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After the 15-year civil war that Lebanon endured, plans were put in place to alleviate the wounds of the war. Solid Waste Management (SWM) was one of the priorities of the Lebanese government. SWM solutions require long-term vision and political commitment and consensus. So far, in the absence of both, the Lebanese government has been relying on emergency response measures.

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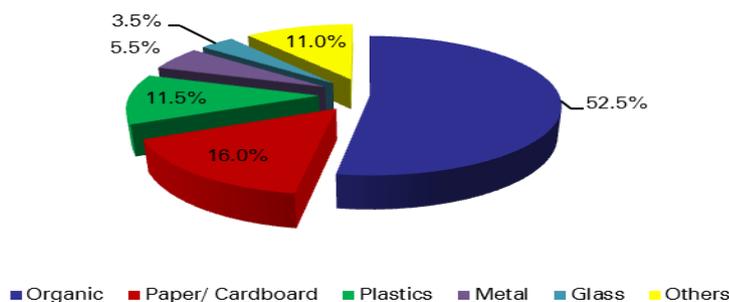
In 1997, in consultation with the Ministry of Environment, the Council for Development and Reconstruction (CDR) adopted the Emergency Plan for SWM in Beirut and Mount Lebanon (except for Byblos district), which is still in force today. The plan contracted Averda Group (Holding company of Sukleen and Sukomi) to collect, treat, and landfill solid waste. Outside Great Beirut, municipalities and federations are responsible for the collection, treatment and disposal of municipal waste and assume all related costs.

In 1999, CDR contracted BATCO, a local waste contractor, to improve waste disposal practices and manage the controlled dump in Tripoli, by retrofitting it with gas extraction wells and flaring units. Over the past 17 years, Lebanon experienced a string of SMW plans, such as transforming waste to energy (WTE) in 2010. However, many of these strategies and policies, including the WTE, have been approved but till now remain inapplicable.

According to Sweep-Net, Lebanon generates around 2.55M tons of waste annually, where each person is expected to generate approximately 0.8 and 1.2 kg per day. Municipal Solid Waste (MSW) is projected to increase by an annual rate of 1.65%. The collection services rate stands at 98%-100% in urban areas, while this rate declines slightly to 90%- 95% in rural areas.

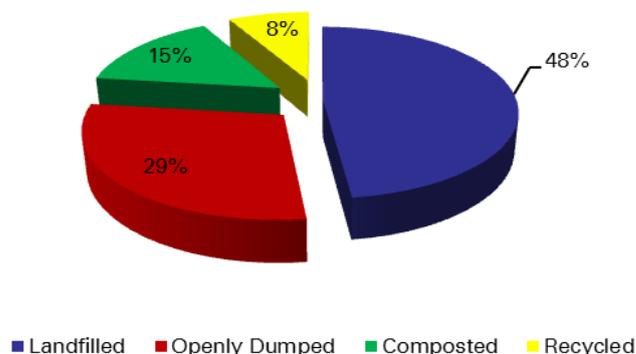
Waste disposal is particularly difficult in Lebanon because of its rugged terrain and limited surface area. Of the waste generated, 48% is landfilled, 29% is openly dumped, 15% is composted, while only 8% is recycled. The organic fraction of solid waste in Lebanon is very high at 52.5%, primarily because of exuberant hospitality and the makeup of the Lebanese cuisine.

Types of Waste Produced



Source: Sweep-Net

Treatment of Waste Produced



Source: Green MED Initiative

According to the World Bank, collecting waste and disposing them in sanitary landfills in upper middle income countries costs around \$100/ton. In Lebanon, Sukleen charges \$147/ton of collected and landfilled waste.

Following the 1997 MSW emergency plan, the government shut down the Bourj Hammoud and Normandy dumpsites and established a waste management system comprising the facilities in the table below.

Facilities Established following the MSW 1997 Emergency Plan

Facilities	Uses
Aamroussiye and Karantina	Facilities for sorting and processing raw solid waste
Coral	Composting plant for sorted organic material
Borj Hammoud	Warehouse facility for storing and shredding bulky and recyclable materials
Naameh	Landfill for the disposal of sorted waste in the form of baled waste consisting primarily of inert material
Bsalim	Landfill for the disposal of inert and bulky materials

Source: UNEP

The Naameh landfill opened in 1997, and was meant to receive an expected 3M tons of trash from the capital Beirut and Mount Lebanon for only 10 years. However, the landfill was filled up as of April 2001 as it received 600,000 tons/year on average since it began operation. The Naameh landfill was planned to receive 1,803 tons of trash per day, however 2,850 tons/day were disposed in 2012. The Naameh landfill received more waste than planned for the following reasons:

1. Bsalim was supposed to host a second sanitary landfill for the North Beirut area, but the environmental impact assessment showed a very high risk of ground water contamination and recommended using the site to dispose of inert materials only,
2. More organic materials were disposed at the Naameh landfill, as composting capacity was not expanded as planned,
3. More recyclable materials were disposed at the Naameh landfill, as recovery of recyclable materials by the Karantina and Aamrousieh sorting plans were well below the plan's target

Hence, the waste at the landfill swelled into a trash mountain of over 15M tons, and is a source of nuisance from odors, gases and perceived ill health by neighbors living in its vicinity. Due to the necessity of continuing to use this sanitary landfill until an alternative was found, the landfill site was expanded and its scheduled closure date was set on the 17th of January 2015. This deadline was extended twice for a 3-month period, the last being on July 17th 2015.

On this date, residents near the Naameh site forced its closure and forbade Sukleen's garbage trucks from adding to the oversaturated landfill. Although Sukleen's contract expired at the same date, the company was requested by the government to continue the street cleaning and waste collection services. However, due to the lack of an adequate place to dispose the garbage, Sukleen halted its activities.

Uncontrolled dumping and improper waste handling causes a variety of problems, such as contaminating water, attracting insects and rodents, and increasing flooding due to blocked drainage canals. In addition, it may result in safety hazards from fires or explosions. Improper waste management also increases greenhouse gas emissions, which contribute to climate change.

Therefore, Lebanon should adopt an efficient solid waste management system, based on preventing waste, recycling, composting, and finally disposing the remainder. Waste prevention strategies include using less packaging, designing products to last longer, and reusing products and materials (such as stuffing used textiles into mattresses).

Recycling involves collecting, reprocessing, and/or recovering certain waste materials (metals, glass, papers, and plastic) to make new materials or products. As organic materials cannot be recycled, and as they are rich in nutrients, they can be converted into soil additives in a process called composting. According to the World Bank, sale of finished compost could generate revenues of as much as \$100/ton. However, the process of recycling and composting is heavily dependent on separation at source, whereby households should divide their wastes into different kinds, before being collected.

Finally, waste that can be neither prevented nor recycled or composted can be placed in a properly managed landfill to produce energy. These wastes undergo procedures which include combustion, gasification, pyrolyzation, anaerobic digestion, and landfill gas recovery to produce energy, what is known as Waste-to-Energy (WTE) process.

According to a cost benefit analysis done by Sweep-Net, if Lebanon adopts a zero waste strategy, whereby trash is either recycled or composted a \$135.7M net present value would be generated over a period of 20 years.

Lebanese Recycling Companies

Name	Material Recycled	Pickup Services
L'Ecoute	Carton, Electronics, metal, plastic	Free pickup service and offer recycling boxes
Terre Liban	Everything	Free pickup service for paper and plastic and offer recycling boxes
Sukleen	Paper, plastic, metal, glass	Free pickup service and offer recycling boxes to offices
Lebanese Recycling Work	Plastic	Only large quantities for fee (at least a ton)
Zero Waste	Everything except glass	Yes for a fee. They offer bins and have a reward system
Soliver	Only bottles and jars that are clean(not green or brown glass)	Only large quantities for fee
Al Zoujaj Al Yadawi	Glass / all types	Only large quantities for fee
Lebanese Cardboard Corporation	Paper	Only large quantities for fee
Plastic Wood	Plastic (water bottles)	Only large quantities for fee
Arc en ciel	Plastic , Paper, metal	Only for old customers, not accepting new ones
Sipco	Paper	No
Unipack Tissue Mill	Only white paper	No
Averda	Plastic bottles and aluminium cans	No

Source: Ecocentra

For instance, one of the best waste management strategies is adopted in Netherlands. Lack of space and growing environmental awareness forced the Dutch government to take measures early on to reduce landfilling of waste. Due to its top-notch waste management structure, the Netherlands is able to recycle more than 64% of its waste, and most of the remainder is incinerated to generate electricity. As a result, only a small percentage ends up in landfill. "Lansink's Ladder" (named after the member of the Dutch Parliament who proposed it), incorporated in the Dutch legislative in 1994, is based on avoiding waste as much as possible, recovering the valuable raw materials from it, generating energy by incinerating residual waste, and only then dumping what is left over in an environmentally friendly way. However, this process is the result of the aggregate of individual efforts, through which more than 90% of Dutch people separate their household waste.

Worth mentioning that introducing a tax on every ton of material landfilled was key as it gave waste processing companies the incentive to look for other methods such as incinerating and recycling. According to Waste Management World, landfilling waste in Netherlands currently costs approximately €35/ton, plus an additional €87/ton in tax if the waste is combustible.

Finally a roadmap for Lebanon to treat the waste may include the following. First, the citizens should be encouraged to participate in waste management by splitting their wastes into glass, plastic, paper, textile, electronics, and organic. Another process of separation should occur after collection, to ensure appropriate segregation of domestic wastes. The recyclable refuse is then sent to a recycling plant, and the organic waste gets composted. Finally, the remnants get disposed of in sanitary landfills, where methane gas could be recovered and used to produce energy. Considering the implementation of such a process, Lebanon could be capable of transforming its waste from a burden on the government to a source of revenue, originating from the sale of recyclable materials and power generation.

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