challenge. The BMLWE, with the support of the CDR and funding by the Islamic Development Bank and the World Bank, is launching the Awali-Beirut water conveyor to supply 150,000 cubic meters/day to Beirut Phase I.
- Energy costs for pumping represent the most important financial liability of the Water Establishments, which amounts to more than half of the O&M budgets for some WEs.
- Ad hoc maintenance, unqualified or limited human resources, and reduced financial capabilities cause accelerated wear and tear of the electromechanical plant at many facilities in the WEs.
- Integrated management of networks, water supplies, and assets is little if at all practiced, which reflects negatively on the status and performance of Lebanon's water infrastructure.

Wastewater

- The waste water sector is still very young. The current operating wastewater sector infrastructure consists of some municipal collection systems in the large and medium urban zones, which discharge untreated raw sewage into the Mediterranean Sea or the nearest body of water. The remainder of the country operates on poorly designed and maintained septic tanks, along with a prevalence of bottomless tanks and discharge wells that take advantage of the karstic geology of Lebanon.
- Rapid urbanization, population growth, and economic growth, along with the extension of construction to the higher mountain ranges, have brought the problem of sanitation and the protection of water resources to forefront. The cost of environmental degradation associated with urbanization and rapid growth has escalated dramatically to an estimated 1% of GDP.
- It is estimated that wastewater collection network coverage is no more than 58%

Water Sector Infrastructure Status in Lebanon

nationwide, with most networks being very old, damaged, and undersized.

- Wastewater treatment facilities are in severe shortage. The CDR focused large efforts to implement a national wastewater management plan, including the planning and construction of about 40 coastal and inland wastewater treatment stations funded by international donors: EIB, AFD, WB, KFW, Italian Aid, Kuwait Fund. Capacity of these stations ranges in size from 10,000 to one million population equivalents.

- Wastewater projects implemented by the CDR have reached a value of $402 million (with as much in the pipeline). Most, however, are incomplete and thus non operational. Where networks are operational, WWTP's are still in planning. For example, in Beirut, and where WWTP's have been completed such as in Tripoli, Saida, Nabi Younes, Jbeil, and Bcharre, wastewater networks are still lacking. The extreme example is the WWTP of Iota in Baalbeck, financed by the WB and completed in 2000 to serve about 15,000 inhabitants, which is not yet operational due to delays in network construction and O&M problems.

- USAID/Lebanon funded the construction of more than 50 very small (250 to 5,000 inhabitants) WWTP's in Mount Lebanon and Bekaa villages through NGO prime contractors. An estimated 16 of these are still operating, half of which are in Mount Lebanon under the BMLWE. Poor design and construction as well as the inability of municipalities to sustain the financial and technical requirements of operation and maintenance (O&M) have resulted in shut- downs. USAID/Lebanon is currently funding the construction of three WWTPs in the Litani River Basin by CDM, the sustainable operations of which is under question, given the limited O&M capabilities of the beneficiary municipalities and the regional water establishment the BKWE.

- Secondary wastewater treatment exists or is planned at some of the larger WWTP under construction.

- Many gaps remain in the national wastewater management plan implemented by the CDR, mostly at the level of isolated villages and communities.

- Under Law 221/2000, project wastewater systems built by the CDR are handed over to the Water Establishment for O&M. These establishments, as well as the supervising Ministry of Energy and Water, do not have the technical and financial capabilities for sustainable operations and maintenance. The CDR is temporarily bridging the gap by appending to its construction contracts a three year operations contract.

Irrigation

- Irrigation currently accounts for 64% of the total water demand, but it increases in the summer. Total irrigated area is estimated at approximately 117,000 hectares, of which

Water Sector Infrastructure Status in Lebanon

56,000 are in the Bekaa and 33,000 are in the North. The total cultivated area of Lebanon is approximately 284,000 hectares.

- Irrigation schemes all date back to before the civil war in the 1970's. More than 50% of the irrigation schemes suffer from old and poorly maintained infrastructure. They consist largely of open channels, which are predominantly fed by gravity from intake structures at springs and rivers.

- Many farmers use private legal or illegal wells to irrigate their lands by drawing heavily on groundwater resources.

- LRA operates all the irrigation networks in the Litani Basin and the South. In the remainder of the country, irrigation networks are operated by the WEs. The smaller schemes are sometimes operated by local water committees which are able to finance O&M costs.

- The largest planned irrigation infrastructure project is the Canal 800, which draws water from the 800-meter elevation mean sea level intake at the Qaraoun dam on the Litani and conveys it all the way to the southern tip of the country, thus feeding about 12 new irrigation perimeters yet to be designed and built.

- Agricultural laboratories and extension services that support farmers are operated by the Lebanese Agricultural Research Institute (LARI) under the Ministry of Agriculture. There is little if any coordination with the MEW and its WEs with respect to the development and use of irrigation water and the control of pollution. LARI is in the process of increasing the number of its regional stations to improve outreach.

- Irrigation water storage infrastructure is very limited. It consists mainly of the Qaraoun Lake, managed by the LRA, and small agricultural ponds and hill lakes ranging from a few thousand cubic meters to about 100,000 cubic meters. Most of the small storage areas are privately owned, while the larger ones are implemented by the Green Plan an agricultural land reclamation entity under the Ministry of the Agriculture for the benefit of local associations of farmers.

Institutional barriers to successful water utility management. National water management is a relatively new establishment in Lebanon. In the 1890s, the Ottomans gave water concessions to private vendors to sell drinking water in Beirut; anyone who had money to invest could obtain a water purveyor's concession. By the 1950s, after Lebanon achieved independence from France, concessions were converted to small water offices, and additional offices were added to supply potable water. The Lebanese water sector is built on the old French model, but it has not modernized as France has modernized.

Today, the MEW has the mandate to control the water sector, including the development of policies, strategies, regulations, and management of the four WEs, which are close to independent water utilities charged with water, wastewater, and agricultural water provision. The LRA has the mandate to provide agricultural water in the Bekaa Valley. There are no river basin authorities in the country. MEW or its agencies provide bulk water to farms, after which the Ministry of Agriculture takes on the role of on-farm crop selection, cropping patterns, cultivation, and irrigation. All of the government ministries and agencies are significantly understaffed and salaries are very low.

Contracting or outsourcing for utility services is constrained in funding, budgetary authority limits, and time limits. WEs usually prefer to outsource certain services such as the provision of unskilled labor or the operation and management of pumping stations or water and wastewater treatment plants through yearly contracts. This arrangement is sub-optimal because it may be unprofitable and financially risky for a business to provide utility services for a one-year commitment only. However, it is more convenient for WEs from an administrative and budgetary standpoint as their budgets are prepared and approved by both MEW and the Ministry of Finance on a yearly basis. The maximum period for contracts or outsourcing agreements - currently allowed by the Directorate General (DG) of Exploitation at MEW, which oversees the operation of WEs - is three years, noting that the WEs, which request such arrangements must be able to commit the necessary funds for the duration of the contract despite the fact they have yearly budgets. The DG of the WEs can issue contracts of up to $30,000; above that amount, the DG must get approval from the WE Board, which may approve contracts up to $133,000. Contracts whose values exceed $133,000 may only be given out by WEs after having obtained the approval of the MEW. Contracts of up to one year are commonly issued. Contracts longer than one year must have the value blocked ahead of time in the WEs operating budget. In nearly all cases, from hiring to firing, staffing, overtime, and budgeting, decision-making in the Lebanese public sector is very political and cumbersome, often with delays and indecision. These factors impede the establishment of a merit-based, corruption-free professional and efficient public service sector.

Corruption. Lebanon ranks 127th out of 178 countries in Transparency International's 2010 Corruption Perception Index. Perception studies indicate that 82% of the persons surveyed believe corruption has increased in Lebanon over the past three years. On a scale of 1 to 5 (5 being extremely corrupt), the same survey indicated these perception results: 4.1, political parties; 3.8, parliament; 3.7 police; 3.4 business; 3.5 media; 3.9 public officials; 3.5 judiciary; 3.0 non-governmental organizations and religious bodies; 2.4 military; 3.0 education.

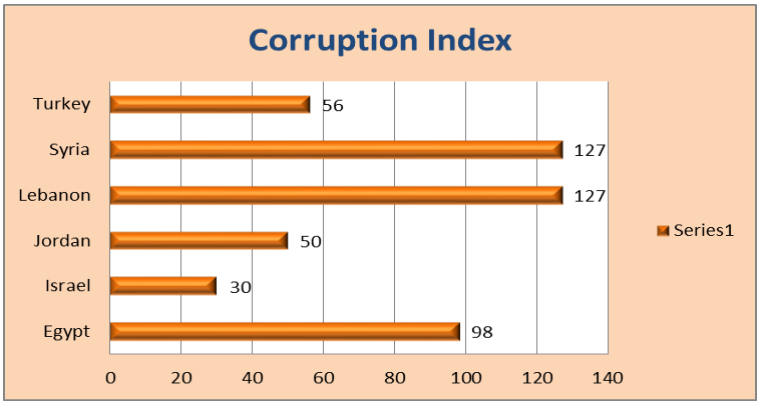

Figure 17: Corruption Index

4.1 Government of Lebanon

The Government of Lebanon (GoL) is a Parliamentary Republic with its executive powers concentrated in the hands of the Council of Ministers and the President. Its confessional and sectarian character imposes a delicate power sharing between its different religious communities and renders decision making a long and tedious process of consensus building. The government is slow to act on legislation and strategic planning when it is not literally halted by political crises or conflict. The GoL has been unable to approve a budget since 2005; even less action has occurred with respect to adopting new water and power strategies or passing the required legislation.

Government of Lebanon and ministry challenges. As governments in Lebanon change and their ministers are exchanged or replaced, their priorities for infrastructure policies change as well, leading to the usurping of once-held national policies and strategies and action plans. Some institutions, such as universities and research centers, appear more protected from these changes. If a particular law is passed with associated funding, these law-passed initiatives are more likely to go forward regardless of shifting governments.

The reform of the energy sector and EDL (based on a French administration model) has lasted more than six years until a recently adopted National Energy Sector. However, for example, a 10-year plan for dams was financed through a budget program law over 10 years ago that was extended annually but never implemented. There is a similar case for the construction of ports.

As in other sectors, the national government is challenged to manage the nation's water resources and supply or assure civil services. Lebanon has not had a Parliament-approved national budget since 2005. There is limited rule of law, honoring of contracts and agreements, and dispute resolution. Reportedly, political and social power divisions (both urban and rural), sectarianism, lack of transparency, inconsistent policies, unstable government and administration, weak regulations and law enforcement, civil strife and civil war, boundary disputes and military conflicts, unchecked armed militia groups, assassinations, kidnappings, coercion, corruption, cronyism, nepotism, and greed all contribute to the lack of fair and equitable national civil services in the water and wastewater sector.

4.2 Council for Development and Reconstruction (CDR)

On a national scale, CDR, an autonomous, public financial institution which negotiates, compiles, facilitates, and allocates donor contributions and grants to Lebanese agencies, plays key roles in several sectors, including physical and social infrastructure, basic services, productive sectors, and others. Its October 2010 Progress Report summarizes its activities in these areas, several of which are directly and indirectly involved in the country's national electricity, water and wastewater, solid waste, public health, and agricultural irrigation activities. From December 31, 1992 to December 31, 2009, it awarded contracts totaling $1,270 million for electricity, $237 million for public health, $51 million for environment and regional planning, $573 million for water supply, $355 million for wastewater, $32 million for solid waste, and $85 million for agriculture and irrigation. Fortunately, it appears that CDR is well funded and staffed, and can likely carry out its mandate. Annex K shows CDR's projects and needs in the sector.

4.3 Ministry of Energy and Water (MEW)

The MEW is in charge of national planning for the water and energy sectors. It retains supervisory authority on the independent WEs and the electrical power company. In addition to planning and setting strategic sector goals, the Ministry retains the executive powers to design and build dams and large reservoirs. It is heavily understaffed, and the Minister's office relies heavily on donor funded advisors, as well as external expertise.

4.4 Water Establishments (WEs)

The WEs, which are charged with supplying potable water, treating wastewater, and providing agricultural water (except for the South Lebanon WE because the LRA has that responsibility) have plans going forward. For example, the Bekaa WE conducted an assessment of its current situation with regard to financial, human resources, and technical capabilities and developed an action plan. The BKWE September 2010 plan has these priority actions: 1) improve wastewater collection efficiency; 2) improve the level of full service; 3) and reduce the number of illegal connections and increase of billings. BKWE's long-term Funding Support initiatives are:

1. Review BKWE's organizational structure (GIZ)
2. Develop a business plan (GIZ)
3. Prepare for taking over the Al Zarka pumping station (TBD)
4. Take over wastewater system extension (USAID/LWWSS + TBD)
5. Increase coverage through system extensions (TBD)
6. Conduct customer surveys (GIZ – Zahle-Chtaura and TBD)
7. Explore metering options (production, zone, households – and reading and billing) (USAID/LWWSS and TBD)
8. Develop and implement a new strategy for water and wastewater tariffs (GIZ – MEW and WEs)
9. Develop a plan to improve information technology (USAID/LWWSS and TBD)

Unfortunately, the BKWE does not have the administrative, financial, or management resources to readily take on these actions in the short term or long-term, as they operate under a deficit and must depend nearly entirely on donors for the foreseeable future. Moreover, other than the BMLWE and the NLWE, the other two WEs are less able to carry out their mandates. All the WEs suffer from excess administrative burdens, understaffing, and a lack of real autonomy to implement their decisions without high-level central government concurrence.

The largest part of operating and maintaining budgets for the WEs is in energy costs for potable water. For example, the BKWE 2009 O&M expense for energy was their largest single expense at 42% of their cost, followed by 35% for staff and 20% for O&M contracts. As accumulated liability, BWE's percentage of energy cost to its total costs is 65% for potable water[6]. According to the BMLWE and NLWE Business Plans, their operating energy costs are only 24% and 30% but it is likely they do not pay their entire electrical bills and are effectively subsidized. According to Small Village Wastewater Treatment Systems for the Upper Litani River Basin, operating small WWTPs in the Bekaa require about 70% of operating budgets for energy costs.

[6] August 2010, Rapid Conditions Assessment and Priority Action Plan

Unfortunately, to reduce energy costs, capital investments, trained and available technical staff, and more O&M are required. Reportedly, WEs may owe energy utilities considerable sums of money and are in arrears for payment.

Table 7. Comparison of Potable Water Systems by WE

	BKWE	BMLWE	NLWE	SLWE
Surface of geographic area (km^2)	4,000	1,992	~2,000	2,130
Water sources	28 springs, 148 wells	29+ springs, 157+ wells, lake	Wells and springs	~250 pumping stations at wells and springs
Total population in service area	489,865	~2,000,000	858,100	731,146
Estimated served population	305,332	2,042,333	452,943	576,945
Percent of population served (%)	62.3	~90	52.8	78.9
Percent of registered customers metered (%)	18	<40	27.4	30
Bill collection rate (%)	<3	66.3	58.5	48.4

From BKWE Rapid Conditions Assessment (2011-2012), BMLWE Business Plan (2010-2014), NLWE Business Plan (2010-2014), SLWE Business Plan (2009-2013). With an estimated July 2010 population of 4,125,247 (CIA 2011) plus a July 2010 estimated 425,640 Palestinians (UNRWA), the total estimated water-utility service population percentage is less than 75%.

4.5 Municipalities

Municipalities have been historically responsible for wastewater and solid waste management and potable water distribution. Municipalities represent the first level of government and are best informed about the needs of their constituents with respect to water, wastewater, and solid waste. They are also responsible for the remaining municipal infrastructure, such as roads and sidewalks, under which potable and waste water networks run. Municipalities wield significant influence and are the natural local partners of the WEs. Municipalities are however limited by both their budgets and the control of central government through the Ministry of Interior and Municipalities. Municipalities have been the beneficiaries and operators of small wastewater plants funded directly by international donors, especially USAID/Lebanon, but they have later faltered in their O&M and financial responsibility of these facilities, some of which they have turned over to WEs or have stopped using altogether.

4.6 River Basin Authorities

Barring the LRA, river basin authorities as such do not exist in Lebanon. The LRA actually is a development agency for the Litani River Basin and not operating truly as a basin authority. With

proper institutional and legislative amendments, the LRA could become a basin authority and become a model for such authorities across Lebanon.

4.7 Water User Associations (WUA)

WUAs do not exist as such in Lebanon. A draft law for their organization has been prepared with the assistance of international donors. Water management committees exist in different agricultural parts of the country. They would represent the nuclei of WUAs once their legal status is defined and would become the counterparts of the WEs in the management of the agricultural water sector or may totally take over.

4.8 Human Capacity

Human capacity, especially in the professions of administration, management, and engineering, is limited in Lebanon, as most Lebanese live, study, and work abroad due to historical conflicts and political instability. Reportedly, when professional training opportunities are offered in the water sector in Lebanon, many seats are unfilled or are filled by people unqualified and un-intending to function in the sector. Sectarian and confessional issues also limit the country's human capacity, including in the water sector. For example, WE Director Generals must be split 50-50 among representatives of Christian and Muslim communities; such agreements filter down to other management and technical staff.

4.9 Finances

Finances for the water sector typically have come from taxes, bonds, donor contributions which do not send signals to the water sector on water shortages or scarcity, or to encourage wise water-use and water conservation, demand reduction, reuse and recycling. Current MEW and WE initiatives to increase sector financing through consumer water metering and charging tariffs (based on fixed-fee low rate plus variable fee based on potable water consumption) are promising, yet challenging, because they are likely to succeed only where there is dependable and safe water delivery, which is a small area.

Table 8. Strengths and Weaknesses of the Water Sector

Strengths and Weaknesses of the Water Sector including Potable Water, Wastewater, and Irrigation
Strengths
• Relative abundance of water resources, all originating from within the country borders (rain and snow precipitation, springs, and rivers) • Public utilities recently organized around four regional establishments (BMLWE, NWLE, SWLE, BKWE) and one river basin authority (LRA) under the (Law 221/2000 and its application decrees in 2005) • Highly urbanized population (87%, highest in the MENA region) with about half in the Greater Beirut area

Strengths and Weaknesses of the Water Sector including Potable Water, Wastewater, and Irrigation

- High GDP per capita (above $6,000) and level of education in the MENA region
- Highly qualified professional and technical human resources available in the private sector
- Willingness to pay for service in the affluent urban areas (as evidenced by the monies spent on bottled drinking water and complementary supply of domestic water from private sector providers, percentage as per WB study)
- Draft NWS recently prepared by the MEW and awaiting cabinet's approval
- Draft legislation for a Water Code (*Code de L'Eau*) ready and in need of parliamentary approval
- Public servants and administrators in charge of the water sector aware and knowledgeable of the central issues and critical problems; modern utility management methods starting to be adopted
- Availability of some qualified and experienced public servants in the operations and maintenance of potable water supply and distribution networks (mostly at the BMLWE and the NLWE)
- Public potable water network coverage averages 78% of the population with connection rate varying from 93% (BMLWE) to 65% (NLWE)
- Market driven economy and highly responsive private sector and citizens
- Good awareness about the criticality and interconnection of the water and environmental issues at the level of municipalities, NGOs, and citizenry
- Parts of a nationwide wastewater collection and treatment master plan for the urban and coastal areas currently being implemented
- Availability of substantial international funds/loans (WB, EIB, Kuwait Fund, AFD, Italian Aid) allocated to the development of the water and wastewater sectors some in excess of the absorptive capability of the implementing agencies (mostly the Council for Development and Reconstruction)

Weaknesses

- Severe lack of reliable data for the whole water sector (natural resources, legal and illegal wells, supply and demand, production and distribution costs)
- Total lack of IWRM approaches (potable water systems development driven by the

supply side only)

- Critical pieces of legislation (such as the Water Code) have yet to be passed or drafted
- Institutional impediments to the operations of the public WEs placed under the operating and financial supervision of the MEW (spending ceilings subject to Minister's approval, budgetary procedures limiting contracting power and outsourcing, insufficient legislative empowerment of the WEs)
- Highly centralized government limits the capabilities of local government (municipalities) and public water establishments
- Multiple Institutional players with conflicting planning and execution responsibilities (MEW, CDR, WEs and Regional development funds such as the Council for the South and the Central Fund for the Displaced)
- Severe to moderate lack of modern asset and public utility management expertise among the key WE decision makers (WEs have prepared a first business plan but have yet to acquire the abilities to develop the budgetary plans and keep audited accounts and financial statements as per modern accounting standards such as GAAP)
- Outdated and leaky distribution networks for potable water, water distribution losses estimated to vary from 35% to more than 50% with an average above 40%
- Unreliable service with water supply varying from 3 to 22 hours per day (with one 24/7 exception in urban Tripoli due to private operator subcontracting between 2003-2007)
- Collection varies from over 90% in some urban areas to less than 12% in some rural areas; (BMLWE is the only WE able to cover O&M costs from collection, other WEs rely on Ministry subsidies while delaying energy bill payments to the Electric Utility as power charges are the single largest O&M cost)
- Total disconnect between cost of supply and demand on one side and tariffs on the other:
    - Potable water tariffs calculated on the basis of a yearly flat fee corresponding to the supply of a fixed quantity per day
    - Irrigation water tariffs calculated on the basis of a flat fee per surface area irrigated
    - No wastewater tariffs are directly applied save for a minimal municipal flat fee
- Wastewater sector development is still embryonic, with network coverage mostly limited to urban areas with direct untreated discharge to the sea or closest water body
- No wastewater treatment plants in operation yet (barring one primary station at Ghadir south of Beirut and a few very small ones in rural areas)

Strengths and Weaknesses of the Water Sector including Potable Water, Wastewater, and Irrigation
• Severe to moderate lack of qualified human resources in the public Water Establishments • Severe lack of expertise and experience in managing wastewater treatment stations • Weak to inexistent O&M policies and strategies (no preventive or planned maintenance only ad hoc repairs, limited or no leak detection capabilities) • Critical water resources at risk of being polluted by wastewater from septic tanks, open networks discharge, excessive fertilizer and pesticide in irrigation return water, and solid waste uncontrolled discharge • Outdated and archaic wasteful irrigation procedures still in use in most remote rural areas • Old, inefficient, and poorly maintained irrigation networks with more than 70% wastage • Severe lack of adequate water storage capacity (reservoirs, hill lakes, dams) • Agricultural extension programs and assistance to farmers still lacking • No formal WUAs established yet (two donor supported programs underway) • Unaccounted for industrial water production and needs • Unaccounted for illegal tapping of water resources, and operation of illegal wells

5.0 LESSONS LEARNED

This section is based on a very large number of interviews and meetings, site visits, discussions, and reviewing over 200 reports. It includes three subsections: What Works; "What Does Not Work; and Next Steps.

5.1 What Works:

Stakeholder Participation, Collaboration and Empowering

1. Reportedly, workshops with main stakeholders such as WEs, municipalities, associations representing industrial and commercial users, academics, and researchers to discuss solid waste, wastewater, and other pollution sources and measures that can be implemented to mitigate them. Such workshops are likely to bring out consensus on what works and what does not work, and to share and learn from each other's experience.

2. Collaboration among stakeholders. In some cases, municipalities can assist WEs in conducting customer surveys and update registries as WEs are poorly staffed. Furthermore,

municipalities can help identifying problems and opportunities such as areas of poorly operating septic tanks, areas of poor drainage and flooding, areas not connected to water service or sewers, and areas where wastes and pollution are prevalent. WEs and municipalities could cooperate on such issues through drafting cooperation agreements.

3. Success requires patience, deep searching, communication, negotiations, collaboration and incremental actions to get results, especially where public agencies move slowly. Coordination with public agencies is required. Long-term donors' commitment is more likely to lead to successes as the donor and implementer builds stakeholder confidence and obtains useful feedback along the way. If recipients participate in developing the project, they are more likely to own and sustain it. For example, in a project to build WWTPs one may early identify, through collaboration, the need for hiring, training, and retaining operational staff, or supply reliable energy, or install sewers and connect them to households to be effective, and the project would be modified to achieve better results.

4. Successes in the USAID-funded LRBMS, LWWSS, and SVWWTPS projects are due primarily to experienced, high-quality US private-sector contractors, and their patience and collaboration with stakeholders.

Fairness

1. Reportedly, interventions in Lebanon, which are geographically sectarian, and somewhat equitable between urban-suburban-rural beneficiaries, are more likely to be perceived as fair and receive popular support. Certainly, donor interventions cannot be expected to please or service everyone. Interviews indicated several groups whose voice has been unheard and needs have been unmet in providing donor-supported potable water, wastewater treatment, agricultural supplies, and drainage control.

Incentives

1. Co-financing and in-kind service contribution by stakeholders and beneficiaries with donors is more successful than gifting because it gives participants a sense of ownership.

2. If WEs routinely provide good quality potable water on a 24-hour basis, customers would be more amenable to pay higher fees than otherwise; if the service is charged on the basis of measured delivery, consumers say they are more likely to pay even more as they would then perceive pricing to be fair[7]. More generally, water consumers and users are more willing to pay if there are credible commitments for water service and there is appropriate bill collection service and enforcement.

3. People respond well to incentives they value. They may respond to, for example, promotional campaigns and fairs (social marketing), high quality water, convenient water-service hours, high water volume supplied, discounts, subsidies, or price. Pricing water appropriately to consumers and irrigators, and collecting the bills, will lead to water conservation and reduced water demand.

[7] (DAI), October 2010. *Lebanon Water Sector Customer Satisfaction Survey Report, Lebanon Water and Wastewater Sector Support (LWWSA),* 20p

4. Ad hoc local WUAs are reportedly perceived as more effective and fairer in allocating scarce water resources than centralized or regional authorities. For example, interviews indicated that rural village farmers have informal associations who routinely allocate irrigation scheduling and resolve conflicts over water use. Interviewers indicated that such associations would benefit from specialized workshops in improved crop selection and irrigation methods.

Knowledge-Based

1. When potable and irrigation water users have sound and practical information on their water use and management options, they may more likely make environmentally and economically sound decisions in water conservation, harvesting, reuse and safe storage, and irrigation scheduling. For example, several interviewees indicated they routinely receive consumer phone calls asking for information on how to harvest their rooftop water for storage and reuse, manage their water-storage tanks safely, and improve their septic tanks.

2. When mechanical and engineering systems offer appropriate technology to the operators such as they can understand it and operate it, sustainability is ensured. This was reported as one of the reasons for success or failure of many of the WWTPs.

3. Sounder and more economical and sustainable water management decisions are likely to be made when appropriate accurate and timely water resources and water use data is readily available.

Operational Support

1. Outsourcing utility services works, especially for short- and mid- term activities until the agency, such as WE, build their own capacity. For example, several WEs routinely outsource the operation and maintenance of pumping stations and water treatment plants and the provision of unskilled labor. Certain specialty services, like laboratory analyses, pipeline leak detection, business and technical training and optimization studies, may best be outsourced for good result.

2. When a committed WE like the BMLWE takes over a task it is unfamiliar with, such as operating small WWTPs in the Chouf, it can be successful because it can institutionally support its commitment.

3. USAID awards to qualified implementing partners would allow proper implementation and follow up of design, construction, and commissioning of projects.

4. Following the implementation of certain projects, enough time (average of one year) should be allowed by implementing partners to ensure proper constructed facility operation and maintenance.

5. More success would be achieved if a significant training program for local team members on the community mobilization techniques is provided, as civil society in Lebanon could help in capacity building.

5.2 What Does Not Work

1. Proposing new legislation, though very logical and needed, may be a non-starter given the bureaucratic and political impediments characteristic of Lebanon. Several interviewees suggested that reforming government and MEW are unlikely to occur in the short- and mid-terms, but would take a long-term commitment of donors.

2. Limiting interventions to short cycles of funding and planning. USAID, with its emphasis on impact, metrics and short timeframes may not be able to support long-term efforts to introduce new legislation as a program goal. For example, it may take timeframes beyond USAID interest to change existing legislation in Lebanon.

3. Projects that rely on inexistent or scarce data. Because reliable water sector data are not available, projects which depend on non-reliable or non-available data are likely not to work well. The difficulty of getting good reliable data and a clear picture of the informal and formal operations of the various institutions and politics is a barrier to making good decisions and implementing infrastructure projects successfully. For example, some government-planned dams may not receive sufficient water.

4. Raising stakeholder and beneficiary expectations by advertising a program as needs or demand driven, when in fact it is donor agenda or criteria driven, is counterproductive and alienates the stakeholder. It is better to advertise the program as collaborative and to engage and empower the stakeholder in project development.

5. Failures of WWTPs were traced to multiple external reasons, which could have been considered at the time of implementation. They can be summarized as follows: poor procurement practices, technical inexperience of some prime implementers, beneficiaries' failure to complete, operate, and sustain projects.

Next Steps

Further investigations and research concerning quantitative assessment of water sources is urgently needed to support the available, non-continuous and sparse data.

The next steps in improving the Lebanon Water and Wastewater Sector, is to use the findings and lessons learned through this evaluation to prepare intervention options to improve the sector. These will be considered with the intention for Quick-Win or short-term impacts (less than 5 years) and mid- and long- term impacts (5 to 10 years), under criteria for screening and prioritizing.