The Toxic Plastic Waste Trade

LEBANON REPORT

2020-2021

Outline

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1. Introduction

Plastic pollution is spread across lands, beaches and in oceans. Small particles of plastic called microplastics, are persistent in marine ecosystems, and can be found in our food and salt (Borrelle et al., 2017). There are a variety of impacts from plastic pollution on biodiversity, ecosystems, food quality and human health, but it is still not well characterized and needs more research attention.

In Lebanon there is a lack of information that quantifies plastic at sources, its accumulation, and path or trajectories. Thus, NGOs, government and industries have concerns and are interested in developing the means and policies to track, collect, and recycle plastic waste and to address this issue of plastic waste pollution at the international level.

Under the International Pollutants Elimination Network (IPEN), Toxics-Free Sustainable Development Goal (TFSDG) Projects- Phase 3, this report aims to reflect the actual situation of plastic pollution as an emerging global threat, and, more specifically, on the local level in Lebanon. It describes the problems associated with plastic waste in Lebanon, including disposal and trade, as well as levels of plastic pollution and impacts on human health and the environment and recycling activities in the country. Although data is limited, an overview for plastics in Lebanon is shown in this report, with recommendations for the social, economic and policy levels.

The "Lebanese Environment Forum" (LEF) is a non-political and non-profit organization, working at the national level since 1992. It comprises more than 60 local, environmental, non-governmental organizations aiming at protecting the environment, spreading information, and enforcing implementation of laws and policies. LEF is part of a regional and global network, has been a member in the IPEN network since 2010, and works closely on applying good management of chemicals and toxics in Lebanon, including heavy metals such as mercury and lead. LEF has participated in several meetings and international conferences related to chemical management, including SAICM, Basel-Rotterdam-Stockholm COPs, and the Mercury Treaty prep meetings.

LEF has been working nationally since January 2014 in co-operation with more than 100 NGOs from civil society on the solid waste management crisis in Lebanon, advocating for a safe and sustainable zero waste and recycling-based plan, and against incinerators and garbage exportation.

Additionally, LEF has undertaken several campaigns and activities such as the "El Baher Elna" (Our Sea) campaign to raise environmental awareness on protecting beaches and marine life from plastic waste pollution and engage youth in volunteering work to clean up the coast in South Lebanon, from Zahrani to Qasmiyeh in 2015.

Jointly with the Lebanon Eco Movement (LEM), the Lebanese Environment Forum (LEF) is now implementing a project funded by the European Union since June 2018 that works for a plastic-free Mediterranean Sea called “Bahr Bala Plastic” (“Sea without Plastic” in Arabic). The global objective of this project is to reduce the impact of marine litter and microplastics pollution on marine biodiversity, public health and the livelihoods of people who earn a living from the sea. This is done by raising awareness, advocating and supporting small, innovative projects implemented by non-governmental organizations and startups to tackle land and sea-based sources of plastic pollution, as well as socio-economic impacts. More than 20 small projects are now under implementation all over the Lebanese coast to fight pollution from plastic waste and microplastics. An awareness campaign is organized by

LEF, aiming at raising the awareness of concerned citizens on the impact of plastic litter and micro-plastics and targeting tourism operators, schools and the general public on the issue of marine litter.

2. Plastic pollution, management and disposal

Plastic pollution causes environmental, economic, health and aesthetic problems. It threatens food safety, food quality and tourism, and contributes to climate change. It also threatens marine life and has several adverse impacts on the marine environment through plastic waste ingestion and suffocation of hundreds of marine species and the destruction of marine habitats and loss of biodiversity. (Azoulay et al., 2019)

Plastic waste in the marine environment also contributes to the spread of invasive marine organisms and bacteria, which disorder ecosystems. Seabirds, fish and turtles mistake plastic waste for prey and after ingesting plastic often die of starvation as their stomachs are filled with plastic debris. Some animals also suffer from infections, reduced ability to move, and other internal injuries. (Immig et al., 2021)

Plastic waste damages the aesthetic value of tourist destinations, which hugely impacts the economy because of decreased tourism-related incomes and major economic costs related to the cleaning and rehabilitation of the sites. Some lands, public spaces and beaches are disfigured by the spread of plastic waste and leaves these areas contaminated and unsuitable anymore for recreational and tourist activities. (Beaumont et al., 2019)

Many studies show the direct consequences of plastic and microplastics on public health through direct exposure in activities such as swimming or fishing and working in the waste treatment and recycling sectors. In addition the impact of microplastics in seafood has a negative impact of human health, disturbing organ functions and other complications. (Wang et al., 2020)

Lebanon produces approximately 6,500 tons of municipal solid waste (MSW) per day across the country, which is composed of about 52.5% organic matter, 16% paper/cardboard, 11.5% plastics, 5.5% metal, 3.5% glass, and 11% inert and other materials (GIZ, 2014).

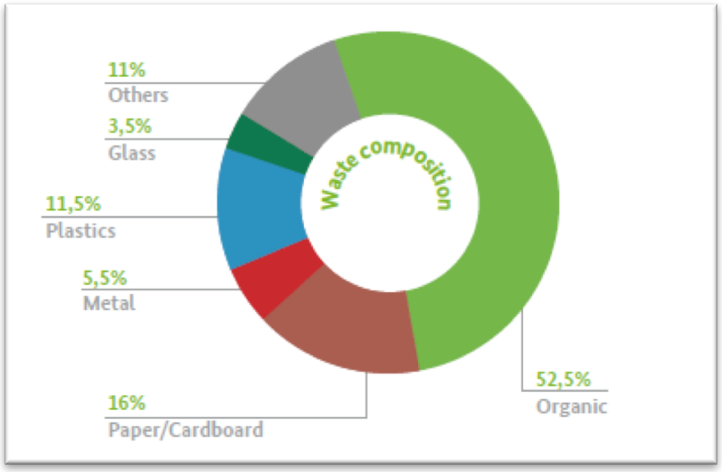

Figure 2: Waste composition in Lebanon (Giz, 2014)

The disposal of waste is currently as follows: about 50% in uncontrolled dumpsites (about 940 dumpsites); about 35% in sanitary landfills; and the remaining 15% of MSW streamed into the recycling process. In this process, recyclable or reusable materials such as plastic and others like paper, cardboard, metal, glass, etc. are sorted, and organic matter is converted into compost in approximately 50 facilities in Lebanon.

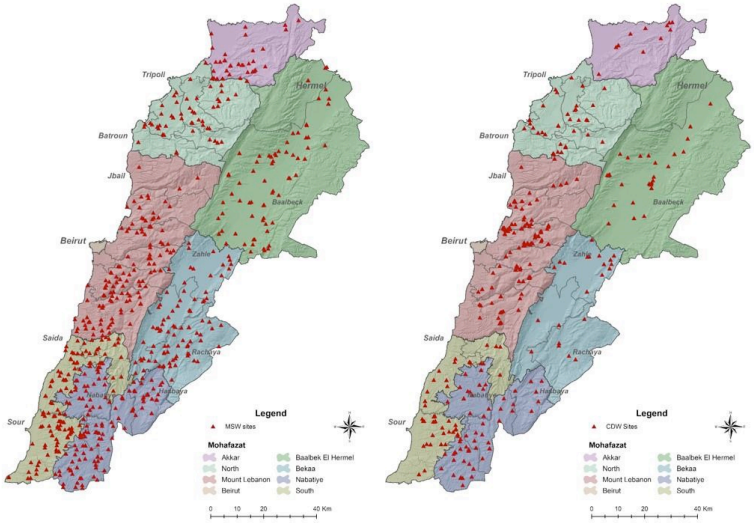

Figure 3: MSW and CDW dumpsites (UNDP/MoE/ELARD, 2016)

A 2015 pilot project carried out by the NGO Arcenciel in the Bekaa towns of Zahleh, Taanayel, and Bar Elias, may provide the most accurate breakdown yet in terms of waste composition, as bins were collected at the household level before any scavenging and without segregation at source. It found that 7.4% out of 118.4 tons collected and sorted could be recycled. This includes: 3.3% plastic, 2.9% paper, 0.7% metal and 0.4% glass. The non-recyclable 92.6% of the waste is made up of 56% organic and 34.6% of other materials. (Arcenciel 2016. Pilot study funded by the Agence Française de Développement --AFD).

For instance, service providers are collecting and reselling 18% of the plastic as shown in the table below:

Table 2: Plastic recyclables generation, 2015

AGGLOMERATION	ACTUAL PLASTIC in Tons
Greater Tripoli	2,730
Greater Tyre	3,000
BML but Jbeil	18,700
Greater Zahleh	1,875
Greater Saida	8,760
Baalback.-Hermel	8,960
Jbeil	2,300
Minieh	1,533
Bint Jbeil	2,300
Ansar	153
Kabrikha	230
Kheyam	383
Aytaroun	383
Kherbet Selm	383
Ain Ebel	307
Mechmech	261

Table 2: Recycling data reconciliation of plastic in 2015

	Estimated recyclable material based on population	Recyclables collected (lower bound)	Exports of recycled material in Lebanon	Total collected + exported (upper bound)
Plastic (tons)	304,933	59,441	56,425	115,866

A survey of NGOs, private companies and trade associations involved with recycling estimated that recyclables are collected also by the informal waste worker sector.

Table 3: Trash collection by scavengers in Lebanon, 1999-2000, in tons

	Beirut and Mount Lebanon	Northern Lebanon	Southern Lebanon	Bekaa, Baalbeck and Hermel	TOTAL
Plastic (tons)	3,875	1,350	1,350	1,200	7,775

Table 4: Recycling data from Lebanon Environmental Pollution Abatement Project (LEPAP) Industrial Audits, in tons/year

INDUSTRIAL LINE OF PRODUCTION	Cable Systems Production	Multi-purpose Industry	Food and Beverages	Food Industry	Chemical Industry	Primary Metals Industry	Textile Products	TOTAL
Plastic (tons)	582.0	3.6	5.3	0.0	6.0	1.0	49.0	647.0

The MSW composition reveals that about 37 % of the waste could be either reused or recycled (Abbas, 2017), excluding organic waste. Unfortunately, only a small amount (8 %) was reused and recycled in most municipalities. It is worth noting that a minority of Lebanese people recover recyclable materials at the source and large amounts of recyclable materials continue to be mixed with other types of wastes. Thus, it is very difficult to recover recyclable materials of acceptable quality from the unsegregated waste stream. When the waste arrives at the two sorting facilities, it is already in a state of decomposition, releasing leachate and foul odors. These undesirable conditions of the wastes do not encourage recycling industries to buy them, quite the opposite. In addition, there are no specific incentives to promote the recycling industry, in particular technologies that can recycle plastics (PVC and PET) and "dirty" recyclable materials. In this context, plastics, except PET and PVC, are recycled into secondary plastic products such as flowerpots and benches. "Clean" cardboard and paper are recycled by one of the few remaining paper recycling plants currently operating in Lebanon. However, these industrial plants rely mainly on informal networks of suppliers for waste paper and cardboard. (Abbas et al., 2017)

Table 5: List of recycling companies

Name	Location	Details
LEFICO	Bekaa	Recycles PET, 4000 tons/year mainly from Sukleen, to produce at their other company FOMACO mattresses. Buying 4,000 tons/year of PET from Sukleen ($US 250 per ton), & exporting it as fibers for $US 1250 per ton. He has 70 employees but is afraid that he will have to shut down the operation due to the current situation.
MAZAR PLAST	Qab Elias-Bekaa	$US 100 to 120 per ton for unshredded plastics and $US 150 to 170 per ton for shredded plastics, Produces Plastic Fruit Baskets, 2,000 to 3,000 plastic baskets daily (0.3 to 1 kg each). Shredded and clean plastics are about $US 700 per ton, they use around 60 tons/month.

Rocky Plast	Jbeil	Import 1500 tons/year plastic wastes (40 to 80% more expensive than local market. Cost of transformation of plastic wastes $US 150-270 per ton, 50% sold to Africa. Doing the same thing at IBC Saida (300 tons/month). Main usage for the HDPE: Irrigation piping and fruit carts. Low density polyethylene (LDPE) used for plastic and trash bags. In 2014, recycled PET was sold between $US 850-1000 per ton, and virgin PET $US 1650-1850 per ton. Now virgin plastic is $US 800 per ton.
Rolls and Bags		Produce plastic and nylon bags
Techniplast		Produce irrigation pipes
Alphaplast		They buy 80% of the recycled plastics from the Gulf
Lebanese Recycling Works	Roumieh	Shred 150 tons/month of PET Bottles then ship them to China.
Remarks	❖ PET is used to produce polyester fiber, tissues, carpets (Commerce du Levant, 2015) ❖ Polyester fiber is imported from Turkey, and competes with the local fiber (Commerce du Levant, 2015) ❖ Most PET is exported to China ❖ Due to the current oil prices, PET recycling is not as competitive as before ❖ 70% of plastic baskets on the market are made from recycled plastic and are 35% cheaper than regular plastics	

3. Levels of plastic pollution and plastic waste

Plastic pollution is considered an internationally significant pollutant of concern that could have huge impacts on environment, public health, and the economy. Global plastic production is continuously increasing, reaching 350 million tons in 2017 (Plastics Europe, 2018), but only 6–26% of it is recycled. Landfills only receive 21–42% of wastes, and the rest is randomly released into the environment (O'Connor et al., 2016). Most of the manufactured plastics eventually end up in the ocean.

It is estimated that 20 thousand tons of plastics in Lebanon are recycled yearly, while 120 thousand tons are land-filled and 73 thousand tons are openly dumped. Therefore, a total of 193 thousand tons of plastics is still a significant quantity and requires urgent action. Wastewater treatment plants and coastal landfills play an important role as sources of microplastic pollution in the aquatic environment.

A study (Kazour, Jemaa, et al., 2019) showed high microplastic pollution in areas located near coastal landfills and includes materials such as polyethylene, polypropylene and polystyrene in transparent, white and different colors, found in packaging, consumer products, and pipes. Even around non-active landfills, some of these are still found and the waste continues to find its path into the sea due to mismanagement, absence of proper treatments and accidental garbage disposal.

Two important seafood species that are wholly consumed by the Lebanese community, the European anchovy - Engraulis encrasicolus, and the spiny oysters - Spondylus spinosus, were sampled in three different sites around the Tripoli, Beirut and Sidon littoral. Sea water and sediment samples were also collected from the 7 same sites. Results showed different patterns of microplastic (MPs) concentration in the analyzed matrices: Sidon water sample was highly contaminated with MPs (6.7 MPs/m3), whilst Tripoli had the highest MPs in sediments (4.68 MPs/g). The occurrence of MPs in the biota was high (83.4% and 86.3% in anchovies and spiny oysters, respectively). Both anchovies and oysters from Beirut region had the highest ingested MPs/ individual (2.9 ± 1.9 and 8.3 ± 4.4 MPs/individual, respectively).

This study is the first to investigate microplastic ingestion by Spondylus spinosus while also indicating the most common polymers found in the three matrices (water, sediments and biota) in the eastern Mediterranean.

The source of these types of polymers in sea surface water and sediment can be traced back to mismanaged landfills. Even though Lebanon is considered a potential sink of plastics in the eastern Mediterranean, it should also be considered as an important source of microplastics in the Mediterranean basin.

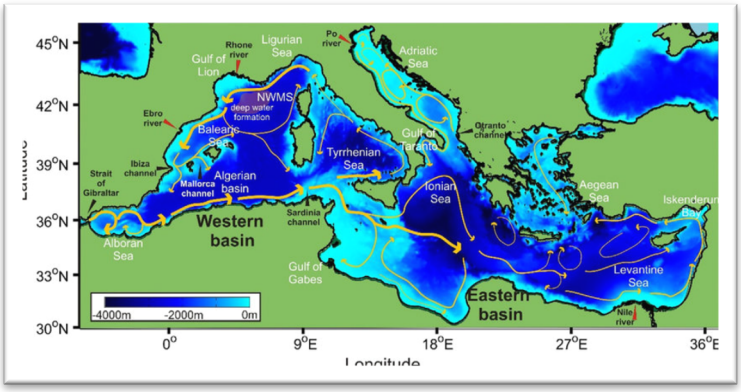

Figure 4: Movements of water currents in the Mediterranean Sea

Table 6: Plastic leakage in Lebanon (source: Boucher & Billard, 2020)

Population considered	Plastic waste generation	Mismanaged plastic waste	Average RR (Release Rate)	Leak waste in the sea (total)	Leak waste in the sea (from coastal areas)	Leak waste per capita
	(kg/hab/ year^{-1})	(tonnes)	%	(tonnes year^{-1})	(tonnes year^{-1})	kg/hab/ year^{-1})
3,635,015	42	46,615	7%	3,321	2,939	0.9

Microplastics found along the Lebanese coastal waters consisted mainly of fragments (77.5%), fibers (15.25%) and microbeads (7.25%). Concentration in the surface waters and sediments were high compared to other Mediterranean regions. (Kazour, Jemaa, et al., 2019) Pellets found on the Lebanese coast were due to direct release of waste by plastic factories and industries onto the beaches or into the rivers.

4. Imports and exports

4.1 Plastic imports

The Lebanese market holds both plastic manufacturers and plastic importers and distributors. According to Lebanese customs, in 2015 Lebanon imported $695.01M worth of raw materials needed for the manufacturing of plastic and finished products. On the other hand, exports of both raw materials and finished products totaled $130.59M. The plastic market is large in Lebanon and the total net exports around $565.69M: the net exports of raw materials amounted to $353.73M while the net exports of finished products amounted to $211.96M.

The major imported items in the plastic category are raw materials. The polymers of ethylene and propylene, which are used across all segments of plastic manufacturing, hold the largest combined share of 28% in total imports with a value of $203.12M. 57.82% or $92.69M of the ethylene polymers originated from Saudi Arabia in 2014 while 14.27% or $22.88M were imported from Qatar.

Saudi Arabia is also the main import source of propylene polymers, accounting for 64.57% or $27.64M of total propylene imports, while 23.30% or $9.97M originated from the UAE.

In 2014, the finished articles of conveyance and packing of goods also held a sizeable 8% share in total plastic imports, with a value of $57.19M. The main import sources for those articles are Jordan (with a 14.45% share or $8.26M), China (with a share of 13.77% or $7.88M) and Turkey (with a share of 13.59% or $7.77M). As for tubes, hoses and pipes, they constituted 6% or $44.66M of total plastic imports in 2014. 23.41% or $10.45M of those items originated from Italy, while 15.95% or $7.12M originated from Turkey.

Lebanese imports of plastics and articles was US$308.67 M during 2020, according to the United Nations COMTRADE database on international trade.

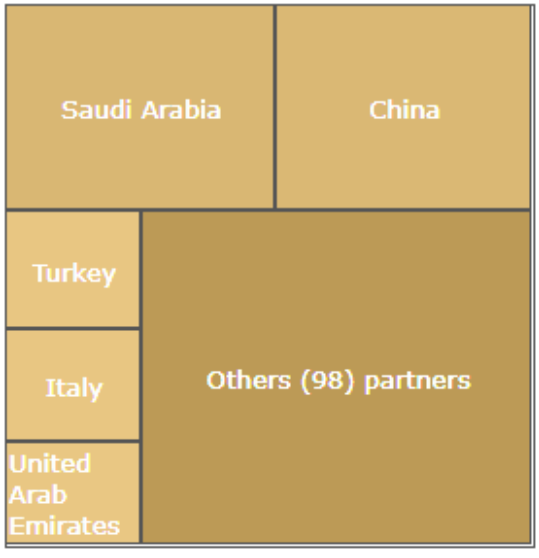

Figure 5: Lebanon 2018 Import Partner Share (source: https://wits.worldbank.org/)

Figure 6: Historical chart on Lebanon imports of plastics and articles in USD million

Table 7: Import Special in million USD From 01/01/2012 To 28/2/2021

Plastic	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total	Average
Prepared rubber accelerators; compound plasticizer	2,786	4,278	4,650	3,276	3,443	3,479	4,422	3,209	2,259	43	31,844	3,206
Waste, parings and scrap of plastics	640	874	1,275	546	513	760	933	420	59	4	6,024	604
Floor coverings of plastics	3,786	4,371	3,527	3,910	4,460	5,303	4,481	4,401	1,113	294	35,647	3,712
Builders' ware of plastics	7,587	11,123	13,702	13,613	15,971	17,008	16,305	12,184	3,836	1,138	112,466	11,816
Other articles of plastics	31,745	35,970	38,569	36,666	38,327	42,631	37,202	30,113	17,298	4,377	312,898	33,478
Machinery for working rubber or plastics	15,988	18,177	22,885	15,811	22,745	15,364	16,147	11,604	4,420	616	143,757	14,684

Plastics imports into Lebanon show a relatively steady increase between 2009 and 2015, with a drop in 2016 and then a significant drop in 2020. The economic crisis in Lebanon has impacted the imports; there has specifically been a decrease in importing plastics.
Raw material import prices for plastic range from 1.9 to 9.6 times the effective real price, while import prices are up to 14.9 times the effective local price for glass, 16.7 for paper, and as high as 242.9 times the local price for tin. These higher prices reflect to a certain extent that imported materials are of higher quality than recycled domestic material. In particular, low world oil prices, lower the price ratio between imported plastics or inputs to plastic manufacture, on the one hand, and plastic made from local recycled material, on the other. This decreases demand for recycled plastic, unless there is excess of local demand for a specific plastic product. Exports of recyclable plastic sell for 1.4 to 20.4 times the effective local price.

4.2 Plastic exports

Meanwhile, the main exported plastic items in 2014 were articles for the conveyance or packing of goods. Their total value amounted to $29.49M in 2014, representing 23% of total exports. Interestingly, the main export market was Syria, with a 15% share in the total or $4.35M, followed by 12% or $3.55M for Saudi Arabia and 12% or $3.48M for Jordan.

The second largest exported items are tableware, kitchenware and other household articles, with a share of 9% in total exports. Exports of these items registered a value of $12.08M in 2014. 16% or $1.94M were sent to Iraq and 11% or $1.38M were sent to Saudi Arabia.

Lebanon's net exports of raw materials for plastic manufacturing amounted to $353.73M in 2014, and Lebanon's net exports of finished plastic products amounted to $211.96M in 2014.

Table 8: Exports of recyclable plastic, 2011-2014

Plastic	Tons	Million $US
2011	52.3	132.5
2012	59.0	148.2
2013	60.0	147.6
2014	54.4	140.9
2011-2014 Average	56.4	142.3

In 2018, the main export market was Syria with a 40% share in the total or $71,862, followed by 9% or $16,376 for Saudi Arabia and 4.42% or $3.48M for both Qatar and Iraq.

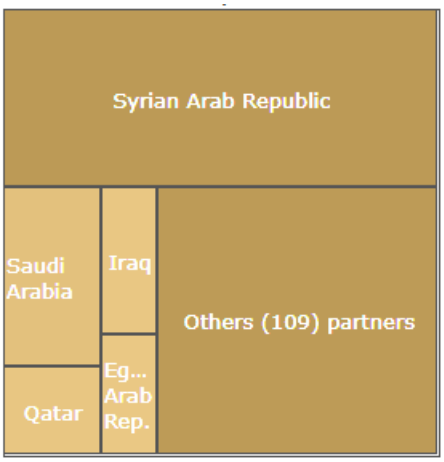

Figure 7: Lebanon 2018 Export Partner Share (source: https://wits.worldbank.org/)

Lebanon Exports of plastics was US$102.41 million during 2020, according to the United Nations COMTRADE database on international trade.

4.3 Plastic balance trade

When analyzing recycling, imports, and exports of different materials, we find a range of results. Plastic recycling is not profitable except for nylon. Some service providers are using waste residues which cannot be recycled.

In this regard, the focus should be on separating waste and plastic especially so that it doesn't end up in landfill, escape into the environment or is burnt in incinerators. The producers of plastic products should ensure their products can be recycled or reused. Recommending Extended Producer Responsibility (EPR) laws before disposal is best. If plastic waste is collected, then there are always better alternatives than landfilling or incineration.

5. Human exposure to plastic pollution

Waste pollution, with its adverse health risks (mainly cancer incidences), is one of the main issues present in Lebanon. Inadequate waste management, which is a challenging situation, is affecting the entire Lebanese population.

For instance, hazardous wastes bring harm to human health including cancers, respiratory and heart diseases, genetic defects, damages to the central nervous system and congenital anomalies. The untreated chemicals from hazardous waste released into the environment and atmosphere, and to which the Lebanese population is exposed, will cause an increase in cancer rates. Moreover, these rates may be enhanced with the consumption of toxic carcinogen-polluted products. (Azar, S. & Azar, S. 2016)

Figure 7: Human exposure to plastic in Lebanon

Plastic degradation in the environment can result in the release of microplastic and chemical pollutants that can then enter the terrestrial and marine food chains. Exposure to microplastics and chemicals leads to serious health consequences such as congenital diseases and malignant cancers. Chemicals such as dioxins released from the plastic polymers are lethally persistent organic pollutants which cause tumors and neurological damage in humans. (Rajmohan et al., 2019)

Several diseases associated with exposure to microplastics have been reported in Lebanon such as eye irritation, liver dysfunction, and cancer, with damaging effects in the brain, liver, and lungs.[1] (Campanale et al, 2020)

Microplastics were found in seafood like clams and fish and in table sea salt, exposing humans to higher health risks. Also, many studies have reported the existence of microplastics in commercial salts from different countries. (Karami et al., 2017)

[1] Campanale, C., Massarelli, C., Savino, I., Locaputo, V., & Uricchio, V. F. (2020). A Detailed Review Study on Potential Effects of Microplastics and Additives of Concern on Human Health. *International journal of environmental research and public health*, *17*(4), 1212. https://doi.org/10.3390/ijerph17041212

Table 9: Detailed information on the salt samples analyzed (source: Study on the presence of microplastics in commercial salts from different countries)

Country of origin	Brand	Packaging material	Salt type
Australia	A	PE[1] +PET[2]	Sea
	B	PE	Sea
France	C	PP[2]	Sea
	D	PP	Sea
	E	PET	Sea
	F	Glass	Sea
	G	PE+PP	Sea
	H	PET	Sea
Iran	I	PP+Hostasol green	Lake
Japan	J	PE+PET	Sea
Malaysia	K	PP	Sea
	L	PP	Lake
New Zealand	M	PE	Unidentified
Portugal	N	PET	Sea
	O	PP	Sea
	P	Glass	Sea
South Africa	Q	PET	Sea

[1]Polyethylene

[2]Polyethylene terephthalate

[3]Polypropylene

The average Lebanon resident may be eating more than 30,000 small pieces of plastic per year from seafood alone[2], according to the results of the first study on microplastic particles in the country. The study, which analyzed two marine species widely consumed in Lebanon – the European anchovy, which is commonly eaten fried as "bizri," and the spiny oyster, often served simply under the name mussels – found high levels of plastic contamination in both.

According to the study, the average Lebanon resident consumes 7 kilograms of seafood per year. When that is multiplied by the average of 4,500 small plastic pieces found in every kilogram of oyster, they could be consuming 31,500 microplastic particles per year.

In Lebanon, microplastics were present in 7 sea salt brands in the Lebanese market, according to a report called "Diagnosis and Roadmap in Managing Plastic Waste in the Mediterranean," developed in 2018 by Michel Chalhoub in Notre Dame University.

In some countries plastic particles were also identified in other food products and in drinking water, but studies in Lebanon and the Middle East & North Africa (MENA) region are still lacking.

[2] (Daily Star Newsletter 2019 https://www.dailystar.com.lb/)

Lebanon is witnessing a waste management crisis that has resulted in the scattering of satellite landfills and incineration sites throughout the country, with grave consequences for health, economy, and environment. There are 617 uncontrolled municipal solid waste dumps across Lebanon and burning is happening at more than 150 of them at least weekly. Open burning of waste is dangerous; a consequence of the government's decades-long failure to manage solid waste in a way that respects environmental and health laws designed to protect people and the environment. Scientific studies have documented the dangers that smoke from the open burning of household waste poses to human health. Children and older people are at particular risk due to possible related respiratory diseases such as chronic obstructive pulmonary disease, coughing, throat irritation, and asthma. (Azoulay et al., 2019) Workers at the dump sites have no protective clothing, no respirators, or masks, and thus no protection against inhaling and ingesting fumes, smoke and dust that is laden with poisonous compounds and heavy metals.

Also, women are exposed to more single-use plastics compared to men, in terms of using cosmetic and personal care products that contain added microplastics. Women are also likely to be exposed to more plastic packaging through the use of household cleaning products and food packaging as the predominant caregivers, cleaners, cooks, and shoppers for their families. (Forbes, 2015).

Lebanon urgently needs better waste management to prevent the escape of plastic waste into the environment. Sustainable zero waste policies support the goal of a circular economy by enshrining better collection and source separation to generate clean recyclable materials. In the home and in public places, the Lebanese community needs access to separate bins for organic wastes and recyclable materials. Without these, contamination of the waste stream and the loss of finite resources is assured. This simple measure can transform Lebanon's waste management system, support the recycling sector, and protect health and the environment.

6. Environmental impacts of plastic pollution

Lebanon has experienced very large problems with plastic waste for decades, especially along its coast. The source of plastic pollution could be categorized as land-based sources, such as the sectors of building and construction, household goods, coastal tourism, food and drink packaging, electronics and agriculture, as well non-controlled waste sites, sewage and illegal dumping located on the coast. Land-based sources of microplastics also include: cosmetics and personal care products, textiles and clothing (synthetic fibres), terrestrial transport (dust from tyres)[3], and plastic producers and fabricators (plastic resin used in plastics manufacture) (Kole et al, 2017). Sea-based sources are dominated by the fisheries and shipping sectors.

The majority of plastic waste come from the post-consumer market, especially single-use items such as shopping bags, cups, and straws.

[3] Kole, P. J., Löhr, A. J., Van Belleghem, F., & Ragas, A. (2017). Wear and Tear of Tyres: A Stealthy Source of Microplastics in the Environment. *International journal of environmental research and public health*, *14*(10), 1265. https://doi.org/10.3390/ijerph14101265

Different studies showed that marine plastic debris travel through rivers. Major rivers surrounded by populated areas generate a higher amount of mismanaged plastic waste (MMPW). Lebanese rivers carry large amounts of solid waste into the Mediterranean, with large and disproportionate direct dumps of solid waste and landfills on its coast (GIZ, 2014) and poor enforcement of the law. Despite all civil society efforts, the solid waste management crisis remains an issue that requires urgent attention in Lebanon.

For example, even though Nahr Beirut contributes about 3% of Lebanese river discharge, the presence of landfills, population density, and industrial activity tripled the percentage in that particular zone, yielding 10% and 11% between Narh el Kalb and Nahr Beirut.

Plastics such as bags, balloons, beverage bottles, caps/lids, food wrappers and containers, straw and tobacco packaging can still be found in large numbers on Mediterranean beaches and in the sea, and, considering their highly persistent nature, they constitute a major threat to the Mediterranean marine environment.

Figure 8: Ghadir River- South Beirut (source: LEF 2021)

Plastics do not constitute the biggest proportion of the municipal solid waste generated in Lebanon (11.5%), but it was shown that once it reaches the sea, it becomes the major pollutant, contributing 85% to floating litter, and up to 95% of litter laying on seafloor. The highest percentage of these plastics come from packaging such as bottles and drink containers, food boxes, and bags, in addition to single-use disposable items including cotton sticks, lighters, and plastic dining utensils. (UNEP/MAP 2015)

Plastic waste is threatening marine species and ecosystems and is considered one of the gravest problems affecting marine environments. The effect of plastics on marine life includes ingestion, suffocation and entanglement, endangering many rare species and negatively affecting marine biodiversity and the food chain. Microplastics, with their great persistence, mobility and toxicity, pollute sea water.
The quantity of plastic flowing every year into the Mediterranean is estimated at 229,000 tonnes/year with low and high estimates of 148,000 and 610,000 tons/year respectively (IUCN 2020). The table below shows the estimation of plastics generated by Mediterranean countries.

Table 10: Coastal population and waste/plastic generation in 2010 in the Mediterranean countries[4]

Country	Coastal population[1]	Waste generation rate [kg/person/day][2]	% Plastic in waste stream[2]	% Inadequately managed waste[3]	Waste generation [kg/day]	Plastic waste generation [kg/day]	Inadequately managed plastic waste [kg/day][4]	Plastic waste littered [kg/day][4]
Albania	2 530 533	0,77	9	45	1 948 510	174 392	77 897	3 488
Algeria	16 556 580	1,2	12	58	19 867 896	2 374 214	1 378 693	47 484
Bosnia/Herzegovina	585 582	1,2	12	40	702 698	83 972	33 813	1 679
Croatia	1 602 782	2,1	12	9	3 365 842	402 218	37 053	8 044
Cyprus	840 556	2,07	12	0	1 739 951	207 924	831	4 158
Egypt	21 750 943	1,37	13	67	29 798 792	3 858 944	2 572 170	77 179
France	17 287 280	1,92	10	0	33 191 578	3 302 562	0	66 051
Greece	9 794 702	2	10	0	19 589 404	1 949 146	0	38 983
Israel	6 677 810	2,12	14	1	14 156 957	1 974 896	12 577	39 498
Italy	33 822 532	2,23	6	0	75 424 246	4 487 743	0	89 755
Lebanon	3 890 871	1,18	8	34	4 591 228	365 003	123 700	7 300
Libya	4 050 128	1,2	12	23	4 860 154	580 788	132 985	11 616
Malta	404 707	1,78	12	6	720 378	86 085	5 456	1 722
Monaco	34 050	2,1	12	0	71 505	8 545	0	171
Montenegro	260 336	1,2	12	30	312 403	37 332	11 353	747
Morocco	17 303 431	1,46	5	66	25 263 009	1 250 519	824 650	25 010
Gaza	3 045 258	0,79	8	6	2 405 754	191 257	11 515	3 825
Slovenia	336 594	1,21	12	1	407 279	48 670	550	973
Spain	22 771 488	2,13	13	0	48 503 269	6 281 173	0	125 623
Syria	3 621 997	1,37	13	65	4 962 136	642 597	419 763	12 852
Tunisia	7 274 973	1,2	12	60	8 729 968	1 043 231	621 077	20 865
Turkey	34 042 862	1,77	12	16	60 255 866	7 200 576	1 187 323	144 012
Total/mean	208 519 478	2	11	23	360 939 138	36 560 188	7 451 413	731 036

Plastic is the main component of litter collected by volunteers in beach areas, followed by paper. Plastics floating in the sea form about 83% of all litter collected, while all other major categories (textiles, paper, metal and wood) account for about 17%.

Between 2002 and 2006, the top 3 plastic marine litter items found in large numbers were cigarettes/cigarette filters, bags, and beverage bottles between. The slow decomposition of cigarette filters may cause serious health problems to marine fauna and flora. (UNEP 2011)

Significant levels of plastic contamination have been found in seawater and sediments in Beirut, Sidon and Tripoli. The most prominent plastic in seawater was polyethylene, widely used in plastic bottles and bags. Sediments showed a higher presence of polypropylene, a plastic used in textiles and packaging for consumer products. Polystyrene, also commonly used in packaging, was present in larger quantities in the organisms sampled. “The levels of plastic particles found were alarmingly high in comparison to other Mediterranean regions”. (Kazour et Al, 2019)

In 2017, a study by the nonprofit reporting organization Orb Media showed that Lebanon’s tap water had the second-highest concentration of plastic microparticles in the world, with just fewer than 94% of

[4] After Jambeck et al., 2015 and http://jambeck.engr.uga.edu/landplasticinput). (1) Coastal populations were estimated from global population around a 50 km buffer from the coastline, (2) World bank estimates, (3) modelled, (4) extrapolated/calculated

samples showing contamination. Tap water is not commonly used for drinking in Lebanon, but it is used for cooking, cleaning and bathing, meaning it is almost certainly ingested.

In parallel, a large portion of the plastics entered Lebanon's groundwater via seawater intrusion. Burning wastes, including plastics, in Lebanon is a source of persistent organic pollutants (POPs). When the plastics are burned, reactions occur that generate highly toxic brominated and chlorinated dioxins, as well as dioxin-like PCBs and other POPs.

7. The Basel Ban and plastic waste amendments

Lebanon ratified the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal pursuant to the law #387 of 21/12/1994 and ratified the Stockholm Convention on Persistent Organic Pollutants for Adoption by the Conference of Plenipotentiaries by virtue of the law #432 of 8/8/2002. The Lebanese government, within the same framework, prepared several related decrees:

- Decree to regulate and monitor the import-export of industrial waste including hazardous wastes,
- Decree to classify wastes (industrial and toxic) and to regulate waste disposal methods for each of the classifications,
- Decree to regulate the licensing process for companies in charge of industrial and toxic waste disposal.

During the Basel Conference of the Parties from 29 April to 10 May 2019, governments amended the Basel Convention to include plastic waste in the legally-binding framework, which will make global trade in plastic waste more transparent and better regulated, whilst also ensuring that its management is safer for human health and the environment. (IPEN & Basel Action Network, 2020)

After the Basel Ban Amendment came into force, Lebanon could no longer import hazardous waste, including those plastic wastes listed under the new amendment, from OECD Members, EU Member States or Liechtenstein. Moreover, the government has elaborated a national plan for chemical safety that is to address all issues related to chemical substances at all stages: from import or manufacture to transport, storage, usage, and disposal.
Efforts in Lebanon are still at the civil society level to establish partnerships on plastic waste to mobilize business, government, academic and experts to assist in implementing the new measures, and to provide a set of practical supports – including tools, best practices, technical and financial assistance. Under the Bahr Bala Plastic project mentioned above in section 1, a national network composed of all stakeholders engaged in the plastic cycle (collection, recycling, pollution, trade, manufacturing…etc.) for combatting plastic pollution in Lebanon, is now established to sustain actions and unify efforts.
Countries such as Lebanon where waste management is inadequate should not have to face the threat of plastic waste or other hazardous waste imports and the inevitable adverse health and environmental impacts it brings. To protect against colonialist waste dumping and to uphold the Basel Convention, an international, legally binding instrument is needed to stop the trade in plastic waste.

8. Toxic plastic recycling

There is no easy solution for plastic waste. Recycling plastic is currently the least profitable way to manage plastic waste in Lebanon. This is because recycled plastic waste feedstocks compete with cheaper fossil fuel based virgin material feedstocks. In addition, most plastic packaging and other single use plastics are difficult to recycle due to the composite and multi-layered materials used in their design. The waste stream contains many different types of plastics making collection and source separation essential to creating clean feedstocks that the recycling industry requires. In addition, recycling plastic often transfers toxic substances such as brominated flame retardants and other POPs into the new products, (IPEN Toxic Recycling 2018) creating a more hazardous waste stream in the long term. Additionally, the pollution footprint of the recycling process itself is very high and the capital costs, infrastructure maintenance, operational costs and waste disposal costs are easily offset by the import of virgin raw materials in Lebanon. Moreover, low oil prices reduce the cost of imported raw material, reducing the demand for local plastic recyclables except where there is a local excess demand for a specific product. There are many technical and economic barriers to recycling plastics, including energy use, contamination, toxic additives, and laminated constructions (Schlögl, 2020).

Waste collection and recycling is characterized by unsafe and unhealthy working conditions, low or irregular incomes, long working hours and a lack of access to information, markets, finance, training and technology, and, the most important risk, the exposure to chemicals and toxic materials especially from plastics.

There is no written data in Lebanon or numbers relating to toxic impacts of the recycling industry and emissions, but the plastic industry is considered as a big producer of waste compared to other industries.
Landfills in Lebanon contain around 280,000 tons of plastic, and treatment of each ton costs the Lebanese government 125 US dollars minimum, as reported by the Ministry of Environment (Fadi Jreisaty).

9. Plastic waste and COVID 19

In the face of the COVID-19 era, healthcare institutions such as hospitals, clinics, laboratories, temporary quarantine centers, and even homes are producing COVID-19-related medical wastes. The detailed composition of COVID-19-related infectious medical waste is not well documented in Lebanon. However, the COVID-19-related waste could be composed of swabs, syringes, needles, sharps, blood or body fluid, excretions, mixed waste, laboratory waste, material or equipment contaminated with the virus, masks or disposable gloves, and PPE that are used for screening and treatment for COVID-19-infected patients (Agamuthu and Barasarathi, 2020).

It was also proposed that the use of plastic products for the prevention of the epidemic, be expanded during the COVID-19 pandemic (Zhou, 2021). Furthermore, wastes contaminated by COVID-19, especially the single use plastics such as gloves, masks, sanitizers, wipes…etc., which are considered as

infectious waste, are thrown everywhere by Lebanese citizens, especially in streets, in front of supermarkets, pharmacies, banks…etc. and thus threaten both the environment and human health.

A study by Maamari et al. (2015) estimated that the total infectious healthcare waste generation rates in Lebanon was equal to 6,383,806 kg per year based on data records for the years 2009–2013. And now, the estimated average of COVID-19-related infectious healthcare waste generation in Lebanon is 39,035 kg per month or 1.3 tons per day, which constitutes between 5% and 20% of total infectious healthcare waste in Lebanon as estimated by Maalouf & Maalouf (2021).

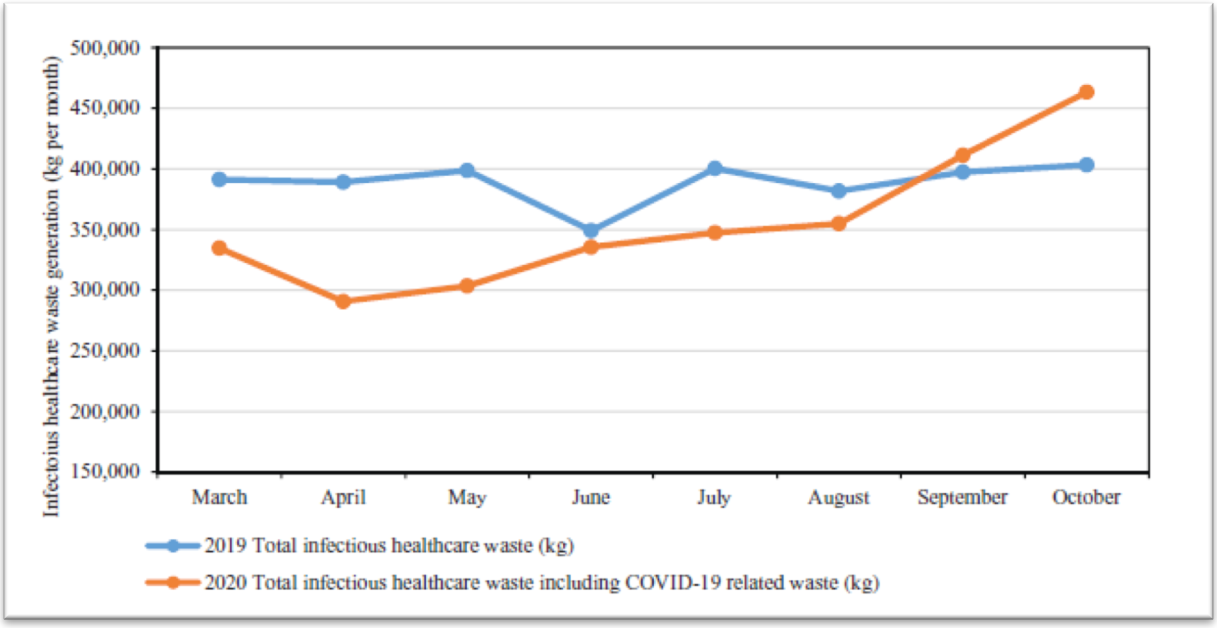

Figure 9:Changes in the pattern of medical waste generation due to COVID-19 in Lebanon. (Source: Maalouf & Maalouf, 2021)

Currently, it is estimated that around 80– 85% of infectious healthcare waste in Lebanon is being treated (via autoclaving) by Arcenciel - a service provider for waste collection and treatment in Lebanon since 2003. The waste is generated by 150 private hospitals, 30 public hospitals, 80 laboratories, 42 dispensaries, 4 associations, 4 universities, and around 200 primary healthcare centers and isolation centers as well as other waste operators (MoPH 2018). The remaining portion (around 15–20%) of the healthcare waste, which is not being collected or managed by Arcenciel or other waste operators, is either incinerated at hospitals without permits or illegally dumped with MSW (MoE/UNDP/GEF, 2016). This highlights the need for proper management and disposal of the amounts of medical waste generated to reduce contamination risks and related environmental threats. MSW incineration is prohibited in Lebanon under the Lebanese Decree 13389/2004 which also prohibits incineration of potential infectious medical waste and recommends treatment using a sterilization method.

COVID-19 cases as in Lebanon of 17 January 2021 reached more than 252,000 cases and 1906 deaths (MoI, 2021). In parallel, there was a rise in the production of medical waste. This highlights the need for proper management and disposal of the amounts of medical waste generated, including sorting at the

source to reduce contamination risks and related environmental threats, particularly during the pandemic. Management includes maintaining intensive control and monitoring of autoclave operations, hazardous waste collection, open burning and illegal dumping or incinerating activities, especially during the COVID-19 pandemic.

LEF launched an awareness campaign for Lebanese citizens on the danger of the wastes contaminated by COVID-19 and provided solutions for not throwing plastic waste contaminated by COVID-19 into the environment.

https://www.facebook.com/lbeforum.org/photos/a.755526054530256/3047699111979594/?type=3&theater

https://www.facebook.com/lbeforum.org/photos/a.755526054530256/2840255639390610/?type=3&theater

10. Description of the activity conducted

LEF aimed through this project to research and report on activities related to pollution from plastic waste in Lebanon including trade, recycling and disposal, as well as their impacts and the implications of the Lebanese government in applying laws, policies and international conventions such as Basel and SDGs.

A survey was done to gather information about industrial firms engaged in the plastic industry, including recycling and production. Info was also collected about trading in the market, as well as an overall review to check on studies and research in Lebanon on plastic pollution and its impact (within the limited data and information).

A brainstorming meeting for LEF board and members for planning to address plastic pollution at the local level was undertaken. This meeting took into consideration financial and market mechanisms and all the financial and economic challenges in the country in order to control plastic waste and pollution, such as taxes (including on plastic waste imports) and single use bans. Plastic incineration was also considered, and communication with relevant ministries such as Ministry of Economy and Trade and Ministry of Environment.

LEF has started advocacy, communication and awareness raising for all stakeholders about plastic pollution, trade and incineration of plastic products with environmental NGOs, LEF members, and national authorities in order to react accordingly and limit pollution from plastics and microplastics.

11.2 Communication with national or local authorities

Communication with the government agencies started by contacting the Ministry of Economy and Trade and the Ministry of Environment to start a partnership within the context of combatting plastic pollution in Lebanon. Several consultation calls were done in order to gather information on existing laws, legislation and plans at all levels (pollution, trading, manufacturing, recycling…).

Due to COVID-19 restrictions and lockdown, personal meetings were impossible, but coordination is still ongoing, and we are planning for a workshop to gather all stakeholders to reflect on all the results of the report and negotiate the best practices and solutions in terms of banning, imposing taxes and creating incentives, especially for industry.

11.3 Changes from the original plans

The activities were delayed because of unexpected events throughout the country such as road blockage and protesting due to the hard economic and financial situation in Lebanon. Also, the COVID-19 crisis, sanitary restrictions, and the confinement measures imposed by the Lebanese government have stopped implementation for a period of time, so online and remote works were applied as alternatives.

11.4 Resources on plastic waste and pollution

Consulting researchers in the domain of waste management and plastics, as well as researching via reports produced nationally and globally were the main resources for gathering data and info on plastic waste and pollution. Additionally, references and websites, articles and academic reports helped in this research, such as:
Lebanese Customs Data: www.customs.gov.lb
Association of Lebanese Industrialists ALI www.ali.org.lb
Ministry of Environment http://www.moe.gov.lb/
Ministry of Economy and Trade https://www.economy.gov.lb/en
Ministry of Information https://www.ministryinfo.gov.lb/
Word Integrated Trade Solution: https://wits.worldbank.org/

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11.6 Communication Efforts

LEF has prepared posts to be shared on social media and raise awareness amongst the general public.

11.7 Outreach to government authorities and industry

LEF NGO members will play a role not only in increasing outreach and spreading awareness among the Lebanese community, but also in advocating toward a good management of waste and plastic waste. The network will continue efforts in lobbying for plastic waste management and enhancing existing laws and legislation.

Since the engagement of the government and national authorities is crucial in the plastic waste issue, LEF will keep communication with members of a committee that was created under Bahr Bala Plastic Project implemented by the Lebanese Environment Forum jointly with Lebanon Eco-movement, involving representatives from the Ministry of Environment and Ministry of Economy and Trade. Discussion on the progress of plastic pollution issues will remain even after the closure of the project to follow up on the application of the laws, enhancing practices and dialogue with the private sectors and industry in line with the international agreements, and urging the Ministry of Environment to adopt the Basel Convention plastic waste amendments, in addition to following up on the draft of a law concerning plastic bag reduction, under the Paris Agreement and SDGs 2030 plans adopted by Lebanon.