



WASTEWATER REUSE IN LEBANON: POLICY, LEGAL, AND REGULATORY FRAMEWORK

JULY 2020

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ACRONYMS

CDR	Council for Development and Reconstruction
CWSAS	Country Water Sector Assistance Strategy
LIBNOR	Lebanese Standards Institution
LRA	Litani River Authority
LWP	Lebanon Water Project
LWPP	Lebanon Water Policy Program
LWWSS	Lebanon Water and Wastewater Sector Support
MENA	Middle East and North Africa
MoA	Ministry of Agriculture
MoE	Ministry of Environment
MoEW	Ministry of Energy and Water
MoI	Ministry of Industry
MPH	Ministry of Public Health
NERP	National Emergency Reconstruction Program
NSEQ	National Standards for Environmental Quality
NWSS	National Water Sector Strategy
PPP	Public Private Partnership
WE	Water Establishment
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

Water resources are increasingly limited in Middle East and North African (MENA) countries; treated wastewater offers a potentially viable, cost effective solution to reduce stress on renewable resources, and promote water and food security. The objective of this study is to provide an overview of the existing policy, legal, and regulatory framework governing wastewater reuse in **Lebanon**, Morocco, and Jordan. This analysis – which focuses on Lebanon (separate reports assess Morocco and Jordan) – could serve as one tool to inform decision-makers and help tighten gaps in the wastewater reuse sector in the MENA region.

The existing wastewater framework is a key factor affecting the expansion – or lack thereof – of wastewater reuse in the MENA Region. The wastewater structure – along with other factors such as infrastructure and financing – can either promote and motivate wastewater reuse, or act as the main barrier to developing the wastewater reuse sector. For Lebanon, it is important to note that the wastewater reuse framework is quite underdeveloped, which is limiting effective reuse.

In addition to conducting desk research for this analysis, to verify data, obtain new information, and solicit feedback on the status of wastewater reuse in Lebanon, the ECOS team engaged with several key stakeholders: the USAID Lebanon Water Project, the Ministry of Energy and Water, and the International Water Management Institute.

The key findings of this study address estimated wastewater volumes; key policies, laws, and regulations; and critical gaps and potential opportunities in the sector. These findings are summarized below.

Available wastewater volume data for Lebanon is identified in Table ES I, with the caveat that there are significant limitations on available and reliable data. Data on treated wastewater volumes may include either municipal or industrial wastewater or both – the data available does not always define which wastewater types are included. Further, as there is limited legal framework for wastewater reuse in Lebanon, almost all reuse occurs informally and there are no official volume estimates. As such, these data on wastewater volumes treated should be considered estimates. For additional information, see Section I.

TABLE ES I. ESTIMATED LEBANON WASTEWATER VOLUMES

COUNTRY	YEAR	VOLUME GENERATED (MILLION CUBIC METERS PER YEAR)	VOLUME TREATED (MCM/YR)	VOLUME REUSED (MCM/YR)	CITATION(S) (AUTHOR, YEAR)
Lebanon	1991	165	4	2	(Karam, et al. 2013)
	2005	226	NA	NA	Ibid
	2012	310	24	NA	(World Bank 2012)
	2015 – 2020 (annual estimates, not five-year aggregate)	460	87 – 260	NA	(Arab Water Council 2015), Ministry of Water and Energy (2020)

Table ES2 summarizes the policy, legal, and regulatory framework governing Lebanon’s wastewater sector. For additional information, refer to Section II.

TABLE ES 2. LEBANON POLICY, LEGAL, AND REGULATORY FRAMEWORK (ILLUSTRATIVE)			
TYPE	TITLE	STATUS AND DATE	DESCRIPTION
Law	<u>Law No. 444 on environmental protection</u>	2002; Current	Establishes quality standards for wastewater discharges by putting a framework on the “polluter pays principle.” The Law directs coordination between the MoE and the MoEW to develop an integrated approach towards natural resource management.
Regulation	<u>Resolution No. 3/1 of 2005 defining the environmental requirements for licenses to construct small stations for wastewater treatment</u>	2005; Current	<ul style="list-style-type: none"> • Defines wastewater, domestic wastewater, domestic wastewater treatment stations, domestic wastewater treatment small stations, and the adopted treatment phases. • Specifies the requirements of disposal for pollutants from small wastewater treatment facilities.
Policy	<u>National Water Sector Strategy (NWSS)</u>	2010; Current	<p>Aims to improve the operating model between the four Water Establishments (WEs), the Litani River Authority (LRA), and the Ministry of Energy and Water (MoEW) through:</p> <ul style="list-style-type: none"> • Development of wastewater infrastructure to increase coverage of collection networks and treatment capacities, optimize treatment processes and sludge disposal, and encourage wastewater reuse.
Law	<u>Water Law No 77 of 2018</u>	2018; Current	The Water Law regulates the extraction and use of water resources; aims to protect resources from depletion and pollution; and provides guidelines to improve the efficiency of transport and distribution systems. Article 4 of the Water Law lists achieving wastewater disposal as one of the law’s primary objectives.

Table ES3 highlights some illustrative critical gaps in the Lebanese wastewater sector, as well as illustrative potential opportunities to help bridge these gaps.

TABLE ES 3. GAPS AND POTENTIAL OPPORTUNITIES IN WASTEWATER REUSE (ILLUSTRATIVE)

ILLUSTRATIVE GAPS	ILLUSTRATIVE POTENTIAL OPPORTUNITIES
<p>Absence of Relevant Standards: there is no legal basis for the reuse of wastewater in Lebanon.</p>	<p>Establish Wastewater Reuse Standards to set a legal and policy basis for the reuse of wastewater in Lebanon.</p>
<p>Outdated Standards for Wastewater Discharge: There are limited standards in Lebanon governing the discharge of wastewater - especially industrial wastewater - and there is minimal enforcement of the standards that do exist.</p>	<p>Improve Data Collection. Develop a nationwide <u>Wastewater Reuse and Treatment Survey</u> of key stakeholders (e.g., operators, municipalities, farmers) to better understand e.g., reuse opportunities and demand.</p>
<p>Lack of Wastewater Tariff or Cost Recovery: Wastewater collection rates have dropped and WEs have limited capacity to pay salaries and operate water supply systems, with no existing government subsidies to the sector. (Some individual municipalities have applied tariffs.)</p>	<p>Improve Monitoring and encourage a transparent data sharing approach to increase confidence in treated wastewater and promote reuse.</p>
<p>Lack of Accountability Measures: There is no independent, autonomous institution in Lebanon assuming a regulatory role in the water and wastewater sectors.</p>	<p>Increase Reuse of Treated Wastewater for Agriculture: To help alleviate water scarcity issues in the country, pursue additional use of direct, treated water and enhance application of indirect wastewater.</p>
<p>Infrastructure Challenges/Shortages: Water storage facilities, water treatment plants, and water supply and distribution pipelines need significant improvement throughout Lebanon.</p>	<p>Develop and Apply a Robust and Transparent Wastewater Tariff Structure – timed during service improvements/investments.</p>
<p>Lack of Groundwater Protection Zones: Lebanon does not have any groundwater protection zones, and landowners hold sole legal rights to groundwater. Aquifers are often contaminated from wells and boreholes and the water quality is untested.</p>	<p>Establish a Framework for Greywater Treatment and Reuse: Because greywater often occurs at the household level (e.g., kitchen sinks, washing machines, showers) and is less contaminated than municipal or industrial wastewater, it can be reused for purposes such as irrigating backyard gardens.</p>
<p>Unregulated Discharges: Wastewater treatment plants (WWTPs) are often unable to effectively treat unregulated effluent discharged into their systems, e.g., industrial wastewater with high COD, metals, and plastics levels. Treated water is then unsuitable (i.e. pollutants levels are still too high) for reuse. Public health threats such as the potential transmission of coronavirus in wastewater also exist.</p>	<p>Improve Human Capital in the Wastewater Sector through, e.g., operator training and capacity building.</p>
<p>Conflicting Roles and Responsibilities: The fractured framework governing the wastewater sector results in a lack of coordination among the different entities involved in planning, construction, implementation, operation, and management of water</p>	

TABLE ES 3. GAPS AND POTENTIAL OPPORTUNITIES IN WASTEWATER REUSE (ILLUSTRATIVE)

ILLUSTRATIVE GAPS	ILLUSTRATIVE POTENTIAL OPPORTUNITIES
<p>and wastewater resources and infrastructure.</p> <p>Limited Capacity for Water Treatment: The vast majority of wastewater that gets collected only goes through preliminary or primary treatment, and very few WWTPs have the capacity for secondary or tertiary treatment.</p>	<p>Improve Wastewater Treatment and Reuse Infrastructure. Further invest in collection networks, wastewater treatment plants, and water supply and distribution pipelines for effective reuse.</p>

I. BACKGROUND

Despite having relatively abundant water resources for the MENA region, Lebanon faces significant challenges to its water security, primarily due to limited infrastructure and management. In recent years, Lebanon's water challenges have been compounded by a significant increase in water demand as a result of the refugee crisis caused by the Syrian civil war. Further, Lebanon's water supply services are relatively weak compared to other middle-income countries, and its wastewater sector – particularly with regard to reuse – is extremely undeveloped. While approximately 60 percent of Lebanon's population is connected to wastewater collection networks, the vast majority of wastewater goes untreated into watercourses and the sea, and virtually no wastewater is formally reused (World Bank 2012). The Ministry of Energy and Water (MOEW) is the authority responsible for the wastewater sector, though it shares authority with other government ministries, including: the Ministry of Agriculture (MOA), the Ministry of Environment (MOE), the Ministry of Public Health (MPH), and the Ministry of Industry (Mol); the four regional Water Establishments (WEs) and the Litani River Authority (LRA); the Council for Development and Reconstruction (CDR); and various municipalities that have assumed informal control of wastewater treatment. As a result, there are significant bureaucratic hurdles to develop coordinated efforts to improve wastewater treatment and reuse.

To advance wastewater treatment and reuse in Lebanon, it is first important to look at the available data. Available wastewater volume data for the country is identified in Table I, with the caveat that there are significant limitations on available and reliable data. Data on treated wastewater volumes may include either municipal or industrial wastewater or both – the data available does not always define which wastewater types are included. Further, as there is no legal framework for wastewater reuse, almost all reuse occurs informally and there are no official volume estimates. As such, these data on wastewater volumes treated should be considered estimates.

TABLE I. ESTIMATED LEBANON WASTEWATER VOLUMES

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2. LEBANON WASTEWATER POLICY SUMMARY

Information about the policy, legal, and regulatory framework governing Lebanon's wastewater sector – which, as with data collection, is critical to advance effective treatment and reuse – is collected and synthesized in Table 2. The legal framework in the table is organized chronologically and includes regulations, laws, policies, and guidelines. Unless information was found indicating otherwise, it is assumed that all laws are current. Where applicable, additional context is provided in the “Comments/Remarks” column.

TABLE 2. LEBANON POLICY, LEGAL, AND REGULATORY FRAMEWORK ¹				
TYPE	TITLE	STATUS AND DATE	DESCRIPTION	COMMENTS/REMARKS
Regulation	Decree No. 8375: Pollution from Solid and Liquid Waste (Karam, et al. 2013)	1974, Current	Established the first protections against pollution by prohibiting the digging of wells for the disposal of raw sewage, as well as the use of sewage for irrigation of vegetables and some fruit trees. In addition, banned wastewater discharges into public water bodies, rivers, and the sea.	This regulation does not address wastewater treatment and enforcement.
Law	<u>Law 216</u>	1993, Current	Created the Ministry of Environment to be the government institution responsible for the development of a national strategy for sustainable development.	While the Ministry of Energy and Water is the responsible authority for managing the wastewater sector, the Ministry of Environment covers some wastewater considerations that overlap with pollution and protection of the environment.
Guideline	<u>Resolution No. 52/I of 1996 defining standards and percentages for pollution control of</u>	1996, Later Amended	Introduced environmental quality standards to address air, water, and soil pollution. This included the development of national standards governing wastewater discharge into receiving water bodies and	Does not provide standards for wastewater reuse.

¹ Some decrees regarding the water sector are remnants of the Ottoman Empire and French Mandate. While these decrees were important for developing the initial framework for more recent legislation, this table only analyzes the policy, legal, and regulatory framework that has developed since the end of the French Mandate in 1943.

TABLE 2. LEBANON POLICY, LEGAL, AND REGULATORY FRAMEWORK ¹

TYPE	TITLE	STATUS AND DATE	DESCRIPTION	COMMENTS/REMARKS
	<u>water, soil, and air.</u>		public sewers. These standards include an array of parameters, including color, pH, temperature, and BOD, COD, Suspended solids, and the concentration of various chemicals and minerals. (Government of Lebanon 2019)	
Law	Law 20 of 1966	Amended 2000	Establishes the MoEW as the authority to oversee water and sanitation. The MoEW is responsible for designing, building, and implementing water and wastewater treatment plants and water networks, and otherwise managing wastewater (Farajalla, et al. 2015).	
Law	<u>Law 221</u> of 2000 on Water Sector Organization	2000, with later Amendments	Law 221 is the main law governing and restructuring Lebanon's water sectors and sought to centralize authority of the water sector to four Water Establishments (WE), based in Beirut, Tripoli, Zahle, and Sidon. Under this law, each WE is responsible for planning, operating, and maintaining the local water system; implementing a cost recovery program to allow for new resources to be invested in the system; fixing tariffs for water services (drinking water, irrigation water, discharge wastewater); and monitoring drinking water,	While Law 221 calls for centralization of the water sector at the level of the Water Establishments, municipalities still largely manage the sector. The four WEs have struggled with revenue collection, the fallout of poor water resource management, and the ubiquity caused by informal water sources and providers. As a result, Law 221 has not been fully implemented.

TABLE 2. LEBANON POLICY, LEGAL, AND REGULATORY FRAMEWORK¹

TYPE	TITLE	STATUS AND DATE	DESCRIPTION	COMMENTS/REMARKS
			irrigation water quality, and the quality of wastewater. Law amended to include Litany River Authority and WEs.	
Law	Privatization Framework Law 228	Current; 2000	Law 228 sets up the general framework for privatization and encourages the participation of the private sector across all sectors, including electricity and water. It establishes a framework for future public-private initiatives to: regulate the relevant economic sector; identify regulatory bodies to oversee public-private transfers; specify the duration of partnerships; and monitor privatized projects (Farajalla, et al. 2015).	While the government and the private sector have an on-going interest in increasing public-private partnerships (PPPs), legislation designed to implement has stalled, most notably a draft PPP bill that would grant the Higher Council for Privatization the purview to develop and procure wastewater and reuse projects. The future of this bill has been uncertain since 2007 (PPP Standards n.d.).
Guideline	<u>Resolution No. 8/I of 2001 amending Resolution No. 52/I regarding the standardization and metrology for air pollutants and liquid waste originated from firms, establishments, and stations for wastewaters treatment</u>	Current; 2001	Through Resolution No. 8/I, the MOE updated the standards established under Resolution No. 52/I with the National Standards for Environmental Quality (NSEQ), covering air and liquid emissions for all sectors. It updated the standards for wastewater discharge to cover the discharge of wastewater to the sea, surface water, and into the wastewater network (Karam, et al. 2013).	Resolution No. 8/I did not set standards for wastewater reuse nor requirements for sampling methods and analyses (Karam, et al. 2013). Lebanese Standards Institution (LIBNOR) and the MOE are currently updating these standards accordingly (source: Lebanon Water Project).
Law	<u>Law No. 444 on</u>	2002; Current	Establishes quality standards for wastewater discharges by putting a framework on	Law 444 has not been fully implemented due to the lack

TABLE 2. LEBANON POLICY, LEGAL, AND REGULATORY FRAMEWORK ¹

TYPE	TITLE	STATUS AND DATE	DESCRIPTION	COMMENTS/REMARKS
	<u>environmental protection</u>		the “polluter pays principle.” The Law provides guidance for coordination between the MoE and the MoEW to develop an integrated approach towards natural resource management. Furthermore, Law No. 444 prohibits any discharges in territorial waters that could affect human health and marine natural resources, in addition to surface and groundwater.	of a coordination mechanism between the ministries.
Regulation	<u>Resolution No. 3/1 of 2005 defining the environmental requirements for licenses to construct small wastewater treatment facilities.</u>	2005; Current	This Resolution is designed to protect the environment against pollution. Article 2 of this resolution defines wastewater, domestic wastewater, domestic wastewater treatment stations, domestic wastewater treatment small stations and the adopted treatment phases. Articles 3 and 4 of this Resolution specify pollutants caused by small stations of wastewater treatment and requirements for their disposal. Graphics I and II of the resolution illustrate the adopted treatment phases and the general pollutants of small stations for domestic wastewater treatment, respectively. Annex I lists the domestic wastewater requirements. Annex II deals with the Wastewater Treatment Monitoring Programme.	

TABLE 2. LEBANON POLICY, LEGAL, AND REGULATORY FRAMEWORK ¹

TYPE	TITLE	STATUS AND DATE	DESCRIPTION	COMMENTS/REMARKS
Regulation	<u>Decree No. 8633 on Environmental Impact Assessment</u>	Current; 2012	Decree 8633, also known as the Environmental Impact Assessment Decree, comprises 17 articles divided into three chapters. The Decree aims to aid in the prediction and mitigation of adverse environmental impacts from projects, including wastewater and sanitation projects. It deals with the requirements for screening, preparation of the environmental assessment, and supervision over the environmental assessment process.	
Policy	<u>National Water Sector Strategy (NWSS)</u>	2010, Current	<p>Aims to improve the operating model between the four WEs, the LRA, and the MoEW. As summarized by the World Bank Lebanon Country Water Sector Assistance Strategy (CWSAS), the NWSS proposes the following measures on wastewater (World Bank 2012):</p> <ul style="list-style-type: none"> • Developing wastewater infrastructure to increase coverage of collection networks and treatment capacities, optimizing treatment processes and sludge disposal, and ensuring reuse where possible; • Improving wastewater collection, treatment, and reuse; and 	Lebanon did not meet most commitments established in the Water Strategy, and a new strategy is being drafted.

TABLE 2. LEBANON POLICY, LEGAL, AND REGULATORY FRAMEWORK ¹

TYPE	TITLE	STATUS AND DATE	DESCRIPTION	COMMENTS/REMARKS
			<ul style="list-style-type: none"> Environmental protection by promoting and improving water quality management, and protection of recharge zones. 	
Law	<u>Water Law No. 77 of 2018</u>	2018, Current	The Water Law regulates the extraction and use of water resources; provides measures to protect resources from depletion and pollution; and improves the efficiency of transport and distribution systems. Article 4 of the Water Law lists achieving wastewater disposal as one of the primary objectives.	Implementation of Law 77 has yet to begin. Law 77 was passed concurrently with parliamentary elections in May 2018, and the new parliamentary commission recommended that it be revised. It has not been ratified as a final law. The revised law is anticipated to include additional detail and include provisions for executive decrees to allow for greater implementation of the law. However, revision has largely been paused since mid-October 2019 as a result of political unrest and then, in 2020, the disruption caused by the COVID-19 pandemic (Ministry of Energy and Water 2020).

3. GAPS AND POTENTIAL OPPORTUNITIES IN WASTEWATER REUSE

Table 3 discusses the current critical gaps in the Lebanese water sector, as well as illustrative potential opportunities to help bridge these gaps. These findings are based on desk research and from consultations with stakeholders.

TABLE 3. GAPS AND POTENTIAL OPPORTUNITIES IN WASTEWATER REUSE		
TYPE	GAPS	ILLUSTRATIVE POTENTIAL OPPORTUNITIES
Rule/ Regulation	<p>Absence of Relevant Standards: As of 2019, Lebanon lacked: soil and sediments standards; guidelines for the disposal and reuse of sewage sludge; and guidelines for effluent/wastewater reuse. As such, there is no legal basis for the reuse of wastewater in Lebanon (Government of Lebanon 2019). Wastewater reuse still occurs informally: farmers use polluted water from water resources such as rivers or even directly from the sewage network. However, LIBNOR is currently developing a standard to regulate the reuse of treated wastewater for irrigation purposes based on international guidelines (International Water Management Institute 2020).</p> <p>Outdated Standards for Wastewater Discharge: There are limited standards in Lebanon governing the discharge of wastewater (especially industrial wastewater), the discharge of which is governed under Article 11 of Decree No. 2761 of 1933 (a holdover from the French Mandate period), which states that “industrial wastewater should not be discharged in sewer lines without the permission of the Directorate of Health, and after it is adequately treated.” There is minimal enforcement of the standards that do exist.</p>	<p>Establish Wastewater Reuse Standards to set a legal and policy basis for the reuse of wastewater in Lebanon.</p> <p>Increase Reuse of Treated Wastewater for Agriculture: Because of water scarcity issues in the country, pursue additional use of direct, treated water (wastewater is already being used indirectly). The safe use of treated wastewater allows for the recycling of productive nutrients and reduced blackwater discharge into aquatic resources. Domestic treated wastewater could be utilized in fodder, food production, and woody crops in agriculture and agroforestry systems. According to Salman et al (2016), treating 30 percent of the available domestic untreated water for use in agriculture would allow for increases of up to 11 percent in available water for agriculture and forestry (Salman, Khalaf and Del Lungo 2016).</p>
Financing, Oversight, and Protection	<p>Lack of Wastewater Tariff Structure or Cost Recovery Schemes: Wastewater collection rates have dropped and WEs have limited capacity to pay salaries or operate water supply systems, with no existing government subsidies to the sector. Some individual municipalities have applied tariffs, but WEs and the LRA have yet to establish an active wastewater tariff structure for cost recovery. As WEs are finally beginning to take control of WWTPs, a tariff for wastewater is currently under development</p>	<p>Develop and Apply a Robust and Transparent Wastewater Tariff Structure – timed during service improvements/investments. A wastewater tariff could be progressively applied which will eventually cover, at minimum, operation and maintenance of the wastewater sector. This could require a sensitization period to allow the</p>

TABLE 3. GAPS AND POTENTIAL OPPORTUNITIES IN WASTEWATER REUSE

TYPE	GAPS	ILLUSTRATIVE POTENTIAL OPPORTUNITIES
	<p>(Ministry of Energy and Water 2020).</p> <p>Lack of Accountability Measures: There is no independent, autonomous institution in Lebanon currently capable of assuming a regulatory role in the water and wastewater sectors. Even where a regulatory role is assigned to certain entities (such as the MoEW and other Ministries), they generally lack the power to enforce. (International Water Management Institute 2020).</p> <p>Lack of Groundwater Protection Zones: Groundwater is a critically important resource for meeting domestic, industrial, and agricultural needs. Its relative availability provides for a high prevalence of local and autonomous water systems and irrigation. Lebanon's current legal and regulatory framework governing aquifers is based on regulations dating back to the Ottoman Empire and the French Mandate (with some successive legislation such as Decree 14438), meaning that modern wells and boreholes are often treated as if they were still dug wells. As a result, some groundwater sources have been found to be contaminated with fecal matter. Lebanon has no groundwater protection zones, and landowners hold sole legal rights to groundwater (Riachi 2016).</p> <p>Unregulated Discharges: Unregulated, industrial wastewater high in contaminants such as COD, metals, and plastics are often discharged to Lebanese WWTPs, which do not have the capacity to treat wastewater with excessively high concentrations. Treated water is then unsuitable (i.e., pollutant levels are still too high) for reuse. The MoEW and other ministries lack the capacity to effectively regulate, monitor, and enforce wastewater discharges. Another example of unregulated discharge is wastewater that merges with stormwater into water networks (Ministry of Energy and Water 2020).</p>	<p>population to adjust to the concept of paying for wastewater treatment for reuse.</p> <p>Establish a Framework for Greywater Treatment and Reuse: Greywater treatment and reuse is one aspect of wastewater treatment and reuse. Because greywater often occurs at the household level (e.g., kitchen sinks, washing machines, showers) and is less contaminated, it can be reused for purposes such as irrigating backyard gardens. More sophisticated greywater reuse requires source separation, which would entail retrofitting existing buildings and the creation of separate systems for new buildings.</p>
Institutional Knowledge	<p>Limited Data on Water Resources and Wastewater: There is a lack of national water information and data in Lebanon. This situation is</p>	<p>Improve Data Collection. Given the limited information available, a potential intervention is a nationwide</p>

TABLE 3. GAPS AND POTENTIAL OPPORTUNITIES IN WASTEWATER REUSE

TYPE	GAPS	ILLUSTRATIVE POTENTIAL OPPORTUNITIES
and Coordination	<p>mainly due to 1) slow recovery of monitoring agencies following the Lebanese civil war, and 2) water resources data is considered confidential and an issue of national security due to ongoing tensions between Lebanon and Israel. As a result, most data is produced by academic and research centers, with environmental data generated through donor-funded projects. Because this data is often left unpublished, it is inaccessible to other institutions and can lead to a duplication of work.</p> <p>Conflicting Roles and Responsibilities: The unclear framework governing the wastewater sector lends itself to overlapping responsibilities among the various actors involved (described in Section 1). This results in a lack of coordination among the different entities involved in planning, construction, implementation, operation, and management of water and wastewater resources and infrastructure.</p> <p>Poor Capacity in Water Management remains a significant challenge to effective recruitment of operators and other water professionals, limiting the extent to which public institutions have hired qualified personnel in water management. Furthermore, young professionals are less attracted to these opportunities due to low salaries and understaffing (Farajalla, et al. 2015). WE representatives have at times stated that they do not want to take over wastewater treatment facilities unless funding sources are assured. The MoEW is understaffed to the extent that five staff members oversee the regulation of the entire water sector (International Water Management Institute 2020).</p> <p>Wastewater Governance Gaps Threaten Sustainability of Foreign Assistance: The lack of proper standards and regulations coupled by inactive enforcement mechanisms are threatening the sustainability of foreign assistance in the Lebanese wastewater sector. Several donors have targeted the rehabilitation of WWTPs in Lebanon, but without the proper standards and regulations in place and</p>	<p><u>Wastewater Reuse and Treatment Survey</u> of key stakeholders (e.g., operators, municipalities, farmers). This effort would likely require significant political will and/or a presidential mandate that obligates all parties to cooperate with the assessment/survey team.</p> <p>Improve Monitoring and encourage a transparent data sharing approach to increase confidence in treated wastewater, and promote reuse.</p> <p>Improve Human Capital in the Wastewater Sector through, e.g., water system operator training and capacity building. In addition, by improving the appeal of public sector employment through competitive salaries and benefits, continuous development of professional skills, and a higher proportion of merit-based hires, the capacity of human capital to effectively manage water resources would improve.</p>

TABLE 3. GAPS AND POTENTIAL OPPORTUNITIES IN WASTEWATER REUSE

TYPE	GAPS	ILLUSTRATIVE POTENTIAL OPPORTUNITIES
	sufficient management capacity at the WE/municipality level, the sustainability of each investment remains at risk.	
Capacity and Infrastructure	<p>Infrastructure Challenges/Shortages: During the 2006 conflict with Israel, almost all infrastructure in southern Lebanon was destroyed, including water storage facilities, water treatment plants, and water supply and distribution pipelines. Since that time, institutional and capacity challenges have prevented water establishments from improving cost recovery methods to invest in infrastructure and extend water network service provision to all citizens (Walnycki and Husseiki 2017). While there are several large WWTPs across Lebanon’s major cities, only few are operational due to obstacles related to management, finances, problematic governance framework, overlapping responsibilities, and political instability. Most towns and villages continue to rely on traditional household septic tanks or draining wastewater into boreholes (which in turn reaches groundwater) (Karam, et al. 2013).</p> <p>While efforts such as the Lebanon Water Project (LWP) have increased the extent of wastewater infrastructure, there remains a lack of capacity and standards in place to allow for effective treatment. This leads to effluent that is of poor quality for reuse in agriculture, groundwater recharge, or industrial operations.</p> <p>Limited Capacity for Water Treatment: The vast majority of wastewater that gets collected only goes through preliminary or primary treatment, and very few WWTPs have the capacity for secondary or tertiary treatment – which is typically required for reuse. WWTPs tend to be run by private operators contracted by the WEs, CDR, or government ministries; however, these contractors do not tend to be experts in the treatment and reuse of wastewater (Ministry of Energy and Water 2020).</p>	<p>Improve Wastewater Treatment and Reuse Infrastructure: One of the primary needs of the Lebanese water sector is improved and expanded infrastructure to increase coverage of collection networks and treatment capacities, optimize treatment processes and sludge disposal, and allow for reuse (World Bank 2012). This includes moving beyond primary treatment of wastewater to secondary and tertiary treatment. Efforts to improve cost recovery and the creditworthiness of wastewater operations would lead to increased investments from donors.</p>

TABLE 3. GAPS AND POTENTIAL OPPORTUNITIES IN WASTEWATER REUSE

TYPE	GAPS	ILLUSTRATIVE POTENTIAL OPPORTUNITIES
	<p>Treated Wastewater is of Insufficient Quality: The majority of treated wastewater is of insufficient quality to allow for reuse, partially as a result of the lack of a standard or policy regulating the reuse. Most existing or planned WWTPs provide secondary treatment, but tertiary treatment is needed to achieve an effluent quality safe for irrigation (International Water Management Institute 2020).</p>	

ANNEX A: BIBLIOGRAPHY

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ANNEX B: ASSOCIATED DONOR PROGRAMS BY COUNTRY

TABLE B I. LEBANON DONOR PROJECTS PROMOTING WASTEWATER REUSE

FUNDER	TITLE AND URL	FUNDING YEAR(S)	BRIEF DESCRIPTION
World Bank Group	<u>National Emergency Reconstruction Program (NERP)</u>	1996	This program launched the design and construction of wastewater discharge networks and the implementation of treatment plants in most Lebanese cities. It was funded through a World Bank loan.
USAID	<u>Lebanon Water Policy Program (LVPP)</u>	2002-2008	The LVPP supported the MoEW to guide Lebanese ministry and water establishments' officials through the process of identifying and implementing sustainable financing and privatization techniques.
USAID	<u>Lebanon Water and Wastewater Sector Support (LWWSS)</u>	2009-2015	Building off of its predecessor, the Lebanon Water Policy Program (LVPP), the LWWSS was designed to improve water supply and sanitation services in Lebanon. The LWWSS project improved water supply to 107,000 inhabitants through enhanced treatment of drinking water in the Beka'a Valley, improved pump station efficiency and water service through equipment replacement, and upgraded water analysis laboratories to improve national water testing standards and capacity.
USAID	<u>Lebanon Water Project (LWP)</u>	2015-2021	Further building on the LVPP and the LWWSS, the LWP works to increase water access, improve water management practices, enhance the efficiency and sustainability of public water utilities, and respond to water challenges caused by the influx of Syrian refugees. It promotes improved water governance to protect Lebanon's water resources over the long term.
Swedish International Development Cooperation Agency (SIDA)	<u>ReWater MENA</u>	2019-2021	<p>Led by the International Water Management Institute (IWMI), and funded by Sida with partners, ReWater MENA is a 4-year project to address barriers to reuse in the region.</p> <p>Current activities in Lebanon include:</p> <ul style="list-style-type: none"> • <u>National Baseline Assessment of Water Reuse Potential in Lebanon.</u> • Water reuse field trials, including a 2-year field trial in Beka'a Valley that began in July 2019.

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FUNDER	TITLE AND URL	FUNDING YEAR(S)	BRIEF DESCRIPTION
			<ul style="list-style-type: none"> Developing methodology for water reuse standards.
World Bank	Ba'albeck Water and Wastewater Project	2002-2012	One component of the Ba'albeck project was to improve and increase service coverage for wastewater collection and treatment, including providing treated effluents and sludge suitable for agricultural reuse. A 2013 Implementation Completion Report noted that "The project succeeded in providing treated effluents and sludge suitable for agricultural use. The treated effluent was chlorinated and discharged to a river and some flow was taken up on a small scale for irrigation, supporting around 1,220 hectares of farmland (with most farmers mixing the treated water with well water)".
World Bank	Lebanon Country Water Sector Assistance Strategy	2012-2016	The Country Water Sector Assistance Strategy (SWSAS) seeks to define an operational plan for the World Bank's involvement in Lebanon's water sector in support of the National Water Strategy.
UNDP	Litani River Basin Management Support Program	2009-2014	Identifies solutions and opportunities to reverse the trend of severe pollution in the Litani River Basin and establish sustainable water management practices to allow water users to access and benefit equitably from the basin's water resources in order to attract increased private investment in water management.
EBRD	Daoura/Bourj Hammoud Wastewater Treatment Plant	TBD	EBRD solicited proposals in July 2019 for a feasibility study for the construction of this WWTP, including primary and secondary treatment and reuse schemes for treated wastewater.