Liquid sanitation in Lebanon

What are we talking about?

Liquid sanitation systems handle :

- black water, corresponding to the mixing of excreta (urine and faeces) with flush water.
- grey water, resulting from cooking, dishwashing, laundry, hand washing and showers.
- In some cases, industrial wastewater or wastewater from craft activities, and rainwater.

There are three segments in the sanitation chain:

The three segments of the sanitation chain

	1: Upstream segment	2: Intermediary segment	3: Downstream segment
Collective sanitation system	Wastewater collection Toilets, hand-washing facilities, showers, sinks	Conveyance of wastewater from the neighborhood. Sewerage system	Wastewater treatment, with or without reuse Treatment system
Non-collective sanitation system	Collection of wastewater and excreta, temporary storage, in some cases, partial treatment Different types of individual installations (pits, cesspools, etc.)	Conveyance of faecal sludge (possibly pre-treated) Vacuum trucks	Discharge of fecal sludge Treatment Fecal sludge, with or without reuse Treatment system

Users benefit directly from segments 1 and 2 which avoid contact with pathogen-containing excreta. The benefits of the downstream link are primarily environmental. A sanitation service with three functional segments enables the discharge of by-products into the environment that do not harm ecosystems or the quality of water resources. This indirectly benefits the user, in particular by protecting water resources used for human consumption from fecal pollution, which can cause water-borne diseases. Upstream link equipment is generally privately owned by users.

A sanitation service refers to the management system put in place to ensure the continuous operation of the infrastructures that make up the intermediate and

downstream links of the sanitation system. (In the case of non-collective wastewater systems, the sanitation department can provide assistance to users in managing the upstream link). This mode of organization has technical, organizational and financial dimensions. The sanitation department operates based on revenues generated by billing users, and generally also benefits from subsidies to support new investments.

Sanitation systems in Lebanon are exclusively collective (a non-collective sanitation project is underway).

Centralized and decentralized systems

Centralized treatment systems involve pooling wastewater collection and treatment for a large number of users. This may be managed by an urban municipality or a group of municipalities or the authority at hand. Many collection networks serve a wide perimeter of dwellings, routing wastewater to a single treatment plant with a high treatment capacity. The treatment processes used for this type of centralized system are known as "intensive". Typical is the activated sludge process.

"Activated sludge" wastewater treatment plants

If they operate correctly, activated sludge treatment plants produce a water output of sufficiently satisfactory quality to avoid degrading the receiving environment (discharge into surface water, infiltration into the soil). Treatment processes aim to trap and transform pollution through physical, chemical and biological processes. Sewage sludge, the "by-product of wastewater treatment", is also generated by these processes.

- **Pre-treatment by primary settling**, screening and grit removal can be optimized by a "coagulation-flocculation" process, which consists of adding chemical reagents to promote the agglomeration and subsequent settling of suspended solids (SS).

- Biological secondary treatment in an "activated sludge" tank involves the creation of successively aerobic (presence of oxygen) and anaerobic (absence of oxygen) conditions, through optimal sizing, syncopated aeration and, sometimes, the addition of chemical reagents, in order to promote the successive degradation of different pollutants by different microorganisms. Sludge composed of microorganisms and the by-products of their activity is separated from the treated water by settling in a second tank, called the "clarifier".

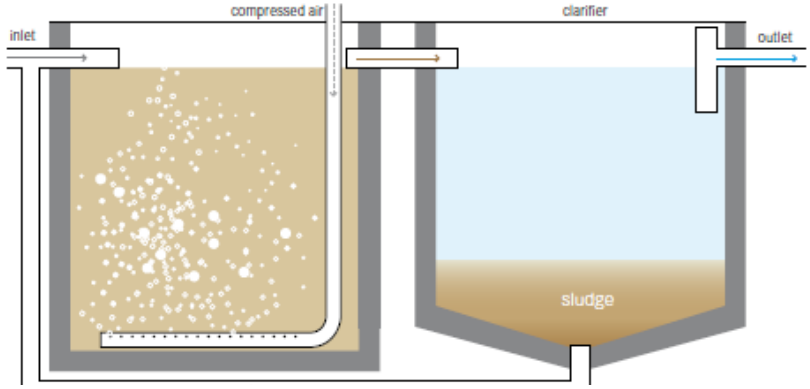


Table 1: activated skudge process for secondary tratment, Compendium of Sanitation Systems and Technologies, eawag, IWA,

In Lebanon, wastewater treatment systems are almost exclusively intensive, using activated sludge technology.

“Local sanitation" or "decentralized sanitation" refers to systems that collect, convey and treat wastewater from small communities or clusters of dwellings, with modest demographics and population density. These are often isolated areas not connected to urban centers. Local wastewater systems treat, reuse or dispose of effluent relatively close to its source of production.

Decentralized treatment systems can take various forms:

A non-collective sanitation system consists of :

- At the level of each dwelling or small group of dwellings, storage systems, or even partial or complete treatment of wastewater;

- In the absence of on-site treatment, a service for collecting and transporting faecal sludge to a centralized faecal sludge treatment plant.

An "extensive" collective system consists of :

- A wastewater collection network. Decentralized wastewater systems respond locally to local needs, so the network length required to transport wastewater from the collection site to the treatment site is reduced.

- A wastewater treatment plant of modest capacity. Technologies adapted to these local scales are often more economical, both in terms of construction (little civil engineering) and operation (low energy consumption). These often "nature-based" technologies are also less costly: in terms of investment for the owner, then in terms of operation and now for the operator. The treatment processes used for this type of decentralized system are known as "extensive". Typical are lagoons and filters planted with reeds.

Typical extensive processing technologies for local systems

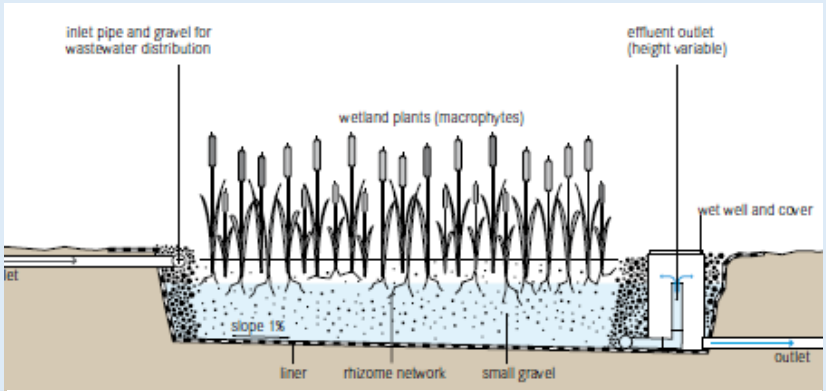
Lagoons provide an ideal environment for the purification activity of organisms, but the process is less efficient due to its simpler design. The sludge produced accumulates by settling at the bottom of the lagoon and is removed when the lagoon is emptied (approx. every ten years).

Sand filters, made up of strata of varying granulometry that maintain aeration by porosity, enable the development of microorganisms that degrade pollution.

In **constructed wetlands**, the root system amplifies water infiltration into the soil and limits the risk of clogging. These systems have the advantage of treating both water and sludge, the latter accumulating on the surface of the filter and being dried and mineralized when removed by cleaning (approx. every ten years).

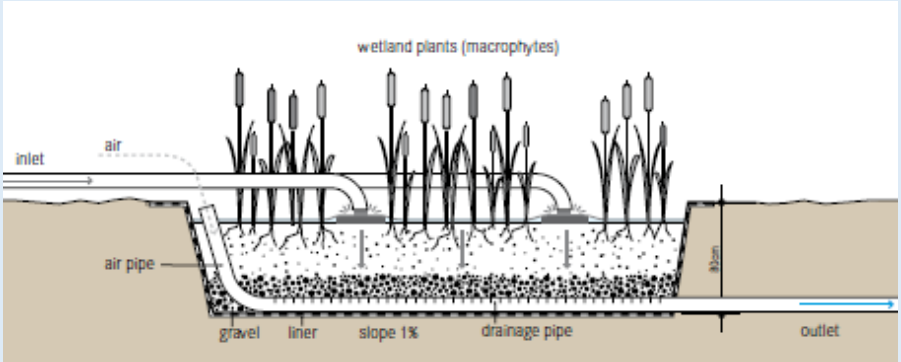
There are two main types of filter :

- Horizontal Subsurface Flow constructed wetlands are continuously fed; conditions are aerobic in the upper part and anaerobic in the lower part.



Horizontal Subsurface Flow constructed wetland, Compendium of Sanitation Systems and Technologies, eawag, IWA, 2014

- Vertical flow constructed wetlands. A distribution system allows some compartments to rest, while others are fed. A chamber is fed discontinuously by a "bâchée": a layer of water several centimeters thick is discharged onto the surface. If the topography is favorable, a self-priming siphon system can be used to feed a compartment without energy input. The conditions inside the basins are aerobic, and oxygenation is further enhanced by the presence of reeds.



Vertical flow constructed wetlands, Compendium of Sanitation Systems and Technologies, eawag, IWA, 2014

What is the sanitation situation in Lebanon?

Low wastewater treatment rates

Lebanon produces 250 million m3 of domestic wastewater and 60 million m3 of industrial wastewater annually. A recent UNICEF study entitled *Vulnerability assessment: evaluate the potential of solarization* (not yet published) estimates that today, 1.5 million people discharge their wastewater into the environment before any treatment, including 700,000 directly into a watercourse. The discharge of untreated wastewater into rivers and the sea, and its infiltration into groundwater, have a considerable impact on the degradation of ecosystems and water resources.

In 2003, the World Bank estimated the cost of environmental degradation in terms of negative impacts on health and quality of life at 2.1% of Lebanon's national GDP. Despite several completed or planned infrastructures, less than 10% of wastewater is treated today, and only 60% of users are connected to a sewerage network. Lebanon remains below the regional average for wastewater treatment, estimated at 46% for the Middle East and North Africa.

Difficulties in the sanitation sector are exacerbated by the energy crisis (availability and cost of fuel for operating facilities) and the financial crisis (remuneration of water authority staff).

Collective wastewater treatment systems with activated sludge solutions now partially operational

Neglected during the period of post-civil war reconstruction and suffering from significant investment delays, sanitation has been on the Lebanese public policy agenda since the 1990s and the entry into force of various international conventions on environmental protection and the de-pollution of the Mediterranean (Barcelona Convention). Since 2019, more attention has been paid to sanitation. Several centralized wastewater treatment plants have been built in recent decades with the support of international aid and under the supervision of the CDR (Conseil du Développement et de la Reconstruction).

However, the Water Establishments are finding it difficult to keep them running, a problem that has been exacerbated in recent years by the economic and energy crisis. Centralized wastewater treatment plant projects are also on standby. According to the Sectoral Strategy for the Water Sector, 53 of the 73 existing WWTPs are currently at least partially operational.

These wastewater treatment plants generally use activated sludge technology.

Ambiguous sharing of responsibilities between stakeholders

Law no. 221 of 2000, amended by laws no. 241 of July 8, 2000 and no. 377 of December 14, 2001, forms the legal basis for the sector. It gives the **Ministry of Energy and Water (MoEW)** responsibility for drawing up sectoral drinking water and sanitation policies.

Four public establishments, called **Water Establishments**, with legal personality and financial and administrative autonomy, are respectively in charge of water and sanitation services. As decentralized authorities under the supervision of the MoEW, these establishments oversee water (including agricultural irrigation) and wastewater services (project management for infrastructure construction or renewal, direct operation or control of a delegate, setting tariffs and monitoring the quality of drinking

water, irrigation and wastewater). These establishments have limited financial resources and staff to manage wastewater services.

The **Council for Development and Reconstruction (CDR**), an institution reporting to the Prime Minister, is responsible for the construction of drinking water, sanitation and irrigation infrastructures financed by the Lebanese government and international donors. It is also responsible for drawing up master plans and carrying out feasibility and detailed investment studies.

Despite the creation of the WEs, in practice **municipalities** remain responsible for operating and owning most of wastewater collection networks, and even small treatment plants in rural areas. Article 6 of corrective law no. 377 of December 14, 2001 stipulates that "the clauses of the present law (no. 221) in no way reduce the competences of municipalities and unions of municipalities, each within its own sphere of competence, as set out in the Municipalities Act (no. 118 of 6/30/1977) and the Municipal Taxes Act (no. 88/60 of 8/18/1988)". Municipalities and federations can therefore intervene in sanitation within the scope of the 1977 law, in networks only according to a strict reading of the law, and in networks and treatment according to a broad reading.

The **National Strategy for the Sanitation Sector** defined by the MoEW (2012-2020) and then reviewed in 2023, the first truly strategic document for the sanitation sector, confirms this municipal competence. Indeed, the MoEW presents municipalities as active stakeholders in the implementation of its National Strategy.

Territorial inequalities

This inadequate access to sanitation services is also marked by major territorial inequalities. While the urban coastal strip has a 90% connection rate to a collective network, mountainous and rural areas have extremely low rates of access to the service.

Wastewater treatment plants located in the coastal zone have a large capacity, as they serve the urban areas concentrated in the western part of the country, mainly around the coast. Plants such as those in Tyre, Nabatieh, Ras Nabi Younes, Ghadir, Jbeil, Selaata, Chekka and Tripoli (among others) cover a large population and discharge their effluent into the Mediterranean Sea. Plants serving inland urban areas also have significant capacity and discharge their water (often only partially treated) into adjacent rivers.

Local sanitation opportunities in the Lebanese context

Why is it relevant in Lebanon?

In the Lebanese context, where many centralized sanitation projects have been defined or are under study, but have been on standby for many years, and where the absence of sanitation can accentuate health problems (such as the cholera epidemic in 2022), the implementation of decentralized sanitation solutions may prove relevant.

If these local sanitation projects are led by local players (municipalities, CSOs) or international NGOs or donors, it is advisable to be aware of the sanitation projects planned in the medium or long term by the MoEW and the WE and which would concern the locality. **The implementation of these local solutions must be consistent**

with other centralized sanitation projects that may be in the pipeline. It must take into account the planned implementation of a collection network or choose a technology whose payback period for investment costs is consistent with the projected construction date of the centralized plant, etc.).

Which are the actors involved?

In Lebanon, decentralized sanitation is not considered a specific sub-sector of sanitation and is supervised and structured by several national players:

- **The Ministry of Energy and Water** (in charge of planning services and defining default areas not served by collective systems, and therefore covered by autonomous sanitation),
- **The Ministry of the Environment** (in charge of supervising facilities and managing septage),
- **The Ministry of Public Health** (designated by the first sub-sectoral texts of the 1930s as the reference ministry), which sets national standards and can carry out checks on installations and the quality of water leaving the system,
- **The Ministry of Public Works and, in particular, the General Directorate of Urban Planning**, which since the 1980s has been responsible, via Decree 148-1983, for defining the technical specifications for autonomous sewage systems (when connection to the sewage network is impossible), enabling owners to obtain building permits,
- **The Ministry of the Interior and Municipalities**, as part of the administrative control exercised over municipalities.

However, among all these players involved in all or part of the on-site sanitation chain, the national reference institution for on-site sanitation is the **General Directorate of Urban Planning** of the **Ministry of Public Works**, which is responsible for most of the texts in force structuring the sub-sector.

Some local sanitation projects in Lebanon

Several projects have been completed or are underway to implement local sanitation solutions in Lebanon. Some are carried out within the framework of the Lebanese-French decentralized cooperation. Decentralized cooperation projects between two local authorities can be an effective way of implementing local sanitation systems. In this case, cooperation should not be seen as an instrument of assistance or emergency aid, but as part of an approach based on subsidiarity and mutual interest. When decentralized cooperation projects are set up, knowledge and experience are shared, giving rise to new territorial and service development approaches for all partners.

Constructed wetland plant, Bcharreh

The construction of the Bcharreh pilot plant is a continuation of the decentralized cooperation project that began in 2005, linking the Water Establishment North Lebanon (EELN), the Bcharreh Federation, the Rhône Alpes Region and the Agence de l'Eau Rhône Méditerranée Corse (AERMC).

From 2007 to 2009, a Sanitation Master Plan (SDA) was drawn up for the Caza de Bcharreh. The plan called for the implementation of 14 reed filter WWTPs and 10 activated sludge plants.

The Bcharreh plant, with reed filters, is a pilot project within the scope of this SDA. The first actions were carried out in 2011, with the hiring of a project manager and an inventory of water resources and protection measures to be considered. The implementation of this consultation process enabled AFD to finance the implementation of a pilot reed filter plant in Bcharreh, which is now operational and serves 300 inhabitants.

Project sheet - Bcharreh pilot reed filter wastewater treatment plant, Ps-Eau, french, November 2017

Constructed wetland, Bcharré

Installation of a non-collective sanitation system in Antoura

A town of 3,200 inhabitants located 20 kilometers north of Beirut, Antoura is faced with the non-existence of wastewater management. In 2012, decentralized cooperation began with the French municipalities of Noisy-le-Roi and Bailly to work on implementing a solution for wastewater management. Following a detailed study conducted in 2018- 2019 by the engineering firm Hydroconseil, the relaunch of the project involves updating its main assumptions and conclusions.

A new partnership has been set up between the Lebanese municipality of Antoura and the Ile-de-France wastewater authority Hydreaulys (an intercommunal body to which Noisy-le-Roi and Bailly belong, set up to manage the public wastewater service), as well as its wastewater authority SEVESC (a public body under the authority of Hydreaulys, which operates collective wastewater infrastructure and provides technical assistance and inspection services for homes with on-site sewage treatment systems), with technical support from the Lebanese engineering firm CubeX.

Since the end of 2022, a study has been underway by CubeX to precisely define the needs and possibilities in terms of equipping households with non-collective sanitation systems, carry out sourcing to identify Lebanese manufacturers, study the possibilities for managing and treating faecal sludge, and draw up a phased, budgeted implementation plan. This initial study phase will be followed by a construction phase to build a non-collective sanitation service.

The MADAD program: support for the implementation of local sanitation systems

The HawkaMaa-EU project, implemented with European Union MADAD funds, aims to support water governance and water and sanitation services in Lebanon for refugees and host communities. The consortium includes ACTED, Action Contre la Faim (ACF), WW-GVC, LebRelief and Solidarités International (SI), in partnership with IMPACT, LCPS, Nahnoo and LEWAP.

Within this framework, ACF and SI have been implementing projects to build local wastewater treatment systems in refugee camps in Akkar and Western Bekaa, although those projects were recently stopped under the HawkaMaa project and might reappear under a different funding.

SI has been working in Lebanon since 2013 to help 75,000 Syrian refugees scattered across 1,600 informal camps in Bekaa and Akkar. As part of the HawkaMaa-EU program, SI has implemented 4 sanitation systems, including 3 in the North and 1 in the Bekaa (Zahlé). All 4 systems comply with the environmental effluent limits set by the Ministry of the Environment. 800 people are currently benefiting from this project, with the aim of covering a further 1,500 by the end of the year.

ACF opened a mission in Lebanon in 2006 for a 4-month post-emergency water and sanitation program, then an operational base in 2012 in the Bekaa, and is currently a major player in the water and sanitation sector in the Bekaa Valley and South Lebanon. As part of the HawkaMaa-EU program, ACF has set up 5 decentralized sanitation systems by 2022 in the western Bekaa (Kafraiya, Kamed El Laouz, Ghazze and Qaraaoun), benefiting a total of around 700 people. ACF plans to set up 7 additional systems to reach a further 2,200 people. The existing systems are regularly tested and all comply with environmental effluent limit values.

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