EUROPEAN UNION EXTERNAL ACTIONS

Technical support to upgrading the solid waste management capacities in Lebanon

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Sub-Activity 1.1
Baseline Report –Districts of Bsharre, Koura & Zgharta

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$	dollars
%	Percentage
AC	Air Conditioning
AUB	American University of Beirut
BDC	
BML	Beirut Mount Lebanon
BOT	Build–operate–transfer
C/N	Carbon-to-nitrogen ratio
cap	capita
CAPEX	Capital Cost Expenditures
CAS	Central Administration of Statistics
CBO	Community-based Organization
CDW	Construction and Demolition Waste
Cf.	confer/conferatur
CFU	Colony Forming Unit
Cr	Chromium
Cu	Copper
d	Day
dm	Dry mass
E. Coli	Escherichia Coli
e.g.	Example
ELARD	Earth Link and Advanced Resources Development S.A.L
Etc.	etcetera
EU	European Union
EU DG Environment	European Union Directorate General for the Environment
G	Grams
H	Height
ha	Hectare
HCW	Health Care Waste
HDPE	High Density Polyethylene
Hg	Mercury
HH	Household
IMFU	Independent Municipal Fund
IRS	Informal Recycling Sector
Kg	Kilograms
Km^2	Kilometer Square
LBP	Lebanese Pound
LDPE	Low Density Polyethylene
LMSEP	Lebanon Municipal Service Emergency
lt	liters
m	meter

m^2	Meter Square
m^3	Meter Cube
m^3/s	Meter cube per second
MBT	Mechanical Biological Treatment
MG	Milligrams
MoE	Ministry of Environment
MoIM	Ministry of Interior and Municipalities
MoSA	Ministry of Social Affairs
MPN	Most Probable Number
ms/cm	Millisecond per centimeters
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
NGO	Non-Governmental Organization
Ni	Nickel
NIMBY	Not in My Back Yard
No/Nb.	Number
NPMPLT	National Physical Master Plan of the Lebanese Territory
O&M	Operation and Maintenance
OMEX	Operations and Maintenance Expenditures
OMSAR	Office of the Minister of State for Administration Reform
Pb	Lead
PDT	Prioritization Decision Tool
PET	Polyethylene terephthalate
pH	potential of hydrogen
PHC	Primary Health Care
PPE	Personal Protective Equipment
PPP	Public Private Partnership
rpm	Run per minutes
RSI	Risk Sensitivity Index
RTO	Regional Technical Office
SSRDP	Strategic Sustainable Regional Development Plan
Tons/u	Tons per Atomic Mass Unit
TV	Television
UN	United Nations
UNDP	United Nations Development Program
UNIFIL	United Nations Interim Force in Lebanon
UNRWA	United Nations Relief and Works Agency
UoM	Union of Municipalities
UoTM	Union of Tyr Municipalities
US	Unites States
Vs.	Versus
W	Width
WEEE	Waste Electrical and Electronic Equipment
WM	Waste Management

WWTP	Waste Water Treatment Plant
y	year
YMCA	Young Men's Christian Association
Zn	Zinc

1. BSHARRE, KOURA & ZGHARTA DISTRICTS PROFILE

North Lebanon is one of the 8 Governorates in Lebanon, comprising 6 districts, with Tripoli being its administrative center. It has a total area of 1,203 km2, which constitutes 11.5% of the total area of Lebanon.

The following table summarizes the main characteristics of each of the studied districts, which are Zghara, Koura and Bcharreh.

Table 1. Characteristics of the studied Districts

No	District	Number of Municipalities	Administrative Center	Area (km^2)	% total area of Lebanon	Geographic boundaries
1.	**Zgharta**	31	Zgharta	210	1.5	**North:** Minnieh-Dannieh **North West:** Tripoli **South East:** Bcharreh & Batroun South West: Koura
2.	**Koura**	37	Amioun	173	1.7	**North & North East:** Tripoli & Zgharta Districts **East:** Bcharre District **South:** Batroun District
3.	**Bcharreh**	12	Bcharreh	156	1.5	**North:** Zgharta and Minieh-Danniyeh District **East:** Baalbek District **South:** Batroun District West: Koura District

1.1. Districts Structure and Administrative Divisions

As mentioned earlier, the North Governorate is one of the 8 Governorates in Lebanon. It includes 6 Districts: Zgharta, Bcharreh, Minnieh-Dannieh, Koura, Batroun and Tripoli.

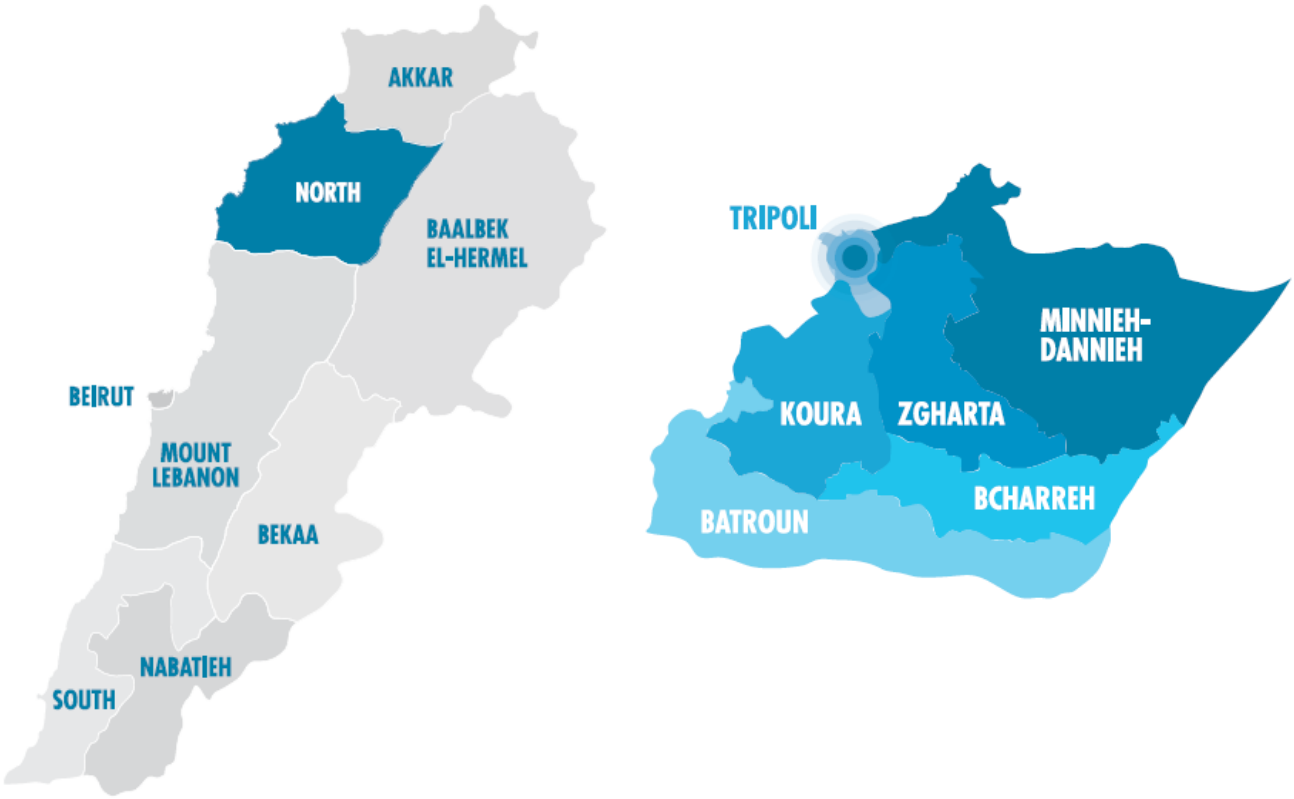


Figure 1. North Lebanon Governorate (Left side) and Districts (right side)

The Data center on local development in Lebanon reports a total of 37 Municipalities within the Koura District, 31 within Zgharta and 12 within Bcharreh. These are schematically illustrated below. It is to be noted that the districts include villages that do not have a municipal council.

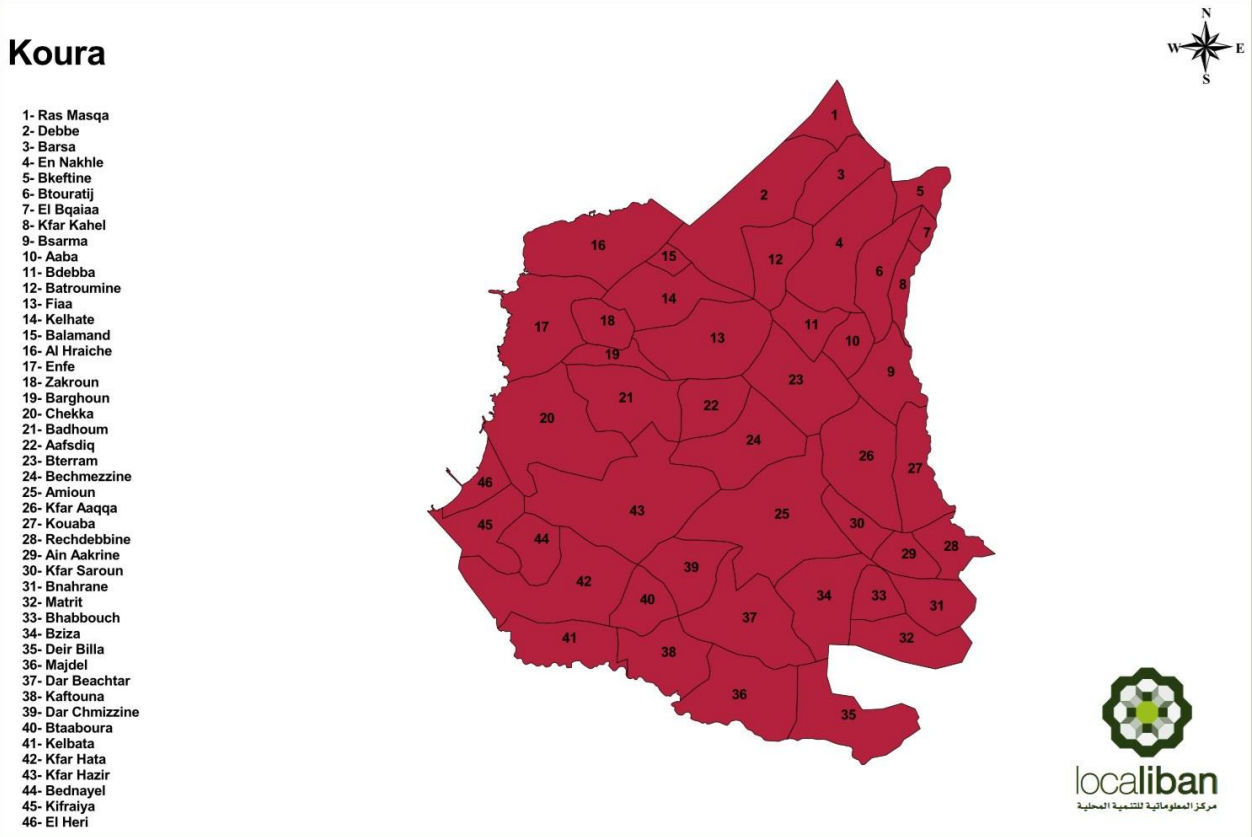


Figure 2. Municipalities within the District of Koura

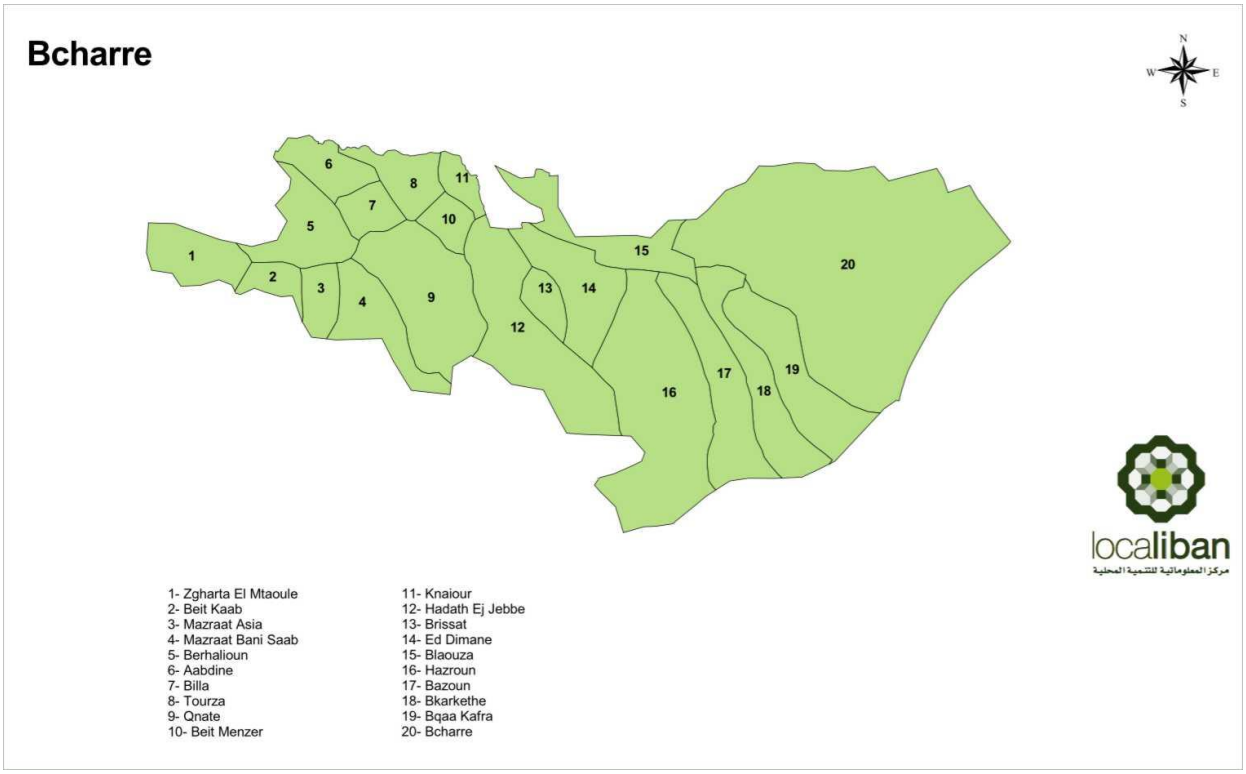


Figure 3. Municipalities within the District of Bcharreh

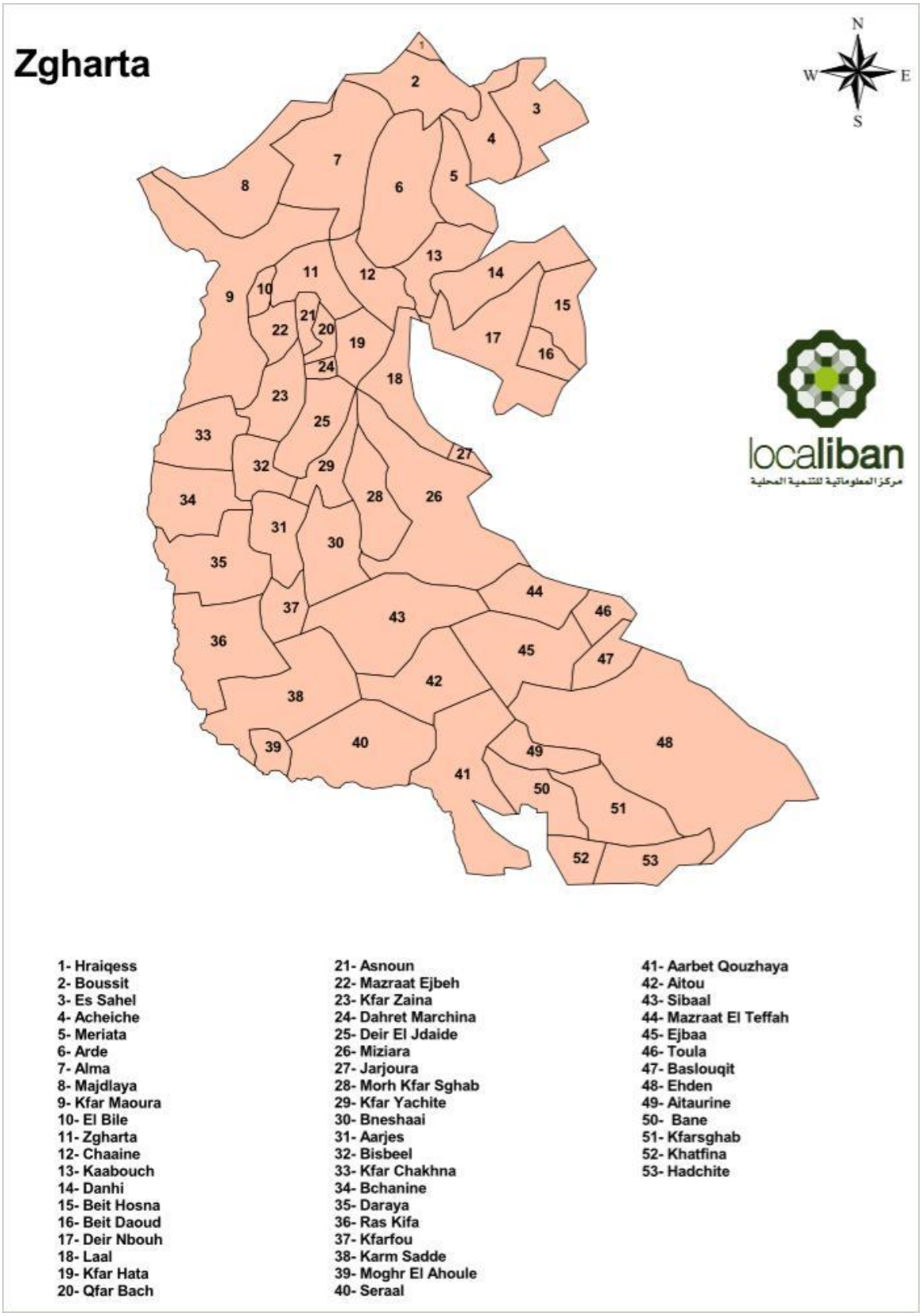


Figure 4. Municipalities within the District of Zgharta

1.1.1. Union of Municipalities

The Lebanese law advocates adjoining municipalities to confederate into 'unions'. The legislative framework governing the establishment of unions of municipalities as well as the constraints impeding their proper operations are elaborated in the national baseline report.

As far as Bcharreh, Zgharta and Koura Districts are concerned, the number of municipal federations or unions and the list of municipalities constituting each are summarized in the below table.

Table 2. Unions of Municipalities in Zgharta, Koura and Bcharreh Districts

No	Municipal Union	No and date of Decree of Establishment	Union's Center	No of Municipalities	Names of Municipalities
1.	Federation of Sahel Zgharta District Municipalities	4561, September 16, 1987	Zgharta	25	Aachach; Aintourine; Aarbet Qouzhaiya; Aarjes; Ardeh-Harf Aden – Beit Okar – Beit Abid; Aytou; Baslouqit; Bneshaai; Daraiya – Bchannine; Haret El Fouar; Izal; Karm Saddeh; Kfar Dlaqous; Kfar Fou; Kfar Hata; Kfar Sghab; Kfar Yachit – Besebaal; Kfar Zeina; Korah Bach; Mazraat Et Teffah; Mejdleiya; Rachaine; Ras Kifa; Seraal; Zgharta-Ehden
2.	Federation of Koura Municipalities	9970; April 04, 2003	Amioun	24	Aafsdiq; Ain Aakrine; Amioun; Barsa; Batroumine; Bednayel; Bkeftine; Bsarma; Bterram; Btouratij; Bziza; Dar Baaechtar;; Dar Chmizzine; Enfeh; Fiaa; Kaftoun; Kfar Aaqqa; Kfar Hata; Kfar Hazir; Kfar Saroun; Kousba; Majdel-Zakzouk-Ouata Fares; Qalhat; Rechdibbine
3.	Federation of Bcharreh Municipalities	10171; May 23, 2003	Bsharre	7	Bazaaoun; Bcharreh; Bqaa Kafra; Bqerqacha; Hadath Ej Joubbeh; Qnat; Tourza

As shown above, there is one Union of Municipalities in each District of the study area. However, not all the municipalities of the study area are members of the above unions. Indeed, and as shown in the below table, whereas 81% of the municipalities of the District of Zgharta are members of the Sahel Zgharta Union, only 33% of the municipalities of the District of Bsharre are members of the Bsharre Union of Municipalities.

Table 3. Union of Municipalities

District	Union	No of Municipalities in Union	Total no. municipalities in District	% of municipalities in union
Zgharta	**Federation of Sahel Zgharta District Municipalities**	25	31	81%
Koura	**Federation of Koura Municipalities**	24	37	65%
Bsharre	**Federation of Bcharreh Municipalities**	7	21	33%
	Total	**56**	**89**	**63%**

The total number of municipalities that are members of Federations is 56 which constitute 63% of the total number of municipalities in the study area.

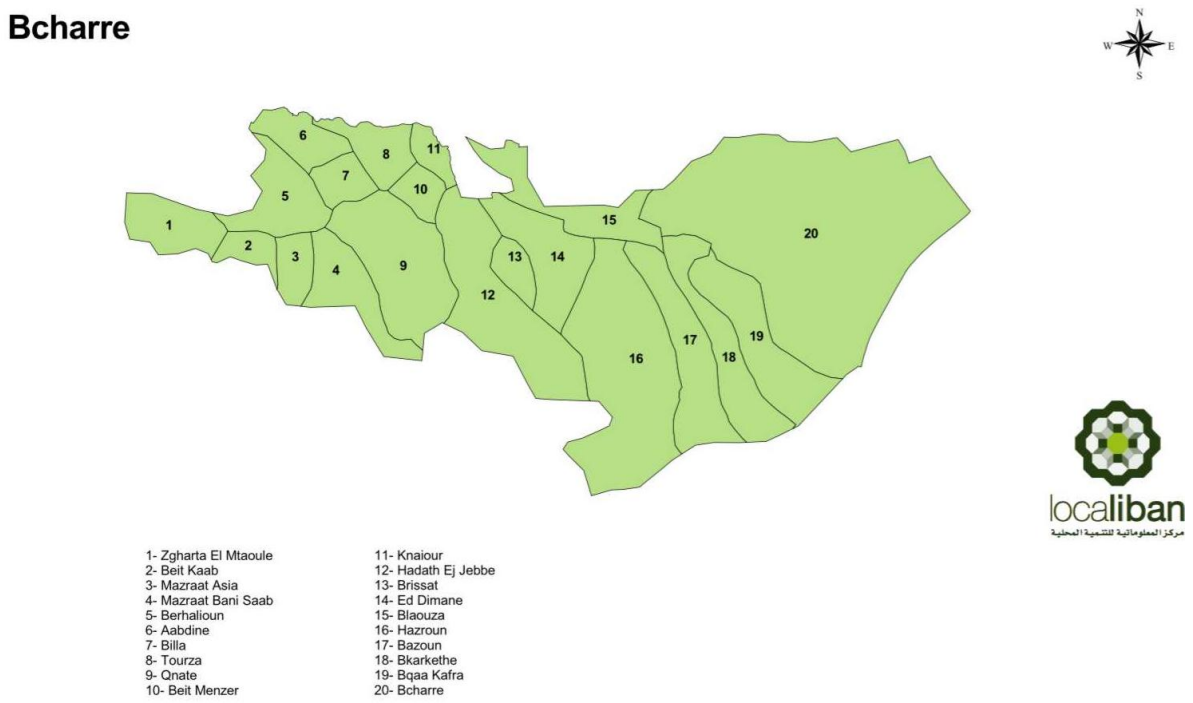


Figure 5. Bsharreh Union of Municipalities

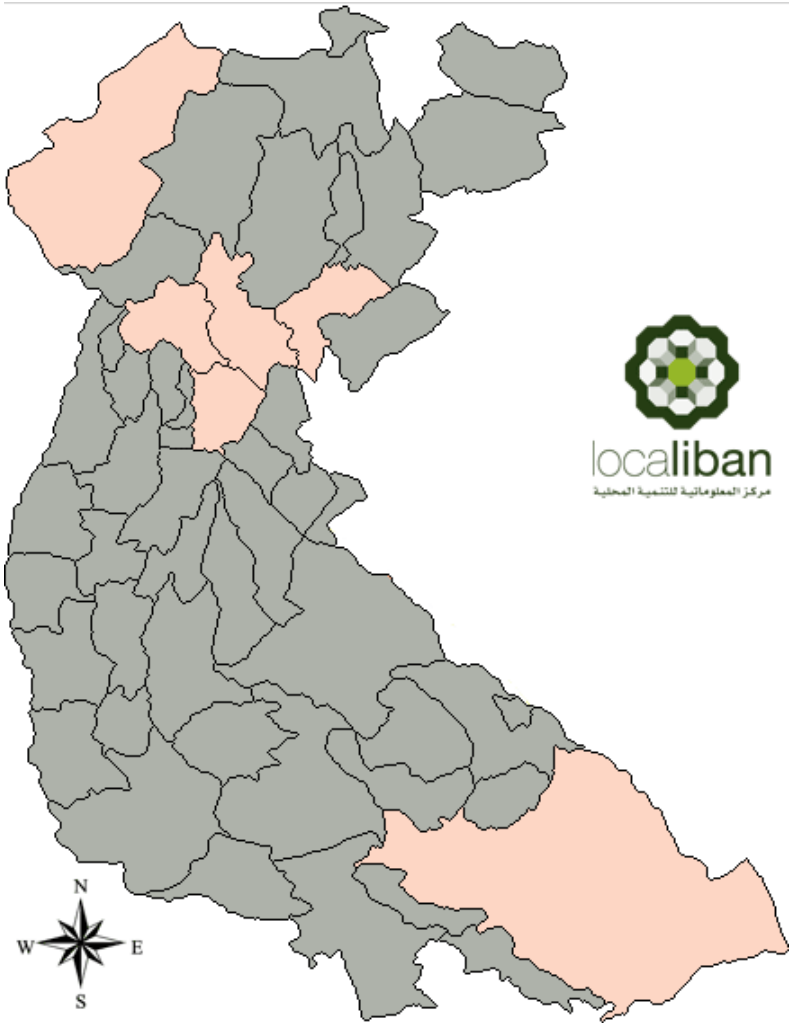


Figure 6. Sahel Zgharta Union of Municipalities

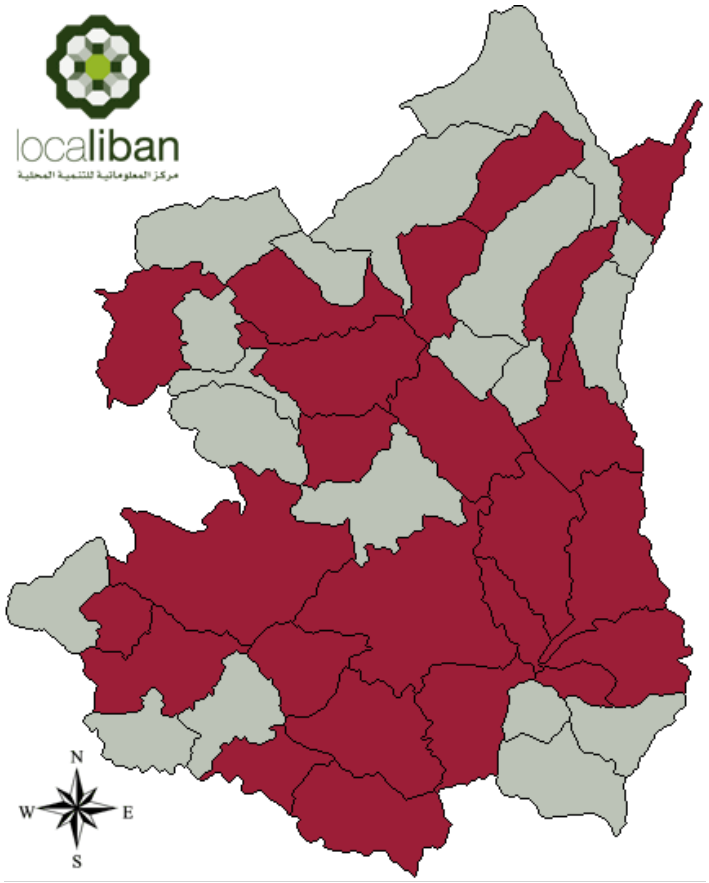


Figure 7. Koura Union of Municipalities

1.1.2. Palestinian Camps Governance

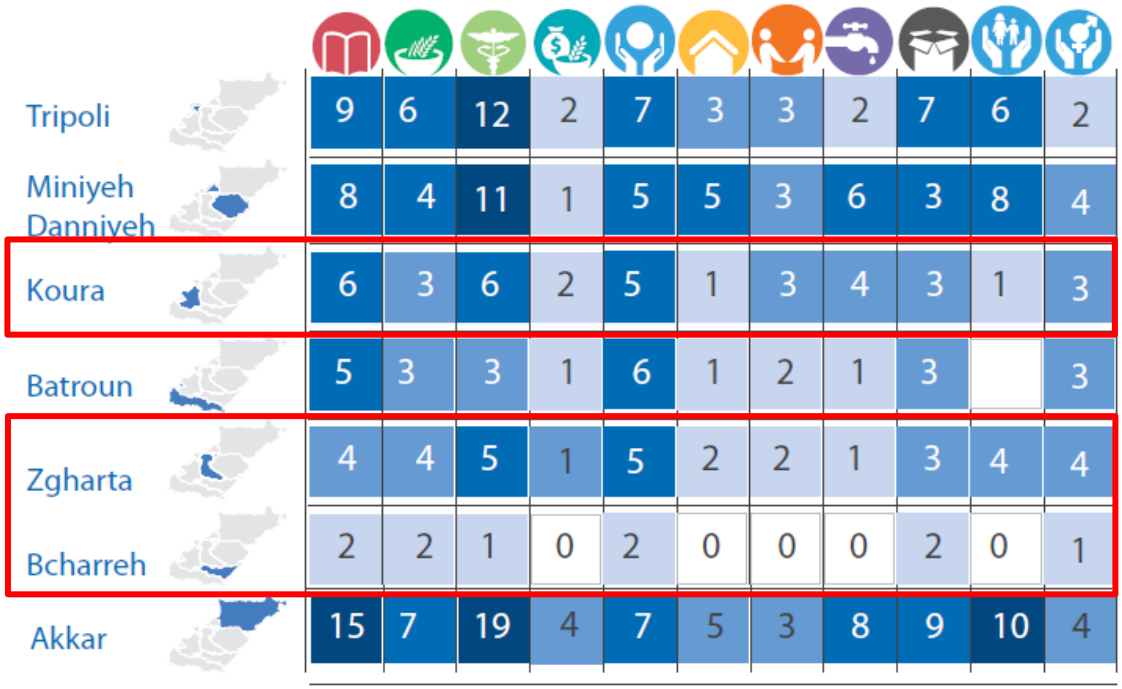
The Palestinian camps have their own governance systems mainly comprising popular committees, local committees and political factions. The camp management system involves local and international organizations which provide key services. UNWRA is the main provider of services in Lebanon's official camps. UNRWA is mandated under the United Nations General Assembly Resolution Nb. 302, to provide to all Palestinian Refugee Camps in Lebanon direct relief and work programs including upgrading of basic urban services e.g., water, sewage, electricity, and road networks; the delivery of social services e.g., education health, and social protection, that being exclusively delivered to Palestinians.

In the last decade, women's leagues known as 'al lajna an-sina'iyyah' have been formed in camps, which mainly contribute to health awareness and education (UN-Habitat & UNDP 2014).

1.1.3. Active NGOs in the Study Area

In view of the increased number of refugees in the North Lebanon area in general, the number of UN agencies and NGOs that are active in the area has significantly increased as shown in the below table.

Table 4. Number of UN Agencies and NGOs that are active in the North



The below table summarizes the NGOs that are active in the North Governorate along with the sector of activities.

Table 5. Active NGOs in North Lebanon Governorate

Sector of activities	Active NGOs & International Organizations
Advocacy	ABAAD;
Child Protection	AVSI; INTERSOS; TdH – It; TdH – L; UNICEF;
Education	AVSI; IR; IRC; MAP;
Energy and Water	Mercy Corps;
Food Security	ACF; CARE; FAO; WFP;

Sector of activities	Active NGOs & International Organizations
Health	AMEL; IMC; IR; IRC; Lebanese Red Cross; MAP; PU-AMI
Human Rights	AMEL; CLMC; NRC; TdH – It; TdH – L;
Livelihoods	DRC; IR;
Reform and Development	Beyond; CHF; IOM; MCC; SHEILD; UNDP;
Shelter	Acted; CISF; CLMLC; Mercy Corps; Solidar Suisse;
Social Stability	Danish Red Cross;
Water Sanitation & Hygiene	Acted; AMEL; CISF; IR; Lebanese Red Cross; Mercy Corps; PU-AMI; Solidar Suisse;

1.2. Urbanization Dynamics & Existing Urban policies

Lebanon has and still is witnessing a fast and unrestrained urban growth and sprawl. The uncontrolled urban expansion is due to limited enforcement of planning regulations. Figure 9 represents the state of urbanization in Lebanon where Beirut constitutes the biggest agglomeration.

North Governorate is characterized by inland agglomerations, most of which are present in the Tripoli District. In fact, Tripoli is a small district but very densely populated.

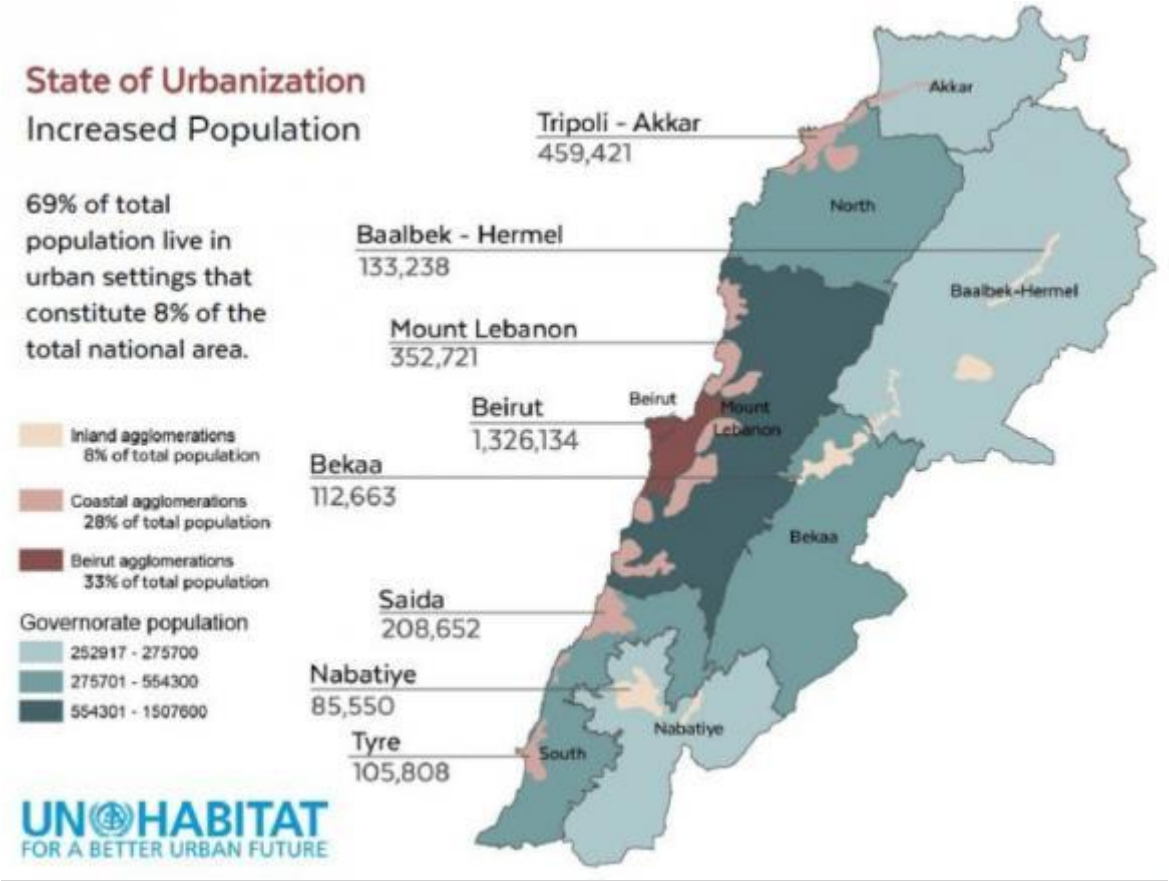


Figure 8. State of Urbanization in Lebanon

Just like in most cities, urbanization in Koura, Zgharta and Bcharreh Districts have taken place mostly along major transportation arteries, mainly roads. It shows a ribbon sprawl that arises on land that is adjacent to major roads (Faour, 2015). Ribbon sprawl – also known as linear expansion – is the expansion of towns and villages along major roads, therefore generating long roads of residential housing units and commercial centers on both sides of the road. The following figures highlight the difference in urbanization that took place in the North Governorate, showing the biggest agglomeration in Tripoli.

Figure 9. Ribbon sprawl in Tripoli City

Figure 10. Ribbon sprawl in Amioun City

Figure 11. Ribbon sprawl in Bcharreh City

Figure 12. Ribbon sprawl in Zgharta City

1.3. Demography

1.3.1. Population Density

According to the National Physical Master Plan for the Lebanese territory, the Bcharreh District is composed of areas with low density - <50 capita per km^2, while Koura District's population density is considered as medium – 250 capita per km^2, and that of Zgharta the highest – 500 capita per km^2.

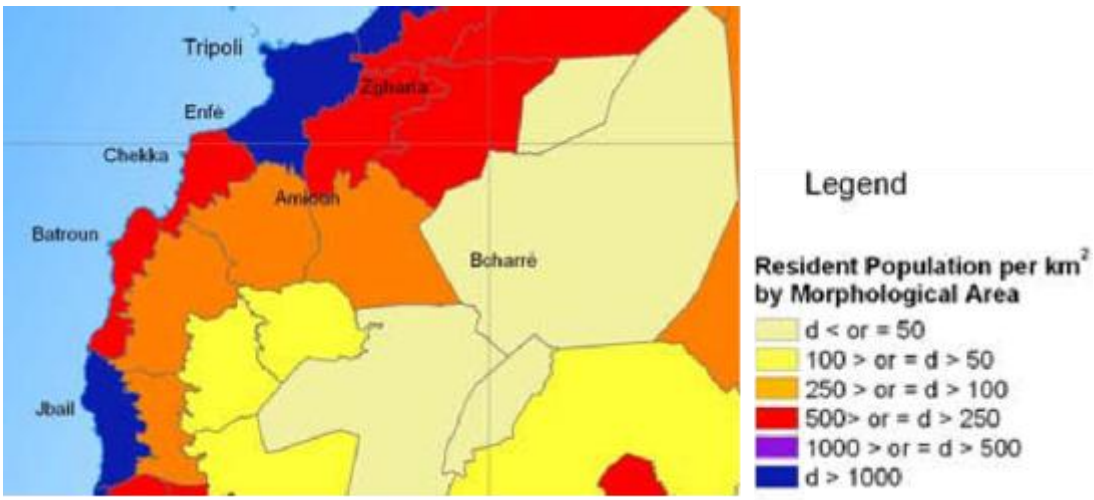


Figure 13. Population density in Koura, Zgharta and Bcharreh districts

1.3.2. Expatriates in the Study Area

The Lebanese diaspora is estimated at between 4 and 13 million emigrants because the actual holders of Lebanese nationality only make up a fraction of the descendants of the Lebanese migrants, who left the territory under Ottoman rule, before the creation of Lebanon in 1920 (European University Institute, 2017). In 2014, 885,000 Lebanese of the first-generation born in Lebanon were estimated to be migrants.

Lebanese who left the country between 1991 and early 2000s, seeking work abroad were mainly from South Lebanon – including Nabatieh Governorate – followed by Mount Lebanon and then by the Beqaa Valley. (European University Institute, 2017).

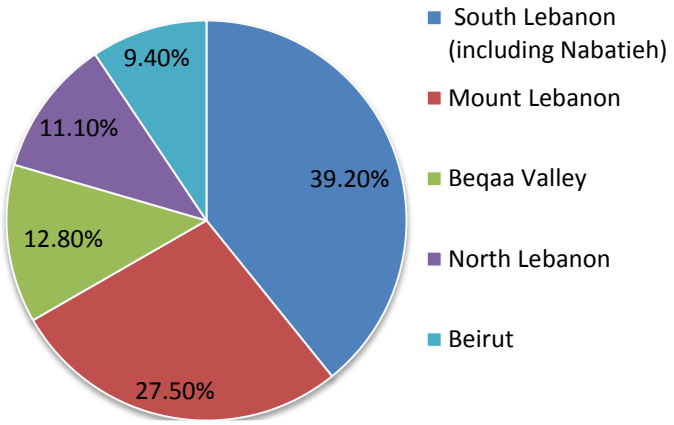


Table 6. Origin of Lebanese Emigrants (Information International, 2001)

Indeed external migration is a phenomenon that affects most of the District where many of the villages and towns reported immigrants in Africa, Germany, the United States and the Gulf Region. As shown in the figure above, North Lebanon has the second lowest rate of migration between Governorates.

Based on the Ministry of Interior and Municipalities, specifically the General Directorate of Personal Status, there are, 2,247 people living abroad who are aged above 21. According to CAS, 60.2% of the population residing in North Governorate is aged above 20. Hence, 7,282 Lebanese people from Zgharta are expatriates, 4,019 from Koura and 4,100 from Bcharreh. This is however a conservative approach because the CAS estimation is outdated and was done on a small sample of the population which might not be representative of the current situation.

During the interviews conducted with a number of municipalities in the study areas, it was mentioned that internal migration within the country is popular whereby families migrate to other areas within the country to work and live all year round and return during the summer. This is the case for Bcharreh District. Given that Zgharta and Koura are considered more urban, the trend tends to be the opposite there.

1.3.3. Lebanese Citizens

Different approaches were used to estimate the population of the study area as described in the below sections:

1.3.3.1. Approach No 1: Population reported by Municipalities

Extensive meetings were held with the Presidents of the different unions of Municipalities in the Districts and with the mayors of the individual municipalities during the month of August 2018.

The population related database obtained during these meetings is summarized in the below table:

Table 7. Lebanese Residents Population as reported by the Heads of Municipalities

No	Municipality	Reported Population	
		Winter	Summer
Municipalities of Koura District			
1.	Fee3	2,000	2,000
2.	Qalhat	2,000	2,600
3.	Kaftoun	300	450
4.	Kfar Qahel	1,500	1,500
5.	Kfar Hata	1,800	2,000
6.	Kfar Hazeer	2,500	2,500
7.	Kfar Saroun	2,000	2,500
8.	Kfar Aqqa	4,500	4,500
9.	Kifraya	1,700	2,000
10.	Kosba	8,000	8,000
11.	Metreet	50	250
12.	Majdel - Zakzouk - Wata Fares	1,000	1,000
13.	Nakhle	8,000	10,000
14.	Amyoun	10,000	15,000
15.	Anfeh		
16.	Ajd Ebreen	1,200	1,200
17.	Bkifteen	800	1,100
18.	Btouratej	3,000	3,000
19.	betroumin	600	750
20.	bte3boura	450	500
21.	behwayta - Afqa - bechnata		
22.	Bednayel	450	500
23.	Bdebba	450	450
24.	Bersa		
25.	Bzeeza	1,000	1,000
26.	Bshemzeen	300	400
27.	Bserma	750	850
28.	Botram		
29.	Dar B3eshtar	3,700	4,500
30.	Dar Shemzeen	250	350
31.	Dede	10,000	10,000
32.	Dechdebbine	800	800
33.	Ras Masqa	19,000	20,000
34.	Reshdebbine	600	600
35.	Zekroun	280	300
36.	afsadeek	800	900
37.	Ain Ekreen	2,000	2,500
38.	Abba	750	750

No	Municipality	Reported Population	
		Winter	Summer
	Sub-Total 1	**92,530**	**104,750**
Municipalities of Bsharre District			
39.	Qnat	230	330
40.	Bqaa Kafra		
41.	Bqar Qasha	4,500	6,000
42.	Ban		
43.	Barhalyoun	0	400
44.	Bez3oun	600	2,250
45.	Bcharre		
46.	Hadath El Jebbeh	600	2,400
47.	Hadchit	80	5,500
48.	Hasroun	3,000	7,000
49.	Torza		
50.	Abdine		
	Sub – TOTAL 2	**9,010**	**23,880**
Municipalities of Zgharta District			
51.	Kfar Sghab	1,000	1,200
52.	Qorah Bash	1,000	1,150
53.	Kfar Fu	150	180
54.	Kfar Yachit - Bsebaal	1,000	3,000
55.	Kfar Hatta		
56.	Kfar Dlaqous	4,000	4,000
57.	Kfar Zeina	900	1,000
58.	Karm Saddeh	1,200	1,200
59.	Majdlayya (Zgharta)	28,000	30,000
60.	Maryata - Qadreyyah	15,000	15,000
61.	Mezyara - Harf - Hmeis - Sakhra	3,000	4,000
62.	Mazraat Teffah	400	550
63.	Aytou	350	400
64.	Eaal	360	1,200
65.	Arde	5,300	5,300
66.	Bneshay	80	200
67.	Buheira (Zgharta)	80	650
68.	Bsaloukit	20	700
69.	Toula-Aslot		
70.	Haret Al Fouar	6,000	6,000
71.	Daraya-Bshennin		
72.	Rass Kifa	170	200
73.	Rasheen	6000	6000
74.	Zgharta - Ehden	36300	48000
75.	Seb'el	1,000	1,200
76.	Ser'el	500	500
77.	Alma	5,000	5,000
78.	Ain Tourin	12	350

No	Municipality	Reported Population	
		Winter	Summer
79.	Arabet Kizhaya	350	550
80.	Arjes	550	600
81.	Ashash	1,000	1,100
	Sub-TOTAL 3	**118,722**	**139,230**
	GRAND TOTAL	**220,262**	**267,860**

1.3.3.2. Approach No 2: Population Extracted from the number of Voters

This approach consists of extrapolating the population of the various districts based on:

- The MoIM official number of registered voters for the latest elections (i.e. the population above the age of 21);
- The population age distribution for the each of the three districts as per the statistics of CAS.

The population calculation representing this approach is summarized in the below table:

Table 8. Population calculations as per Approach 2

No	District	No of Voters as per MoIM	% Population above age of 20 (CAS)	Total Population
1.	Bsharre	49,605	60.2	82,400
2.	Koura	78,183	60.2	129,872
3.	Zgharta	60,981	60.2	101,297
	Total	-	-	**313,570**

1.3.3.3. Approach No 3: Population as per North Lebanon Water Authority

This approach consists of Population database reported in the Water Supply Master Plan study for North Lebanon, an EU funded project managed by the North Lebanon Water Authority and executed by the Consultant Khatib & Alami in November 2016.

As far as the Zgharta & Koura Districts, the study has comprehensively analyzed the population in all the municipalities on the basis of the following:

- Number of households reported by the municipalities and villages during filed surveys carried out by the project team;
- Average family size in Lebanon as reported by CAS (4.8 individuals).

For Bsharre District, on the other hand, the population was estimated using electricity and water subscribers in each zone as well as an extensive count of the housing units and the estimated number of inhabitants per housing unit.

It is to be noted that this study addressed not only the villages that have municipal councils but also all the villages of the three districts.

According to the Water Authority Master Plan, the population in the three Districts of the study area is as detailed below. The population figures are representatives of the summer season because they are based on the number of households.

Table 9. Population as reported in the North Lebanon Water Supply master plan (Khatib & Alami 2016)

No	District of Koura			District of Zgharta			District of Bsharre		
	Municipality Name		Population (2018)	Municipality Name		Population (2018)	Municipality Name		Population (2018)
	English	Arabic		English	Arabic		English	Arabic	
1.	Ras Masqa	راس مسقا	14,652	Majdalaya	مجدليا	24,420	Bane	بان	665
2.	Dedde	ددة	14,652	Haret Al Fouwar	حارة الفوار	9,768	Barhalioun	برحليون	1,276
3.	Barsa	برسا	7,204	Aalma	علما	4,884	Bazoun	بزعون	1,681
4.	En Nakhle	النخلة	7,326	Kfar dlaqous	كفردلاقوس	733	Bsharre	يشري	10,300
5.	Bkiftine	بكفتين	1,954	Arde	أردة	3,907	Bkaakafra	بقاعكفرا	1,677
6.	Btouratij	بتوراتج	10,745	Miryata	مرياتا	6,349	Bkerkasha	بقرقاشا	2,377
7.	Bsarma	بصرما	1,416	Rachaain	رشعين	4,884	Hadath Joubbe	حدث الجبة	5,470
8.	Kfar Qahel	كفرقاحل	781	Aachach	عشاش	830	Hadshit	حدشيت	4,083
9.	Aaba	عابا	108	Zgharta	زغرتا	19,536	Hasroun	حصرون	5,145
10.	Bdibba	بدبا	488	Karabach	قره باش	244	Aabdine	عبدين	2,321
11.	Batroumin	بترومين	2,188	Kfar Hata	كفرحتا	98	Qnat	قنات	1,208
12.	Fih	فيع	1,954	El Khadriye	القادرية	488	Torza	طورزا	3,951
13.	Qalhat	قلحات	2,198	Kafar Zeina	كفرزينا	977	Dimane	الديمان	734
14.	Anfeh	انفه	1,465	Bsibaal	سبعل	488	Brissat	بريسات	311
15.	Zakroun	زكرون	122	Kfar Sghab	كفرصغاب	586	Blaouza	بلوزا	823
16.	Afesdik	عفصديق	1,221	Iaal	ايعال	195	Beit Mounzer	بيت منذر	457
17.	Btirram	بطرام	2,540	Sakhra	صخرة	244	Dahr Baazekta	ضهر بعزقتا	854
18.	Bechmizzine	بشمزين	3,907	Miziara	مزيارة	9,768	Qnaiouer	قنيور	440
19.	Amioun	اميون	4,884	Bnichaai	بنشعي	488	Wadi Qannoubine	وادي قنوبين	21
20.	Kfar Akka	كعرعقا	3,175	Aarjess	عرجس	752	Bella	بيلا	802
21.	Kousba	كوسبا	6,838	Bchannine	بشنين	586	Chira	شيرا	209
22.	Rishdibbine	رشدبين	977	Darayia	دارايا	733	Deir Mar	دير مار	687

No	District of Koura			District of Zgharta			District of Bsharre		
	Municipality Name		Population (2018)	Municipality Name		Population (2018)	Municipality Name		Population (2018)
	English	Arabic		English	Arabic		English	Arabic	
							Alisha	اليشع	
23.	Ayn Ikrin	عين عكرين	1,123	Raskifa	راس كيفا	342	El Arz	الارز	1,002
24.	Kfar Saroun	كفرصارون	2,686	Kfar Fou	كفرفو	1,074	Bnahle	بنحلي	516
25.	Mitrite	متريت	366	Karm Sadde	كرم سده	830	Metrtit	متريت	1,259
26.	Bziza	بزيزا	1,954	Sebeel	سبعل	2,002			
27.	Dar Bishtar	دار بعشتار	3,419	Aitou	ايطو	733			
28.	Kaftoun	كفتون	488	Mazraat Et Toufah	مزرعة التفاح	635			
29.	Dar Shmizzin	دار شمزين	366	Toula	تولا-أسلوت	537			
30.	Btaaboura	بتعبورة	733	Bouhairet	بحيرة	244			
31.	Ijdabrine	اجد عبرين	366	Baslouqit	بسلوقيت	586			
32.	Kfirhata	كفرحاتا	1,821	Ehden	اهدن	5,861			
33.	Kfarhazir	كفر حازير	3,907	Ain Tourine	عينطورين	415			
34.	Bidnayel	بدنايل	698	Aarbet Qozhaiya	عربة قزحيا	562			
35.	Kifraiya	كفريا	1,617	Seraal	سرعل	503			
36.	Mejdel	مجدل	537	Kfar Sghab	كفرصغاب	2,369			
37.	Oueta Fares	وطى فارس	122	Aardat	عردات	586			
38.	Dahr El Ain	ضهر العين	14,652	Hilan	حلان	1,563			
39.	Akbet Bkiftine	عقبة بكفتين	977	Et Talle	التل	488			
40.	Balamand	بلمند	366	Kfar Haoura	كفرحورا	1,221			
41.	Hreiche	حريش	122	Mazreet Ejbeaa	مزرعة الجباع	122			
42.	Barghoun	برغون	488	Asnoun	اصنون	366			
43.	Bdeihoun	بديهون	147	Harik Zgharta	حارة زغرتا	147			
44.	Bnehrane	نبهنار	488	Mazreet Jnaid	مزرعة جنيد	176			
45.	Kilbata	كلباتا	244	Jdeide	جديدة	244			
46.	Zgarta El Mtoule	زغرتا المتولة	195	Kfar Chakhna	كفرشخنا	171			
47.	Bahbouch	بحبوش	635	Kfar Yachit	كفرياشيت	371			
48.				Ejbeaa	اجبع	977			
49.				Haouqa	حوقا	764			
50.	**Total Koura**		**127,089**	**Total Zgharta**		**112,874**	**Total Bsharre**		**47,438**

1.3.3.4. Comparison of Approaches & Conclusions

The below table summarizes the population counts resulting from the above presented approaches:

Table 10. Estimated population for the three approaches

No	Approach	Basis of Population estimation	District	Study Area Estimated Population	
				Summer	Winter
1.	Approach No 1	Population of the various districts based on the interviews held with the Union of Municipalities and the individual municipalities	Bsharre	21,480	8,410
			Koura	95,650	83,480
			Zgharta	84,680	76,072
			Total	**201,810**	**167,962**
2.	Approach No 2	Using the MoIM official number of registered voters for the elections (i.e. the population above the age of 21) and extrapolating the total population on the basis of the recent statistics of CAS for the population age distribution	Bsharre	82,400	-
			Koura	129,872	-
			Zgharta	101,297	-
			Total	**313,570**	-
3.	Approach No 3	Population data reported in the North Lebanon Water Authority Water Supply Master Plan for North Lebanon, an EU funded study prepared in November 2016.	Bsharre	47,438	-
			Koura	127,089	-
			Zgharta	112,874	-
			Total	**287,401**	-

It is to be noted though that each of the above approaches is associated with uncertainties that could not be avoided. The latter are summarized below for each of the adopted approaches:

Table 11. Uncertainties associated with the population estimation approaches

No	Approach	Uncertainties
1.	Approach No 1	- The numbers given by the heads of municipalities are sometimes a bit exaggerated and/or subjective. - Not all municipalities responded to the questionnaire.
3.	Approach No 3	- CAS statistics for the population age distribution is based on a sample of the population in 2007 and might not be representative of the current status - The Ministry of Interior and municipalities records of voters residing in Lebanon might not be very accurate.
4.	Approach No 3	- The study used here adopts the realistic approach of deducting the population from field surveys, water company bills, and electricity bills. - The uncertainty associated with the water and electricity bills is minimal compared to the other approaches.

Approach 1 could not be adopted because not all municipalities responded to the questionnaire prepared by the project team and/or responded to the phone calls/request for meetings initiated by the team. Indeed, data could not be obtained from 12 municipalities out of the 81 municipalities of the study area, i.e. the equivalent of 15%. In addition there are some villages that do not municipal councils.

As for Approaches 2 and 3, they lead to very similar results in terms of total population of the study area with a difference not exceeding the 10%. However, the distribution of the total population amongst the three districts is not the same especially for Bsharre District (see below figures).

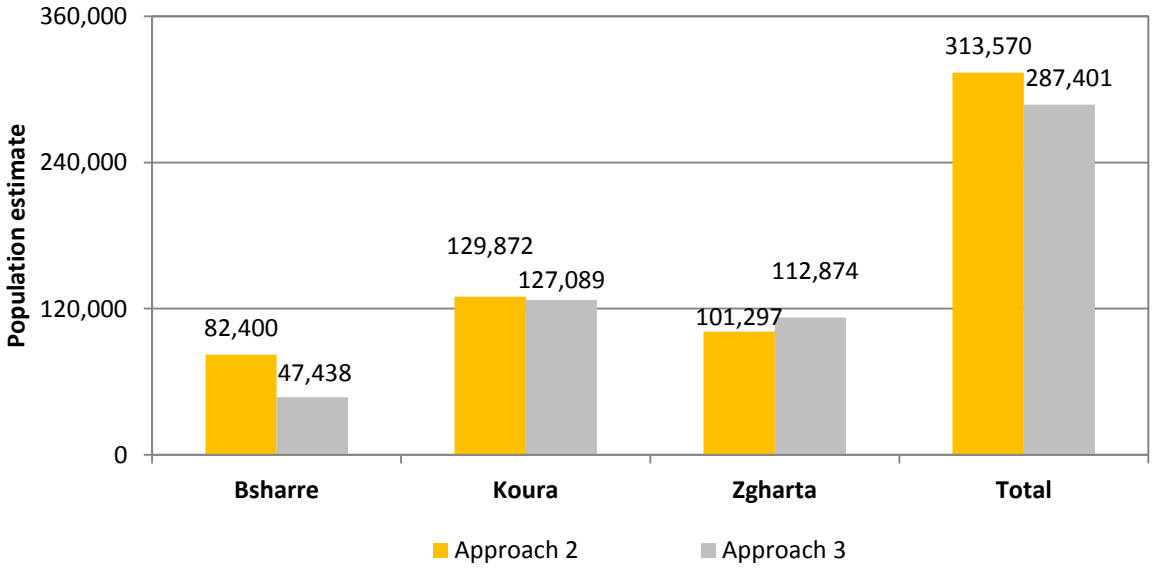


Figure 14. Approach 2 versus Approach 3

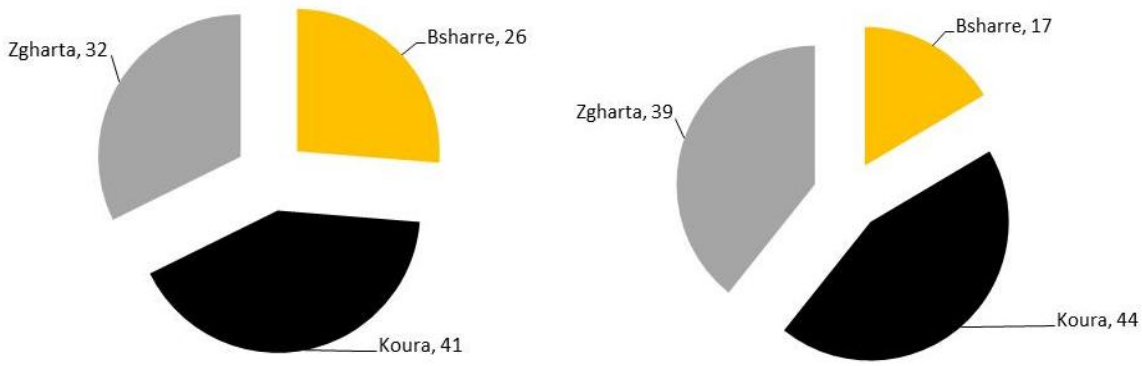


Figure 15. Population distribution between the three districts

Both approaches 1 and 2 are based on outdated statistics by CAS:

- Population age distribution for Approach 2
- Average family size for Approach 3

The uncertainties associated with the parameters leading to the population count in Approach no 2 are more significant than those of Approach 3. Accordingly, the Consultant will adopt the outcome of Approach 3, i.e. a total population of the order of **295,000 during the summer season**.

As for the summer winter variation and as per the data made available by the municipalities, the percentage increase in the population during the summer season ranges between a minimum of 0% and a maximum that is as high as exceeding 400% (see below chart). Indeed, a significant percentage of the population in the study area resides outside the District (mainly in Beirut) for work and come back during the summer season to their home towns.

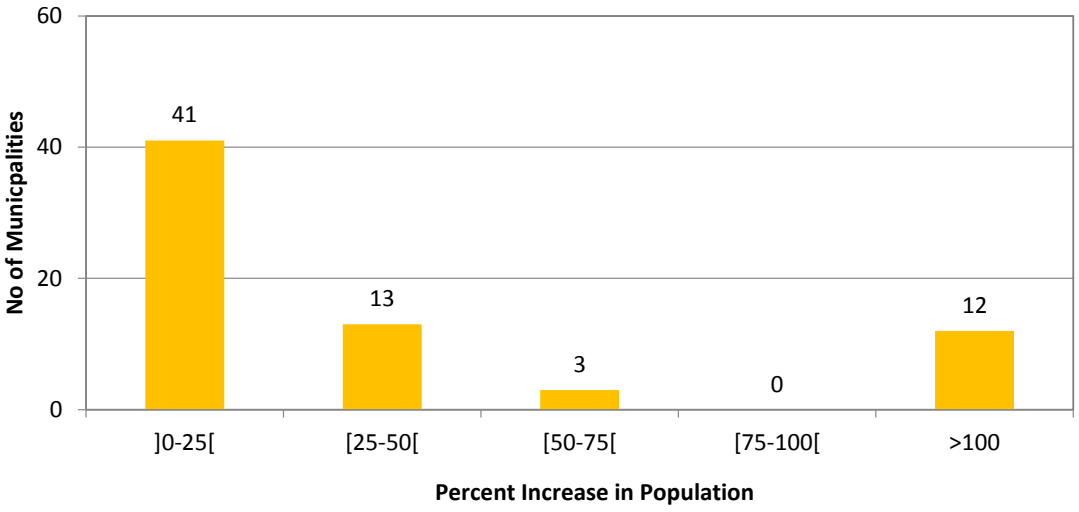


Figure 16. Percent increase in population during the summer season as reported by the municipalities

The total population of the study area increases by 22% during summer season.

Therefore the total population in the study area is **240,000 during the winter season and 295,000 during the summer season**.

1.3.4. Palestinian Refugees

According to the UNHCR (2016), there are currently over 504,000 Palestine Refugees registered by UNRWA in Lebanon. Nevertheless, it is expected that many of them are no longer present in the country; estimations are such that only 260,000 to 280,000 remain in Lebanon.

In the study area, as seen in the figure below, there are no Palestinian camps or gatherings. Based on the OCHA report (2016), there are 0 Palestinian refugees in the Districts of Bsharre, Koura and Zgharta. Indeed this was confirmed during the meetings with the heads of municipalities who did not report cases of Palestinian refugees residing in their villages.

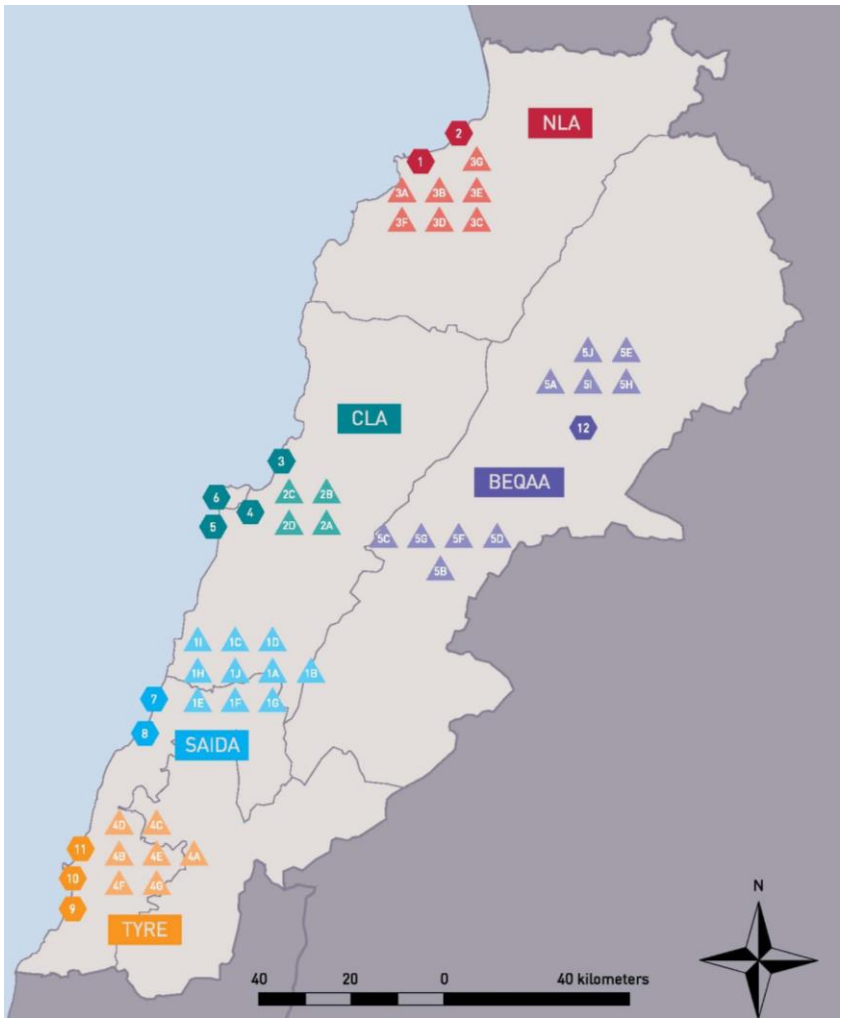


Figure 17. Palestinian Refugees geographic distribution in Lebanon (Chaaban et al., 2016)

1.3.5. Syrian Refugees

According to the North & Akkar Governorates Profile published by OCHA (2016), the number of registered Syrians in the study area sums up to around 31,600 refugees. More recent database was published by UNHCR where the number of registered Syrian Refugees in the study area is reported to be of the order of 33,000 as of January 2018. The distribution of the registered Syrians between the three districts is as summarized in the below table and illustrated in the following map:

Table 12. Distribution of Syrian refugees in the districts of the study area

No	District	No of Registered Syrians	
		OCHA 2016	UNHCR 2018
1.	Bsharre	2,848	2,094
2.	Koura	16,306	15,726
3.	Zgharta	12,438	15,045
4.	**Total**	**31,592**	**32,865**

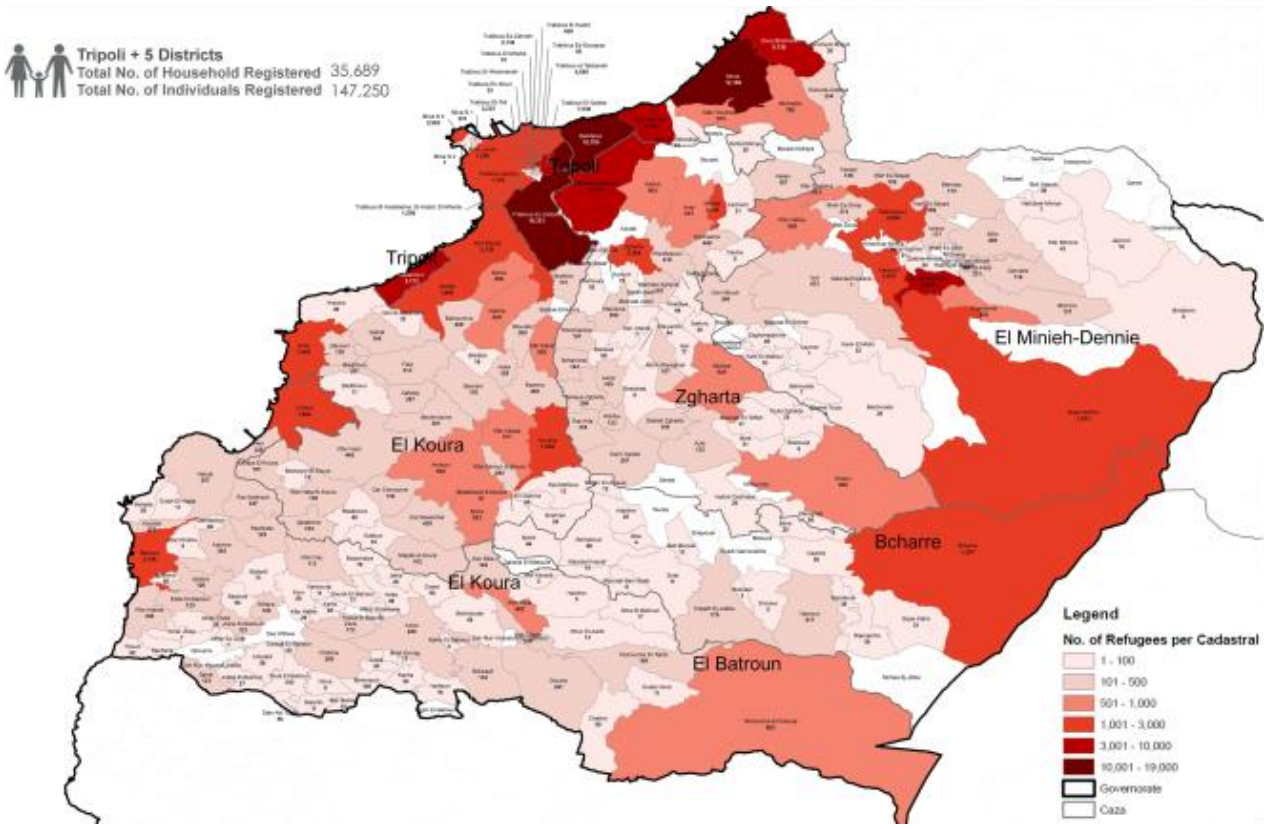


Figure 18. Distribution of the registered Syrian refugees at the cadastral level

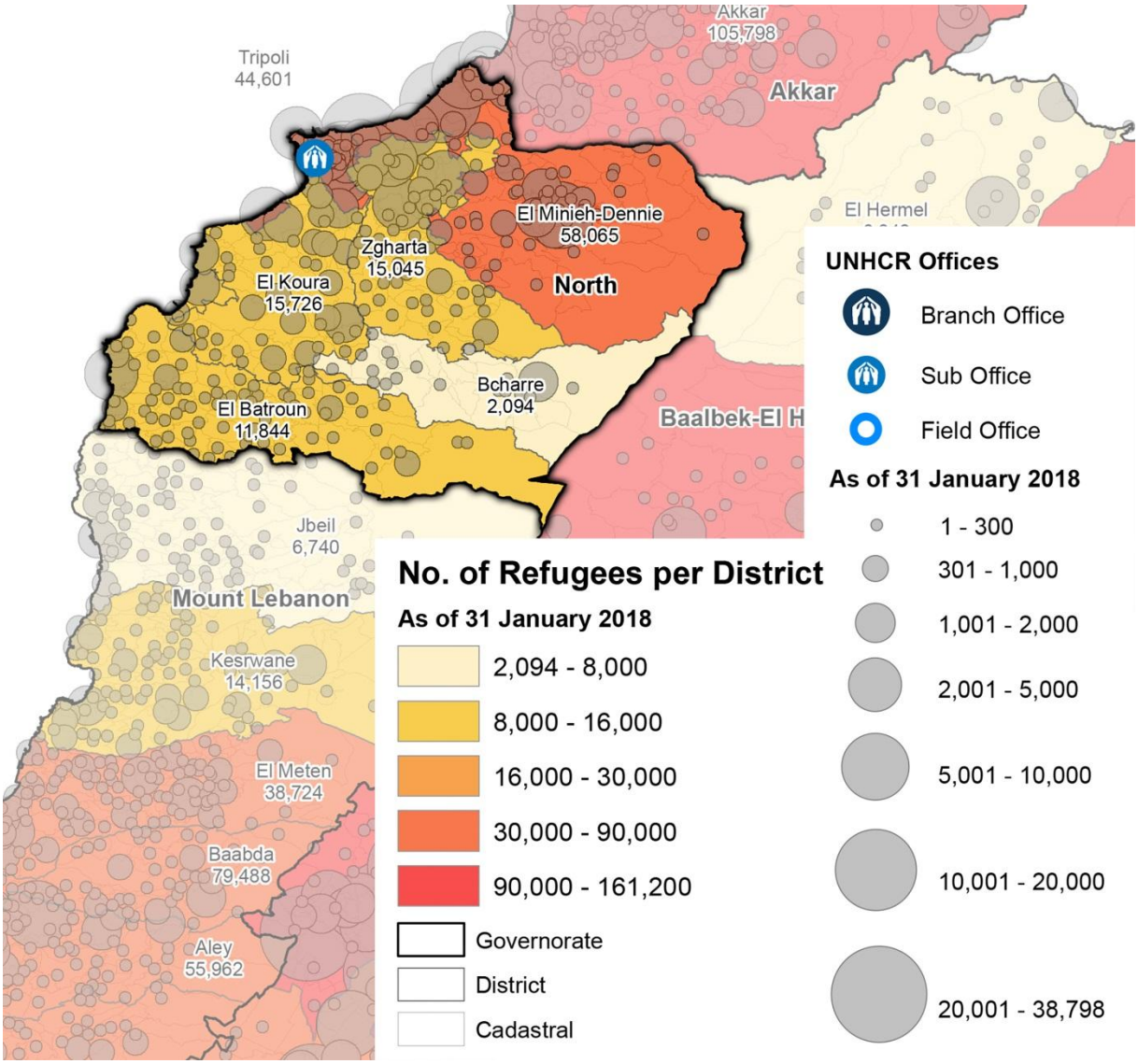


Figure 19. Syrian Refugees in the study area

As for the informal settlements, there are 122 informal settlements in north Lebanon housing some 9,419 Syrians. None of these settlements can be seen in Bsharre. Few are in Zghharta and more in Koura (OCHA, 2016) (See below Figure).

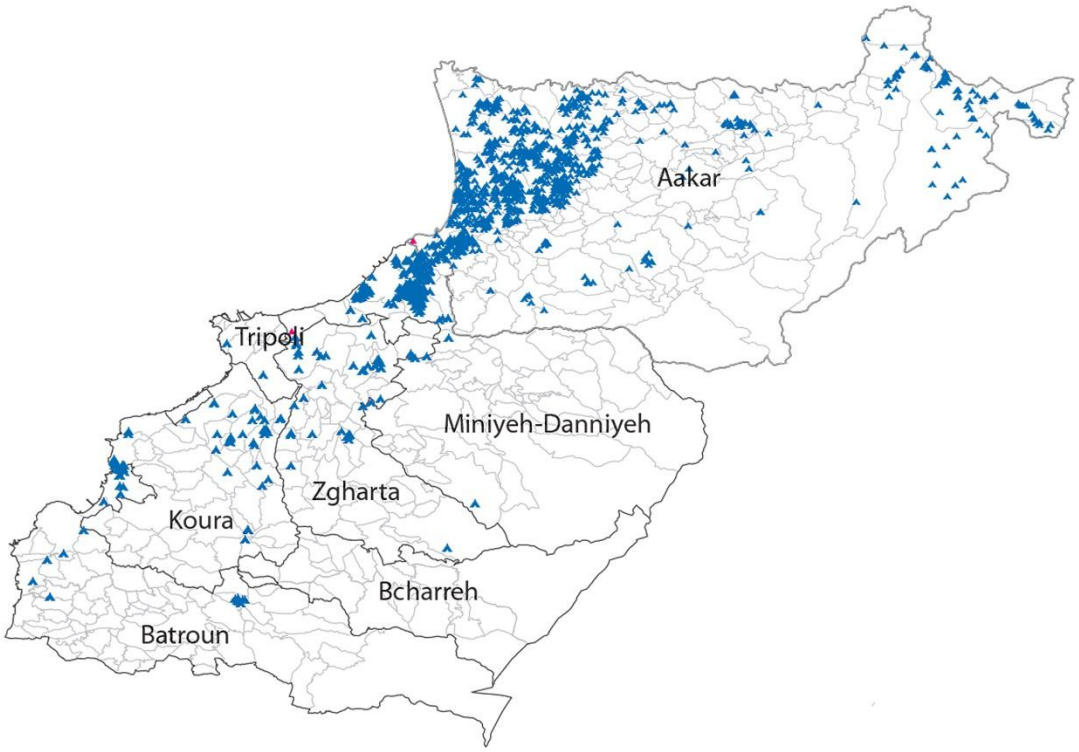


Figure 20. Informal Settlements in the North region

Based on the interviews held with the heads of municipalities in the study area, the following information was obtained in terms of the Syrian refugees' counts:

Table 13. Syrian refugees counts as reported by the Heads of Municipalities

No	Municipality	Reported Syrian Refugees
Municipalities of Koura		
1.	Fee3	500
2.	Qalhat	400
3.	Kaftoun	45
4.	Kfar Qahel	50
5.	Kfar Hata	550
6.	Kfar Hazeer	1,200
7.	Kfar Saroun	589
8.	Kfar Aqqa	1,000
9.	Kifraya	350
10.	Kosba	1,200
11.	Metreet	200
12.	Majdel - Zakzouk - Wata Fares	400

No	Municipality	Reported Syrian Refugees
13.	Nakhle	2,500
14.	Amyoun	1,500
15.	Anfeh	
16.	Ajd Ebreen	400
17.	Bkifteen	400
18.	Btouratej	3,000
19.	betroumin	250
20.	bte3boura	160
21.	behwayta - Afqa - bechnata	
22.	Bednayel	70
23.	Bdebba	25
24.	Bersa	
25.	Bzeeza	600
26.	Bshemzeen	300
27.	Bserma	500
28.	Botram	
29.	Dar B3eshtar	1,000
30.	Dar Shemzeen	150
31.	Dede	4,000
32.	Dechdebbine	90
33.	Ras Masqa	5,000
34.	Reshdebbine	100
35.	Zekroun	250
36.	afsadeek	300
37.	Ain Ekreen	200
38.	Abba	100
	Sub-Total 1	**27,379**
Municipalities of Bsharre		
39.	Qnat	30
40.	Bqaa Kafra	
41.	Bqar Qasha	30
42.	Ban	
43.	Barhalyoun	0
44.	Bez3oun	70
45.	Bcharre	
46.	Hadath El Jebbeh	169
47.	Hadchit	0
48.	Hasroun	500
49.	Torza	
50.	Abdine	
	Sub – TOTAL 2	**799**
Municipalities of Zgharta		
51.	Kfar Sghab	250
52.	Qorah Bash	0
53.	Kfar Fu	180

No	Municipality	Reported Syrian Refugees
54.	Kfar Yachit - Bsebaal	200
55.	Kfar Hatta	
56.	Kfar Dlaqous	1500
57.	Kfar Zeina	300
58.	Karm Saddeh	250
59.	Majdlayya (Zgharta)	3500
60.	Maryata - Qadreyyah	4000
61.	Mezyara - Harf - Hmeis - Sakhra	0
62.	Mazraat Teffah	40-45
63.	Aytou	45
64.	Eaal	250
65.	Arde	700
66.	Bneshay	0
67.	Buheira (Zgharta)	15
68.	Bsaloukit	0
69.	Toula-Aslot	
70.	Haret Al Fouar	3000
71.	Daraya-Bshennin	
72.	Rass Kifa	120
73.	Rasheen	1300
74.	Zgharta - Ehden	3200
75.	Seb'el	75
76.	Ser'el	0
77.	Alma	500
78.	Ain Tourin	0
79.	Arabet Kizhaya	0
80.	Arjes	260
81.	Ashash	25
	Sub-TOTAL 3	**19,670**
	GRAND TOTAL	**47,848**

Apparently, the number of Syrian refugees residing in the Districts of the study area is higher than what is officially reported by the UNHCR. For the sake of this study, we will assume **55,000 Syrian refugees** (reported number +15% to account for the municipalities for which no data could be collected).

1.3.6. Total Population in the Districts of Bsharre, Koura & Zgharta

Based on the analysis presented above, the total population of the study area is as summarized below:

Table 14. Total Population in Nabatieh District

No	Population Category	Number	Notes
1.	Lebanese Citizens	240,000	Winter Season
		295,000	Summer Season
2.	Syrian Refugees	55,000	UNHCR + Municipalities
3.	Palestinian Refugees	0	OCHA + Municipalities
4.	**Total Population**	**295,000**	**Winter Season**
		350,0000	**Summer Season**

1.3.7. Future Population Growth

The population growth rate in North Lebanon is around 1.75 per cent as reported by the water supply master plan study prepared by North Lebanon Water Authority. No other recent data is available in order to get new future population growth rates.

Taking the summer and winter Lebanese population on their own, and considering an average growth rate of 1.75% while keeping Syrian and Palestinian numbers stable, the following graph represents the estimation growth rate until 2027.

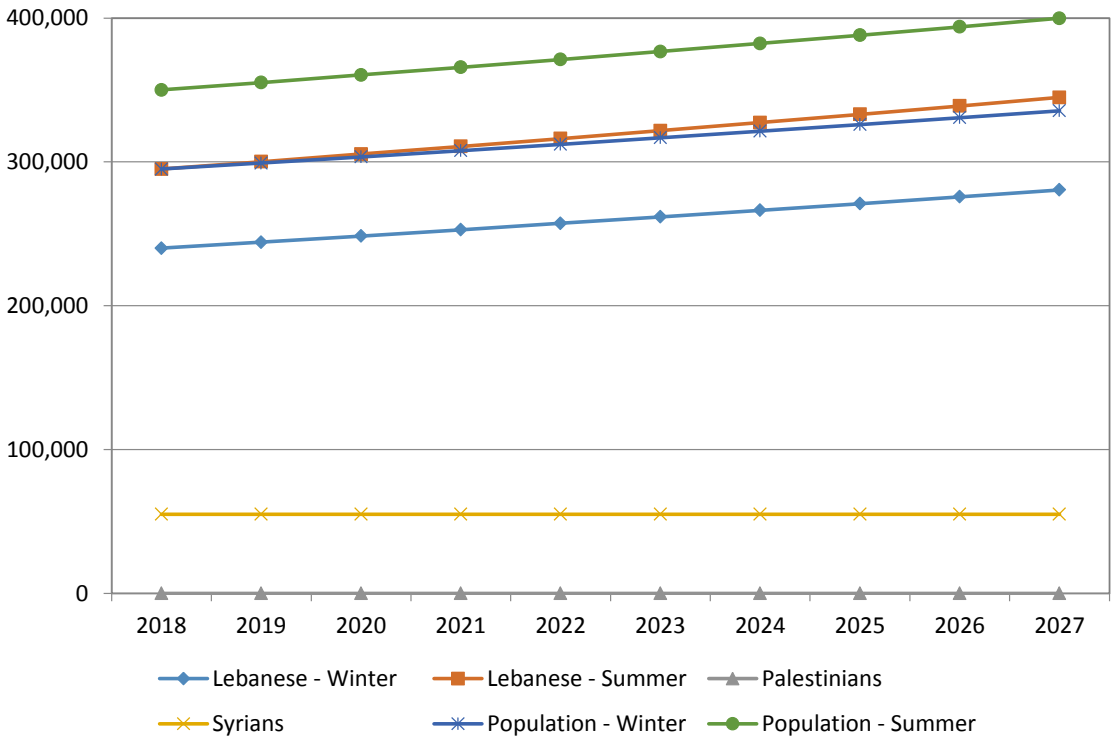


Figure 21. Estimation of Population in the study area

1.4. Natural, Cultural and Archeological Characteristics of the Study Area

The Governorate holds many touristic attractions as shown in the following figure.

Figure 22. Map of North Lebanon Touristic Attractions (IDAL, 2018)

In fact, the Governorate holds 153 natural and eco-touristic attractions, 101 of them are present in Bcharreh, Zgharta, Koura and Batroun Districts and are summarized in the following table.

Table 15. Attractions in North Lebanon Governorate (IDAL, 2018)

District	Attractions	Number of sites
Bcharreh & Zgharta	▪ Wadi Qadisha ▪ Deir Saydet Qannoubin ▪ Monastery of Saint Eliseus ▪ Monastery of Saint Serjurs ▪ Monastery of the Cross ▪ El Baher Mosque ▪ Barbar Moseque in l'al ▪ Ain El Jami prayer hall	55
Koura & Batroun	▪ Churches of Amioun ▪ Monastery of our Lady of Hammatoura-Kousba ▪ Deir Balamand ▪ Churches of Anfeh ▪ The Covent of Virgin Mary – Keftoun ▪ Bechmezzine Mosque ▪ Barbar Mosque in l'al	48

Many monuments and natural attractions are distributed in the villages of the different Districts. Some of the touristic attractions from each district are summarized in the table below.

Table 16. Natural Attractions and Monuments in North Lebanon Governorate (tourism-lebanon)

City	Monuments	Natural Attractions	Recreation
KOURA			
AMIOUN	▪ Mar Ghala Church ▪ Mar Gerges Al-Kefer Monastery ▪ Remains of an Old Mill ▪ Mar Doumit Monastery ▪ Old Well ▪ Saint Barbara Church ▪ Mar Geaorgios Al-Dahaliz Cathedral ▪ Mar Fawqa Church ▪ Ancient Tower ▪ Al-Saydeh Church ▪ Mar Sema'an Church ▪ Mar Sarkis Monastery ▪ Old Town holds Heritage Houses and Olive Presses ▪ Mar Youhanna Al-Chir Monastery with Cemeteries and Hermitages Carved into Rocks ▪ Al-Na'oura ▪ Serail ▪ Marina Church with Caves ▪ Carved into Rocks	▪ Al Hayat Tree, a very old rock with inscriptions ▪ Perennial Olive trees and woods	▪ Artisana Al-Koura Atelier ▪ Oil and Soap Plant
ANFEH	▪ Al-Natour Convent ▪ Olive Press ▪ Saydet Al-Rih Church ▪ Phoenician Citadel ▪ Saint Catherina Church ▪ Old Village holds Heritage Houses and Ancient Oil Presses ▪ Old Souk ▪ Mar Youhanna Monastery ▪ Al-Ghir Hill ▪ Al-Banat School ▪ Mar Sema'an & Mar Mikhael Church ▪ Mar Antonios Hill	▪ Al-Ghir Cave ▪ Anfeh Spring inside the Cave ▪ Al-Hamam Cave	▪ Marina del Sol Beach ▪ Las Salinas Beach
BCHARREH			
BEQA'A KAFRA	▪ Mar Houchab Ancient Church ▪ Al-Saydeh Cave ▪ Mar Saba Church ▪ Saint Charbel Church	▪ Bridge holds several Springs & deep Caves	▪

City	Monuments	Natural Attractions	Recreation
	▪ Saint Charbel House ▪ Al-Saydeh Church's Square ▪ Mar Charbel Square		
BCHARREH	▪ Mar Sarkis Monastery Jibran's Cemetery & Museum ▪ Remains of Phoenician Vestiges ▪ Jibran's House ▪ Mar Alicha'a Monastery ▪ Qadisha Electricity Company ▪ Remains of the British Army's Stables ▪ Teleferique dating back to 1950 ▪ The French Room ▪ Old Mill ▪ Mar Nohra Church	▪ Cedars Forest ▪ Qornet Al-Sawda ▪ Qadisha Cave ▪ Saydet Lourdes Cave ▪ Qadisha Valley ▪ Skiing and Paragliding Area ▪ Dahr Al-Qadib ▪ Mar Sema'an Spring ▪ Al-Nasimeh or A'aychana Farm ▪ Mar Sarkis Wood ▪ Qadisha River ▪ Nbat River Cascades ▪ Bnahli Area, Apple Gardens ▪ Qammou'h Bcharre	▪ Artisana Souk ▪ Horseback Riding Club
ZGHARTA			
EHDEN	▪ Saydet Al Hosn-Church ▪ Al-Midan, the Old Souk ▪ Mart Moura Monastery ▪ Mar Sarkis Monastery ▪ Qozhayya Ancient Monastery ▪ Yammine Old Mill ▪ Mar Ya'acoub Monastery ▪ Mar Boutros Church ▪ Saydet Al-Hara Church	▪ Pine Woods ▪ Mar Estephan Spring ▪ Cave ▪ Ain Al-Fawwar ▪ Ain Mar Sarkis ▪ Ain Roumeh ▪ Ehden Wood Reserve ▪ Soua'in Spring	
ZGHARTA	▪ Saydet Zgharta Church ▪ Filles De La Charité Monastery ▪ Saydet Barbara ▪ Remains of Old Ruins ▪ Mar Youssef ▪ Antonine Sisters Monastery ▪ Old Souk ▪ Old Mill ▪ Old Press		

Figure 23. Wadi Qadisha in Bcharreh District

Figure 24. Anfeh – Al Koura District

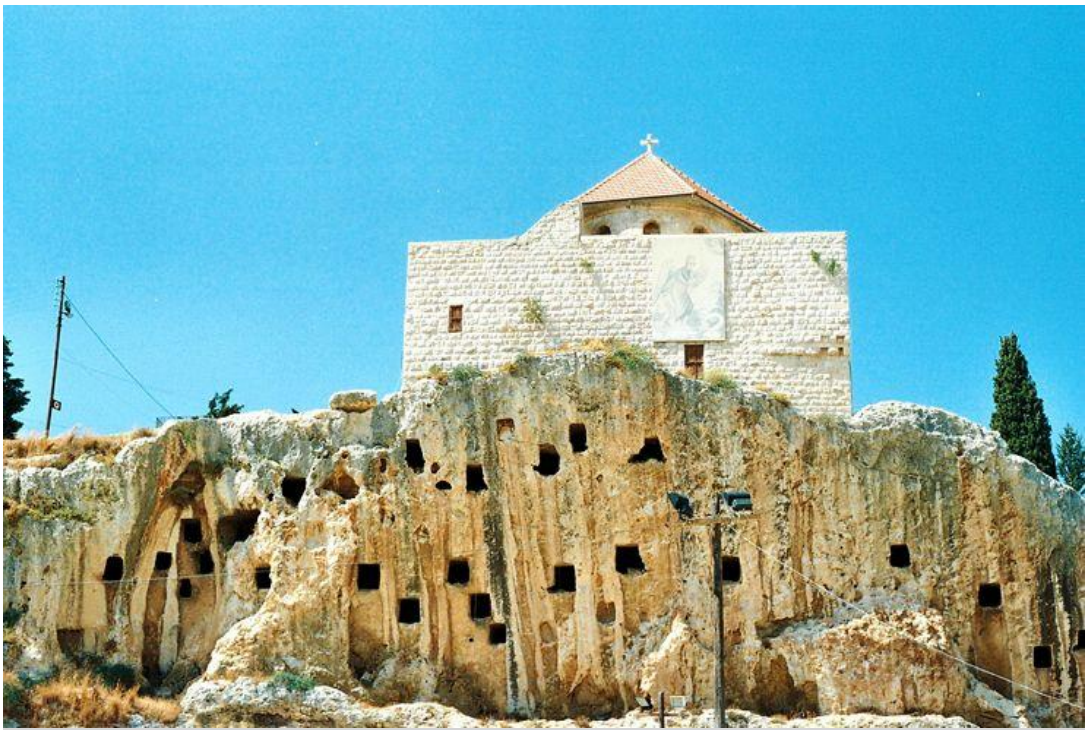


Figure 25. Church in Amioun – Koura District

Figure 26. Horsh Ehden – Zgharta District

1.5. Economic activities

The North Lebanon Governorate is services-oriented, with industry and agriculture forming 14% and 11% respectively of the total labor force, as shown in the following figure.

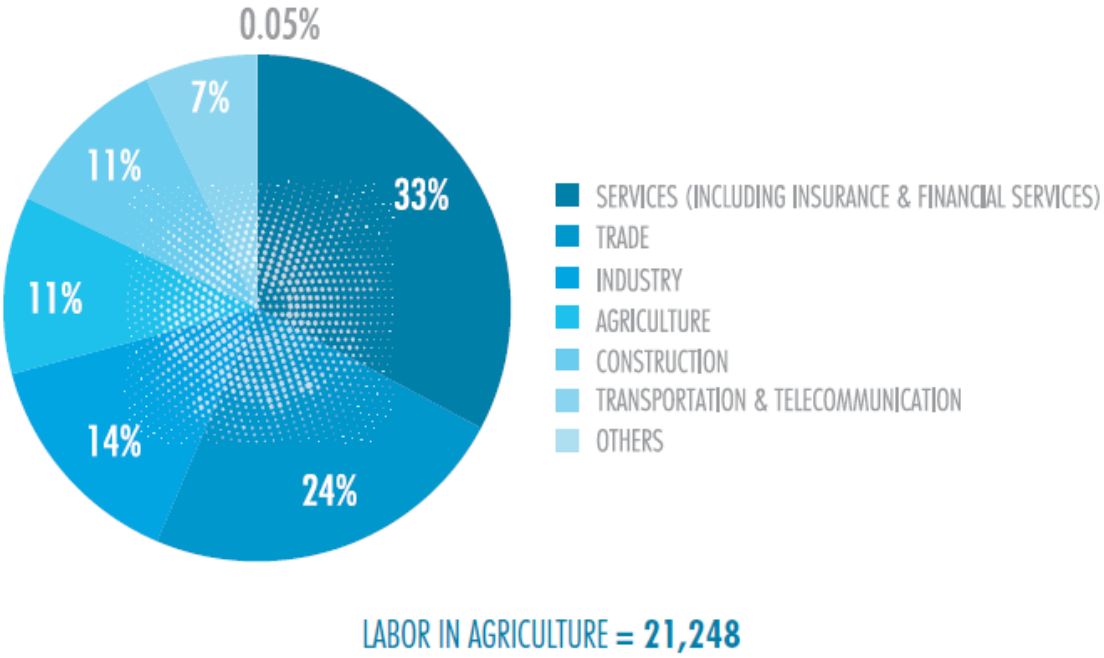


Figure 27. Distribution of Labor force by activity in North Lebanon (IDAL, 2018)

The Governorate is characterized by the different economic activities that are described below which are assumed to be representatives of the activities taking place at the level of the individual districts constituting the governorate and more specifically the study area (considering a top-down approach).

1.5.1. Agriculture

Based on the "INVESTMENT OPPORTUNITIES IN NORTH LEBANON", a document prepared by IDAL in 2018, the agricultural area in North Lebanon Governorate constitutes 15% of the whole area, with a decreasing quality of soil as moving inland.

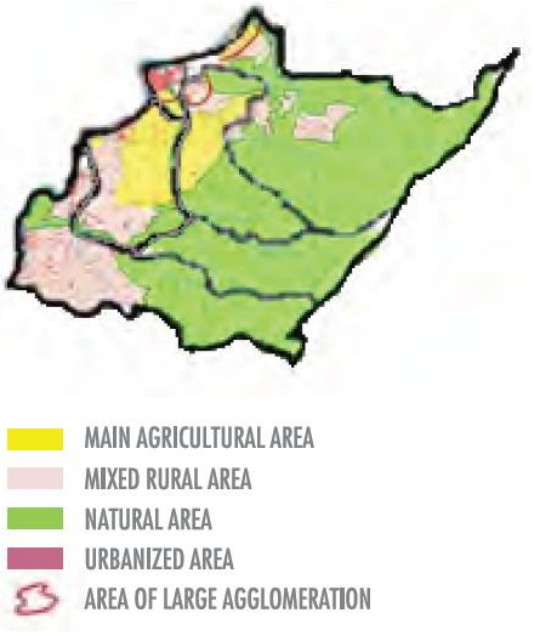


Figure 28. Land use map of North Lebanon Governorate

Cultivation of olive trees is the most prominent in the Governorate. In fact, 62% of the cultivated lands are dedicated for olive trees cultivation. The distribution of the cultivated land per produced is represented in the following chart.

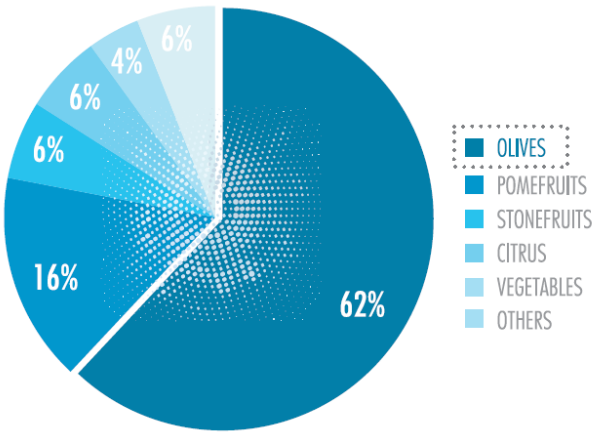


Figure 29. North Lebanon cultivated land per produce (IDAL, 2018; MoA)

North Lebanon is known for its olive trees that constitute 50% of Lebanon's, which is actually the highest concentration in the Country – 274 olive mills in the Governorate. It also holds 51% of olive mills that operate in the country. 34% of olive oil exports are present in North Lebanon.

This was furthered discussed during the meeting with the heads of municipalities that shared their concerns about the waste coming out of the mills.

1.5.2. Industry

According to the Ministry of Industry, the North Lebanon Governorate comprises 444 industrial firms, of which 78 are in Zgharta District, 72 in Koura District and 1 in Bcharreh District.

This Governorate encompasses 10.58% of total Lebanese industrial firms. The majority operates in the food and beverages sector, constituting 21.15% of industrial firms in the governorate. The rest are shown in the table below, according to the Directory of Exports and Industrial Firms in Lebanon (2015-2016).

Table 17. Establishments by type in North Lebanon Governorate

Industrial Sectors	Percent Distribution (%)
Food and Beverage	21.15
Non-mineral mining products	8.21
Chemical Industries	5.54
Leather, Leather products and Footwear Industries	1.23
Wood Products Industries	5.34
Paper Products and Printing	6.57
Textile	7.59
Metal Products	13.96
Machinery and Electrical Appliances	2.46
Furniture	26.28
Transport Machinery and Equipment	1.44
Jewelry, Precious Stones & Equipment	0.23
Total	**100**

1.5.2.1. Summary of the Competitive Advantages in North Governorate

The following table summarizes the competitive advantages of the Governorate as per the IDAL study (2018): “Investment Opportunities in North Lebanon”.

Table 18. Summary of Advantages in North Lebanon

Access to Resources	Access to Human Capital	Access to Markets	Access to Finance
▪ **Natural Resources:** - 3 rivers and fertile land on the cost - 41% of Lebanon's olive groves ▪ **Economic Activities:** - 41% of Lebanon's olive groves - 19% of total production of furniture in Lebanon - 30% of industries related to F&B	▪ **Technical and Vocational Schools:** 32% of the countries vocational schools and 3 entrepreneurship programs ▪ **Universities:** 18 private universities offering business & law, and engineering programs ▪ **Labor pool:** 2nd largest in the country	▪ **Infrastructure:** access to the second largest seaport in addition to infrastructure and logistics projects to enhance access to international markets ▪ **Exports:** 28% of Lebanese fruits and vegetables exported from North Lebanon	▪ **Financing:** 3rd largest share of kafalat loans

1.6. Accessibility & Roads Network

Accessibility to the three Districts is shown in the following figures.

Figure 30. Roads leading to Zgharta District

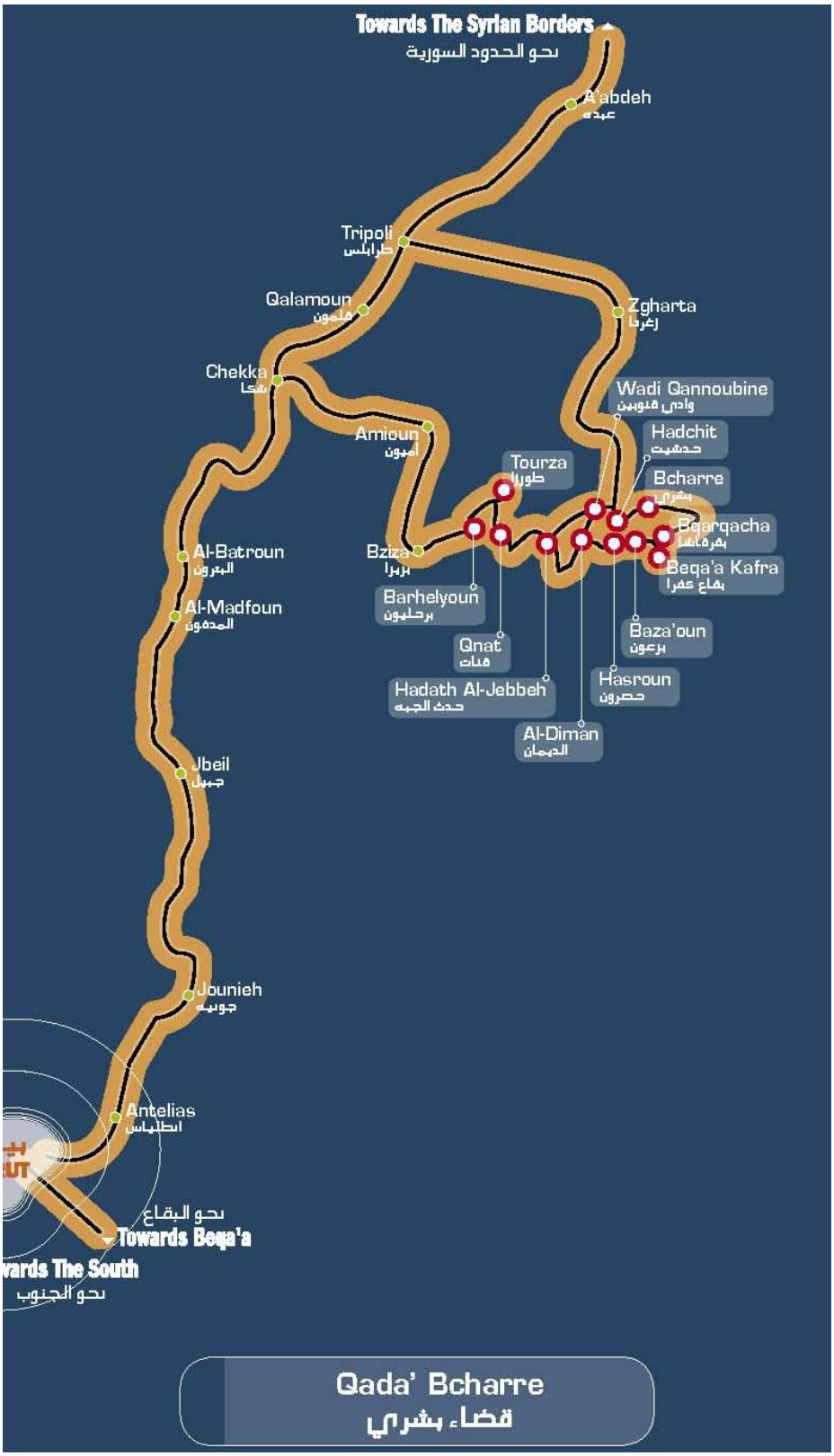


Figure 31. Roads Leading to Bcharre District

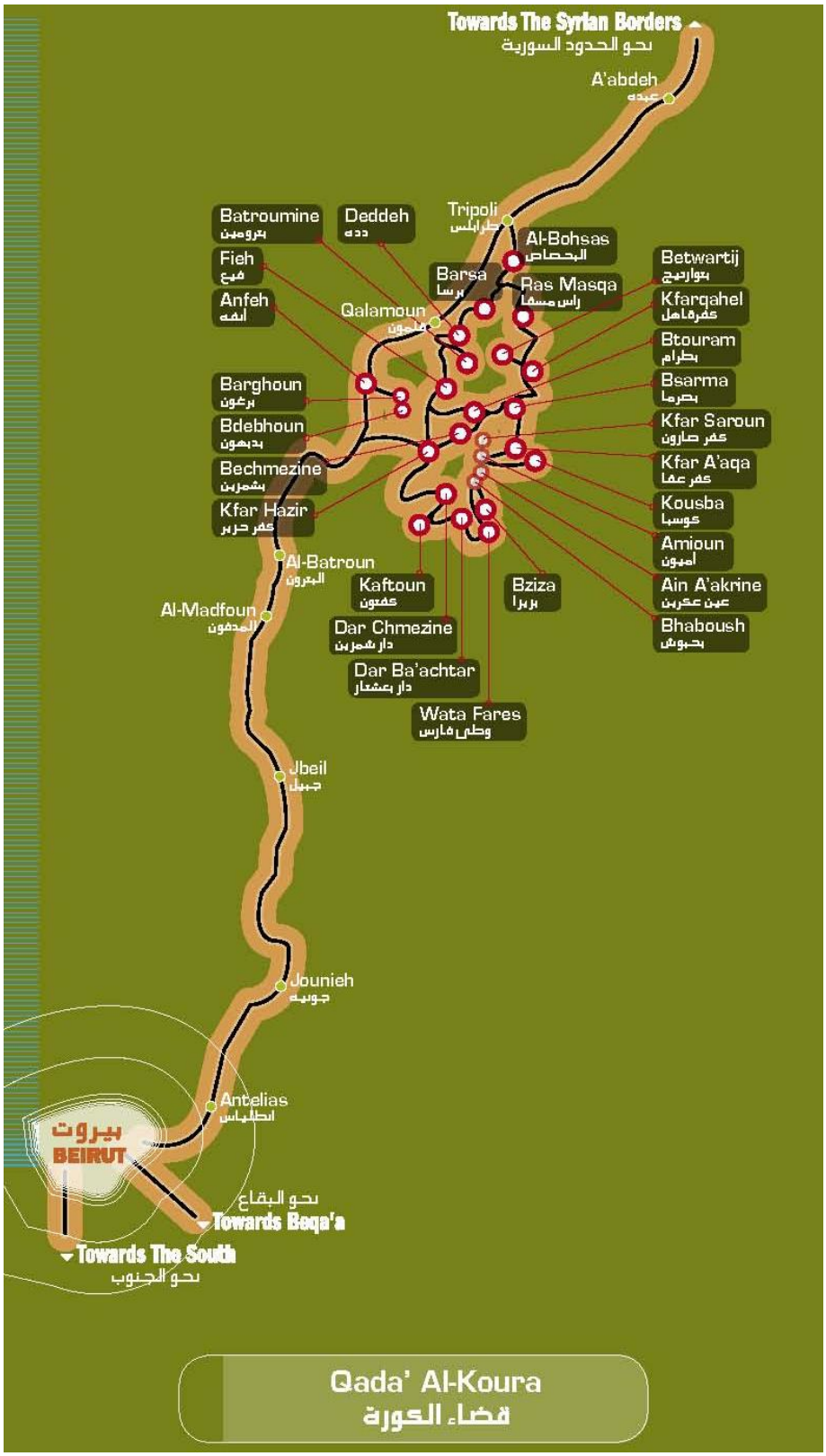


Figure 32. Roads leading to Koura District

2. MSWM Practices in the Districts of Bsharre, Koura & Zgharta

This section of the report provides a brief yet comprehensive overview of the different aspects of the current status of solid waste management in the districts of Bsharre, Koura and Zgharta. It addresses such features as waste sources, types, composition, quantities, collection & recycling schemes, current management practices and associated tariffs, etc. The data presented in this section is of fundamental concern for planning an ISWM plan.

The waste management practices addressed in this report include the whole lifecycle of the municipal solid waste from generation at the source until ultimate disposal. The analysis of the system will be included in a separate section.

2.1. Stakeholder Analysis & Institutional Arrangement

This analysis aims at identifying the key stakeholders involved in the solid waste management practices in the study area and who are expected to influence the implementation of the anticipated waste management plan.

The intention is to further involve these stakeholders during the planning and implementation stages of the proposed plan to maximize the chances of meeting the objectives of the master plan.

The Districts of Bsharre, Koura and Zgharta have a number of key stakeholders, which are briefly described below.

Table 19. List of key stakeholders involved in waste management in the study area

No	Group	Stakeholder	Description
1.	Local Institutions	Union of Zgharta Municipalities	It is one of the main stakeholders in the union of Zgharta Municipalities given its important and dominant role in solid waste management and implementation of sorting at source.
		Union of Koura Municipalities	The Union of Municipalities of Koura also has an important role in the management of waste especially in the context of the integrated waste management program they are planning at the moment and given the fact that they are subsidizing a recycling factory.
		Union of Bcharreh Municipalities	The Union of Municipalities of Bcharreh also has an important role in the management of waste especially in the context of the integrated waste management program they are planning at the moment.
		Municipality of Zgharta	It plays a key role in the whole District and Governorate since it is the main urban center.
		Municipality of Amioun	It plays a key role in the whole District and Governorate since it is the main urban center.

No	Group	Stakeholder	Description
		Municipality of Bcharreh	It plays a key role in the whole District and Governorate since it is the main urban center.
		Municipality of Bechmezzine	The recycling factory that is operational in Koura District is in Bechmezzine. It receives recyclables from more than 6 municipalities. Recyclables include glass, paper, plastic, and cans.
		Remaining municipalities of the three Districts	Waste collection, transportation and street sweeping activities are under the responsibility of each municipality. Some municipalities pay contractors for the collection of waste. Rare are the municipalities that hired a contractor for street sweeping. The municipalities are at the moment each responsible for their own treatment and disposal
2.	NGOs	Midan	Midan is a non-profit organization that is a key stakeholder in the environmental conservation and management sector specifically in Zgharta District.
		Mercy corps	Conducted in different areas awareness campaigns about sorting at source and provided bins and plastic bags. It also donated many equipment and truck for the sorting facility in Bechmezzine
		Rene Mawad Foundation	Helping in the sorting at source campaigns and providing some funds for that
		Other NGOs	Several NGOs in the District have been involved in public awareness campaigns related to waste management
3.	National Institutions	MoE	Through the MoE does not really influence the process, it should be involved to increase the influence as the MoE keeps the control of the nation territory
		OMSAR	It acts as both a funding agency and a policy making ministry. It develops regional plans and implements – supervises waste management projects outside Beirut and Mount Lebanon area. They have influence and interest both at national level and a local level as they are trying to shape the proper level of regionalization and the technological solutions required. In these three districts, the planned waste treatment facility in Koura is actually part of the OSMAR projects being undertaken for the upgrade of waste treatment facilities.
4.	Others	Informal Recycling Sector	These include workers and enterprises that are involved in the informal recovery of recyclables from waste, either to an intermediate processor, a broker, or a manufacturer. Their numbers increased with the Syrian crisis. Their activities are most of the time not formally organized and not recognized by the local authorities. They have very low influence but high interest. However, informal recycling is not extensive in the study area.
		Political parties	In Bcharreh District: Lebanese Forces In Zgharta District: Al Marada and Independence Movement In Koura District: Al Marada, Lebanese Forces & Syrian Social Nationalist Party
		Commercial, Industrial and Touristic Activities	Afraid of increase of taxation, if not properly consulted they can have a negative influence. They do not have real interest but are a Potential key stakeholder for waste source sorting initiative.

No	Group	Stakeholder	Description
		Contractors in charge of the collection services	This is a representative of the private sector that is active in waste management in Bcharreh, Koura and Zgharta. Driven by the profit, can have negative influence when forced to keep environmental standards or operational safety measures which need financial investments.
		The Lebanese Waste Company SARL	The Lebanese waste company is operating its own sorting facility which receives source separated recyclables from the study area
		University of Balamand	The University of Balamand is managing the Koura Biofuel Production Facility

2.2. MSW Characterization

The knowledge of the sources, types, composition and quantities of solid waste is basic to the design and subsequent operation of the functional elements associated with the management of the generated solid wastes.

2.2.1. Sources, Types and quantities of MSW

Sources of solid wastes in a community are in general directly linked and associated with the land use and zoning of the community. For the Districts of Bsharre, Koura and Zgharta, the sources and types of waste that are generated are summarized below:

Table 20. Classification of the sources and types of solid wastes

Source	Description	Types of waste
Residential	Apartments, houses, etc.	Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, tin cans, aluminum, other metals, diapers, ashes, street leaves, special wastes (bulky items, consumer electronics, white goods, batteries, oil, and tires), household hazardous wastes, bulky items
Commercial	Restaurants, malls, supermarkets, hotels, etc.	Paper, cardboard, plastics, wood, food waste, glass, metals, special waste (same as above), hazardous waste, bulky items, etc.
Touristic	Waste generated from touristic activities (resorts, hotels, rest houses, etc.) mainly during the summer season	Food wastes, paper, cardboard, plastics, glass, tin cans, aluminum, other metals, etc.
Institutional	Schools, hospitals, prisons, governmental centers, etc.	As in commercial waste
Construction	Construction sites, etc.	Wood, steel concrete, etc.

Source	Description	Types of waste
& demolition		
Municipal services	Streets sweeping, green waste from public landscaped areas, etc.	Street sweeping, landscape and tree trimmings, general waste from recreational public areas, etc.
Treatment plant sites	Water and waste water treatments facilities	Treatment plant wastes, principally composed of residual sludge
Agricultural	Field and row crops, orchards, vineyards, dairies, feedlots, farms, etc.	Spoiled food wastes, agricultural wastes, rubbish, hazardous wastes
Industrial	Construction, fabrication, light and heavy manufacturing, refineries, chemical plants, power plants, demolition, etc.	Industrial processes wastes, scrap material, etc. Non-industrial wastes including food wastes, rubbish. Ashes, demolition and construction wastes, special wastes, hazardous waste, etc.

2.2.1.1. Healthcare waste

As far as health care waste is concerned, it is to be noted that a total of ten hospitals and ten health care centers are operational in the three Districts of the study area (See below table). However the current study will only address non-hazardous fraction of waste generated within these facilities.

Table 21. Health care facilities in the Districts of Bsharre, Koura & Zgharta (MoPH, 2018)

No	Type of Health Care Facility	Name	No of beds	District
1.	Private Hospitals	Al Borji Hospital	35	Koura
		Al Koura Hospital	135	Koura
		Albert Haykal Hospital	109	Koura
		Dr. Rashed Salem Succari Hospital	-	Koura
		Mohamad Sultan Mohamad El Halabi Hospital	-	Koura
		Family Medical Center	-	Zgharta
		Hospital Al Chamal	144	Zgharta
		Hospital Saydet Zgharta	117	Zgharta
2.	Public Governmental Hospitals	Bcharreh Governmental Hospital	32	Bsharre
		Ehden Governmental Hospital	-	Zgharta
3.	Health care centers	Cedars Medical Center - Qnat	-	Bsharre
		Hassroun charity center	-	Bsharre

No	Type of Health Care Facility	Name	No of beds	District
		Bhabbouch medico social center	-	Koura
		Kosba government center	-	Koura
		Najdeh chaabieh - kfarsaroun	-	Koura
		Jihan Franjieh social development center- zgharta	-	Zgharta
		Meziara charity center	-	Zgharta
		Meriata - Kadrieh Municipality Health Center	-	Zgharta
		President Rene Mouawad Center	-	Zgharta
		Socio-Medical Center - Khaldiyeh	-	Zgharta
4.	Pharmacies	7 Pharmacies	-	Bsharre
		30 Pharmacies	-	Koura
		30 Pharmacies	-	Zgharta

For details about the classification of health care waste in Lebanon, please refer to the national baseline report.

The non-hazardous fraction of the HCW that is generated from the administration offices, the cafeteria, the kitchen of the hospital, the patient's rooms, etc. is already accounted for as part of the MSW quantities reported in other sections of this report. As for the remaining categories of HCW, the entire database related to their quantities and the treatment and disposal means are elaborated in the national baseline report.

According to the database obtained during the meetings held with the various Union of Municipalities of the study area, the infectious fraction of the HCW that is generated from the various hospitals is being collected by the Arcenciel which handles them through autoclaving technology in the IHC facility they manage in Zgharta. The project team got in touch with Arcenciel in an attempt to obtain information about the quantity of HCW that is collected from the study area. Unfortunately such database could not be obtained. However, given the number of beds of the hospitals of the study area, and assuming 60% occupancy, one would estimate a HCW quantity of the order of 16-18tons/month.

2.2.1.2. Restaurants waste

Based on brochures prepared by tourism-Lebanon for each Governorate, there are around 23 restaurants in Zgharta District, 18 in Bcharreh District, and 14 in Koura district, summing up to a total of 55 restaurants.

Restaurants are known to generate significant amounts of waste, especially organic/food waste. Usually, the amount of waste generated by a certain restaurant is directly correlated to the capacity of the restaurant in terms of either area (m^2) or number of seats. In the absence of detailed characterization of the existing restaurants, we have adopted the generation rates published by the United States Environmental Protection Agency whereby a typical restaurant produces on average 68 tons of waste per year with the following composition:

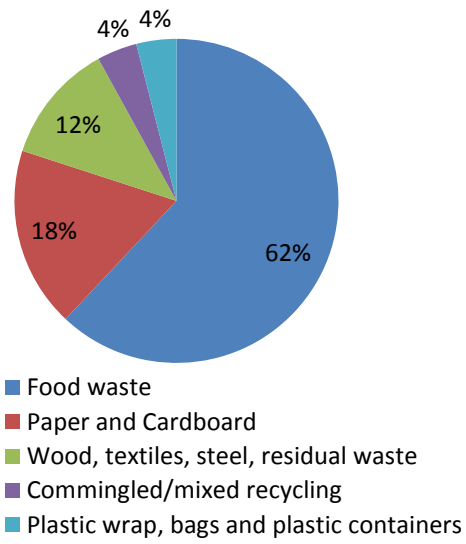


Figure 33. A typical waste composition in a restaurant as per USEPA

Considering each restaurant in the District produces 68 tons/year on average, this would sum up to a total of **3,800 tons/year of waste** produced by restaurant, of which 2,600 tons are organic in nature. This is important to note since the waste composition in Lebanon also has a high percentage of organics, making the waste management of the country integrated more easily.

2.2.1.3. E-Waste

Legal and Institutional Framework, strategies and planning, financing, collection treatment and disposal, private sector involvement, case studies, best practices and lessons learned, and upcoming initiatives factors could not be developed for electronic waste or E-waste as it was done for other type of wastes (GIZ 2014 Country report on the solid waste management in Lebanon). However, a local non-governmental organization (NGO) called Beeatoona has been involved since 2009 in collecting E-waste from various private and public institutions (GIZ, 2014). Beeatoona works on raising awareness among local communities concerning the dangers of

hazardous disposal of E-waste. They classify the types of E-waste into 4 categories (see below Table).

Table 22. Types of E-waste accepted at Collection Points (Beeatoona, 2012)

No.	Category	Description
1.	Desktop Computers and Peripherals	- Computer Monitors - Desktop Computers - Computer Speakers - Mice and Keyboards - UPS Systems
2.	Portable Devices	- Laptop Computers - Cell Phones - PDAs - Digital Cameras
3.	Network Components	- Computer Cables - Servers - Networking - Equipment
4.	Office Apparatus	- Scanners - Printers - Fax Machines - Toner/Ink Cartridges

They have allocated drop-off points for the local communities to dispose of their E-waste (Table below). Two centers are allocated in the study area (see below).

Table 23. E-waste collection points in the study area managed by Beeatoona (Beeatoona, 2012)

District	Area	Collection Point
North	Tripoli	Zahed Computers, Qabass Computer, Nar Computer
	Bsharre	**TDN Computers**
	Batroun	Ace Computers
	Koura - Tripoli	**Albert Haykal Hospital**

The E-waste is later collected by trucks provided by Beeatoona, ensuring a safe disposal of the collected material in a special warehouse (Beeatoona, 2012). After segregation, this waste is shipped abroad for treatment (E-waste recycling) and/or disposal (GIZ, 2014). However this activity is becoming more difficult because of the complications and time associated with export procedures as they must comply with the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

The Consultant could not get information about the quantity of E-waste generated in the study area. In the absence of a country estimate for the E-waste, it is very hard to make any estimation for the study area.

2.2.1.4. Tires Waste

Tire waste is considered as municipal solid waste (MSW) and is treated similarly. Different initiatives and approached are adopted in the country to handle tires. These are elaborated in the National Baseline Report.

According to an interview done by the Daily Star (2015) with Ahmad Hikmat Shamseddine, OLA 3R's owner, there's at least one tire damaged for every car.

Based on WHO (2011), the total number of registered cars in Lebanon is of the order of 1,530,000. In addition, the IPT group conducted a study on road transport and air pollution in 2012, and reported a total number of registered vehicles of the order of 1,580,000. A 3% increase is noticed from 2011 until 2012. Projecting these numbers till 2018, the total number of registered vehicles adds up to 1,880,000. Based on the WHO, in Lebanon, for every 1,000 person there are 434 vehicles.

Applying this to the study area, and taking into consideration that 240,000 are permanent residents, 104,160 cars are estimated to be in Bsharre, Koura and Zgharta. Since at least one tire is damaged for every vehicle per year, there is a minimum of **105,000 waste tires generated each year**.

2.2.1.5. Industrial Waste

As elaborated in the National Baseline Report, the types of industries in Lebanon are mainly light manufacturing industries. Details about the types and quantity of industrial waste in the country are also elaborated in the National Baseline.

As far as the study area is concerned, industrial firms mainly operate in the services sector – retail, financial services, construction and health. These industries generate industrial waste of class III, that are insoluble and do not decompose (Lone Star College, 2018). Construction and medical wastes can cause serious threat to the environment and the ecosystem.

In addition, olive oil mills are one of the biggest industries present in the North Governorate. In fact, in the North, olive oil production constitutes 41%, of which 18% take place in Akkar (Blominvest Bank, 2015). Olive trees are actually grown in 6 regions: Batroun, Koura, Zgharta,

Akkar, Rachaya El Foukhar and Hasbaya. The following table summarizes the olive oil production in the Governorate.

Table 24. Olive oil production in the North

Total Annual Production (tons/year)	% production in North Governorate (%)	Annual Production in North Governorate (tons/year)
20,500	41	8,405

Olive oil extraction is actually one of the most polluting agro-industrial sectors due to the formation of the Olive Mill Wastewater (OMW). In Lebanon, OMW is known as Zibar. Based on LAU research on olive oil mill waste water bio-treatment (2010), OMW accounts for up to 50%(v/v) of the total olive oil mill output, olive oil 20% and the remaining 30% are solid residue known as Jift or pomace. In the same study, it is estimated that 1.6 million liters of Zibar are produced in Lebanon per year and are directly disposed in digs, wells, rivers, lakes and valleys. Considering that 41% of the olive oil is produced in North, 656,000 L of Zibar are produced in the North annually.

The density of olive oil is around 930 g/L, that of waste water is 1,100 g/L and that of the pomace is 30g/kg. Every 54 1 L of olive oil produces around 54 L of waste water. Based on densities, the quantities of waste are calculated and presented in the following table.

Table 25. Waste generated from olive oil production in the North

	Waste water from olive oil mills	Olive oil	Solid residue (pomace)
Volume (L)	328,000	131,200	196,800
Weight (tons)	360.80	122.02	3.67

2.2.2. Composition

As far as the waste composition is concerned, no attempts were made to carry out any comprehensive waste characterization campaigns within any of the villages of the Districts of the study area. Studies have been done in other areas in Lebanon which could be used as an indicator of the anticipated waste composition.

In the current report, we will adopt the waste characterization campaign carried out by the Danish Consultant Ramboll for the waste generated from the Greater Beirut Area and part of Mount Lebanon and which was done as part of the feasibility study for the integration of waste to energy into the waste management schemes in Lebanon. Details about the sampling

campaign methodology, number of samples, time of sampling, parameters analyzed, source of waste, etc. as well as the results are elaborated in the National Baseline

In order to correlate the results of the above characterization study to the study area of Nabatieh, we have compared the average household monthly income reported for the Districts of Bsharre, Koura and Zgharta to that of the districts covered in the above study (See below chart).

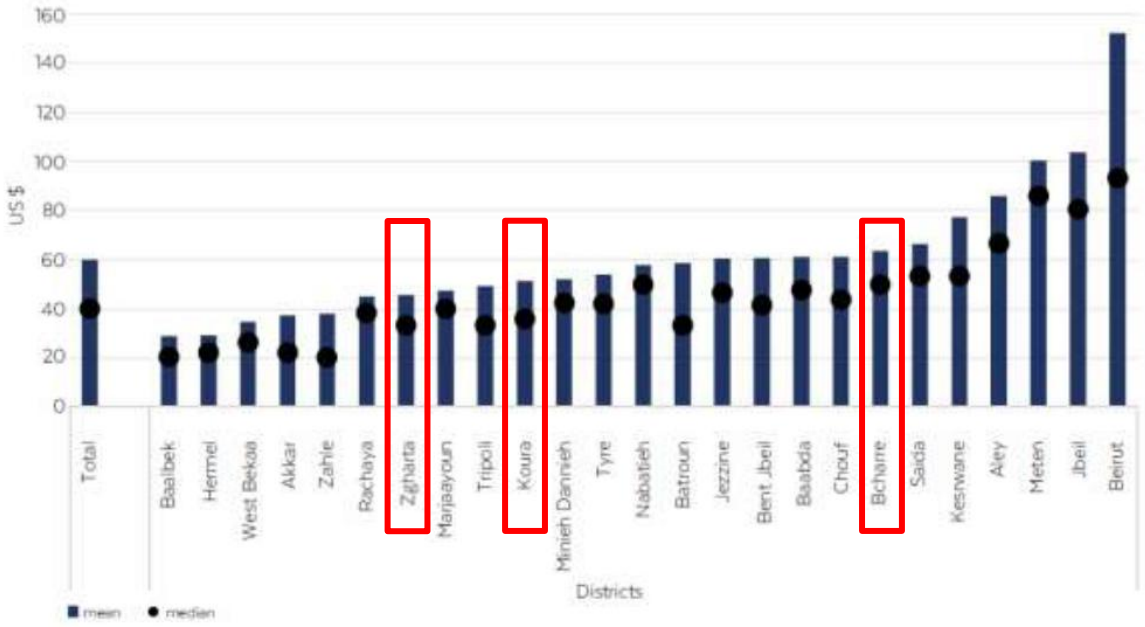


Figure 34. Average household monthly income per capita at District Level (UNHCR et al. 2016)

The above chart indicates that whereas the District of Bsharre is close to the Districts of Chouf and Baabda in terms of average household monthly income, the Districts of Zgharta and Koura are not close to any of the areas covered in the study of Ramboll. Instead they are close to the District of Tripoli. Fortunately, the Consultant has carried out some waste characterization for the waste collected from the District of Tripoli as part of the environmental audit of the Tripoli sorting facility. For further details about these waste characterization done as part of the audit, please refer to the Audit report.

Therefore, for the sake of the current study we will assume that the waste composition in the District of **Bsharre** to be similar to that measured in the Districts of **Shouf and Baabda** and that of the Districts of **Zgharta and Koura** to be similar to that of **Tripoli** (see below tables).

Table 26. Waste composition in Baabda & Shouf (Ramboll Study) and Tripoli

Component	Composition (%)		
	Baabda	Chouf	Tripoli
Organic	55.13	56.86	59.97
Paper and Cardboard	11.97	11.11	8.84
Plastics	12.84	11.96	10.66
Metals	1.90	2.26	1.74
Textiles	3.52	2.67	4.21
Glass	2.77	3.08	2.26
Wood	1.03	0.95	
Diapers	4.55	4.8	
Others	2.16	1.72	12.32

However, a plan should be developed to carry out a comprehensive waste characterization campaign to have more accurate data about the waste composition.

2.2.3. Waste generation trends

In the absence of a sorting facility that receives the waste from the various villages of the study area, it is quite hard if not impossible to study and come up with waste generation trends be it a weekly trend, a monthly trend or a seasonal trend.

However, it is anticipated that the seasonal variation in waste quantity will follow the trend of the seasonal variation in population which increases by a factor of 21% during the summer season.

2.2.4. Waste Quantities

In terms of waste quantities, the only approach that could be adopted to estimate the waste quantities generated from the various municipalities of the study area is to use the waste generation rates reported in the literature and apply those rates to the population during both the summer and the winter season.

Per capita municipal solid waste generation rates have been reported in various studies. While some are based on actual measurements, most of them were based on assumptions. The below table summarizes waste generation rates reported in the literature for the districts of Bsharre, Koura and Zgharta or for districts of similar urban fabric.

Table 27. Literature reported waste generation rates

No	Study	Waste generation rate	Notes
1.	Sweep net country Report 2014	- 0.80 Kg/capita/day in Rural Areas - 0.95-1.2 Kg/capita/day in Urban Areas	- Waste generation rates for rural and urban
2.	Fichtner 2006 Master Plan Study for Lebanon	- 0.85 Kg/capita/day	- Reported for the study area which is considered of rural to semi-rural urban fabric.

On the basis of the above and given the fact that the study area is pre-dominantly characterized by a rural to semi-rural urban fabric, the per capita waste generation rate adopted to calculate the waste quantities generated within the District under Approach 1 is 0.8 kg/capita/day for the residing Lebanese. As for the Syrians and Palestinians, a waste generation rate of 0.5kg/capita/day will be used similarly to what has been adopted in the baseline reports of other study areas under the current contract. This would lead to the following waste generation quantities:

Category	Population	Special Waste Generation (kg/cap/d)	Daily SW generated «winter» (tons/d)	Daily SW generated "summer" (tons/d)
Lebanese-Winter	240,000	0.8	192	-
Lebanese-Summer	295,000	0.8	-	236
Syrian Refugees	55,000	0.5	27.5	27.5
Palestinians	0	-	0	0
TOTAL	**-**	**-**	**219.5**	**263.5**

Considering 75 days of the year as high "summer" season and 290 days for the "winter" season, the estimated waste quantities are as follows:

"Winter" season : 220 tons/day and 65,000 tons/winter season in total

"Summer" season : 270 tons/day and 20,000 tons/summer season in total

"Annual waste" generated: 85,000 tons/year

Sensitivity analysis

The calculations above are based mainly on three major parameters, namely:

- The Lebanese population
- The Waste Generation Rate per day and capita

A basic sensitivity analysis for the current approach was elaborated for those three parameters.

Lebanese Population

The following table presents the changes in the generated waste due to changes in the Lebanese population. The results are also normalized as percentages, in order to make the sensitivity analysis comparable for all the parameters.

Table 28. Waste Generation versus Population

Population	Annual waste	Population change %	Waste change%
195,000	53,000	100.00%	100.00%
210,000	57,000	107.69%	107.55%
225,000	61,000	115.38%	115.09%
240,000	65,000	123.08%	122.64%

The results demonstrate that roughly for 1% increase of the Lebanese population, there will be a 1% increase to the waste generated. The next graph presents the normalized correlation of the changes to waste generated versus the changes to Lebanese population.

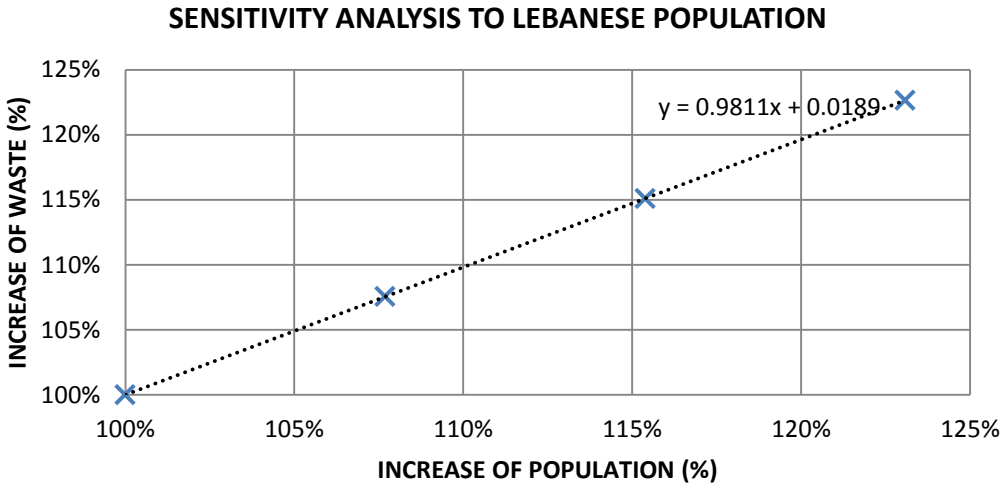


Figure 35. Normalized correlation of changes to waste vs changes to Lebanese population

Special Rural Waste Generation Rate

The following table presents the changes in the generated waste due to changes in the Special Rural Waste Generation Rate. The results are also normalized as percentages, in order to make the sensitivity analysis comparable for all the parameters.

Table 29. Waste Generation versus Special Rural Waste Generation

Waste Rates Urban (Kg/capita/day)	Annual Waste (tons/year)	Waste Rates Change (%)	Waste Change (%)
0.75	79,938	100.00%	100.00%
0.8	83,418	106.67%	104.35%
0.85	86,898	113.33%	108.71%
0.9	90,378	120.00%	113.06%

The results demonstrate that roughly for 1% increase of the Special Urban Waste Generation rate, there will be a 0.7% increase to the waste generated, due to the urban/rural distribution and the summer season effect.

The next graph presents the normalized correlation of the changes to waste generated vs the changes to Special Rural Waste Generation rate.

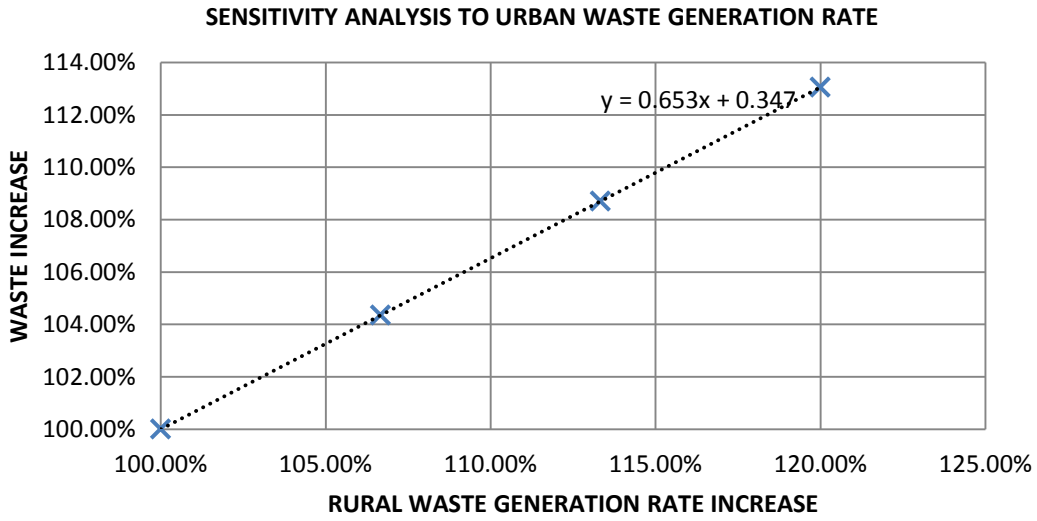


Figure 36. Sensitivity analysis of the waste increase vs the Special Rural Waste Generation Rate

Conclusions from the sensitivity analysis

The sensitivity analysis demonstrated that:

- For 1% increase of the Lebanese population, there will be a 1% increase to the waste generated.
- For 1% increase of the Special Urban Waste Generation rate, there will be a 0.7% increase to the waste generated.

The previous are also highlighted at the next graph.

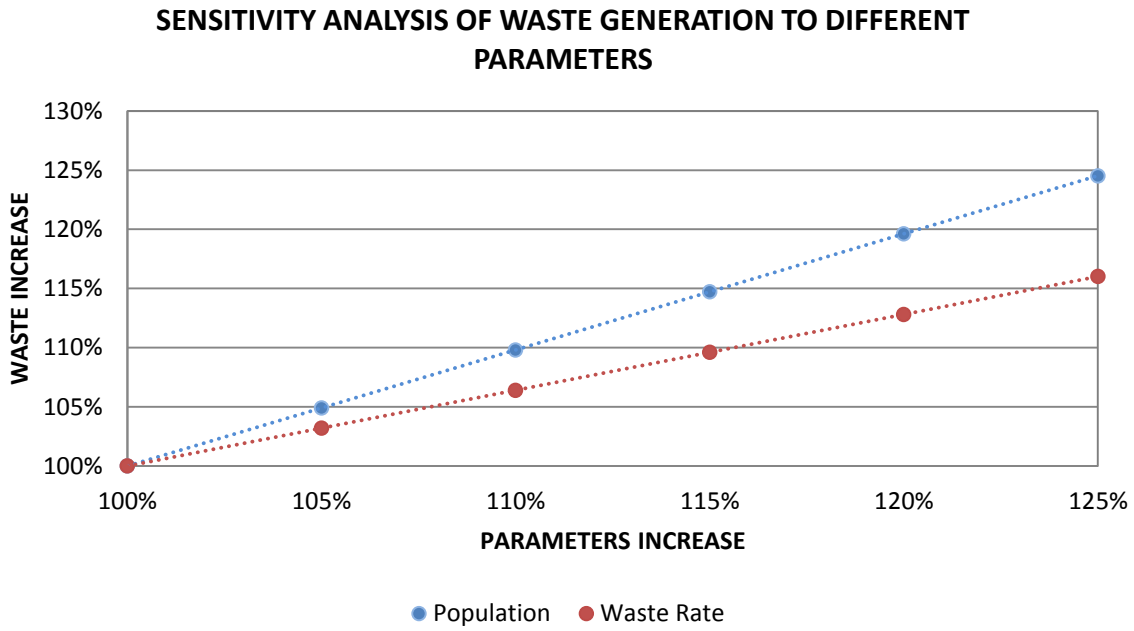


Figure 37. Sensitivity analysis of the waste increase vs the three major parameters (Lebanese Population and Special Rural Waste Generation Rate)

The results in the figure above demonstrate that the most important parameter is by far the Lebanese population.

The sensitivity analysis demonstrates that the calculations of the waste generated are mainly sensitive to the estimation of the Lebanese population, and to a lesser extent to the waste rate.

2.3. Storage, collection and street sweeping

2.3.1. Storage

Municipal solid generated by households and commercial establishment is primarily collected through oil barrels (240), two wheeled 240L plastic containers, and street containers of various sizes (600 – 1,000 L) with and/or without cover and in non-optimal conditions.

According to the meetings held with the Municipalities, the use of 240L barrels for the storage of waste is mainly imposed by social considerations resulting from the local community's resistance to having the waste of their neighbors stored in nearby containers. This is similar to the "Not in my backyard" syndrome. In addition because of the dominance of low to medium rise buildings, small size containers are more convenient.

The below photos have been taken during the team field visits to the study area.

Figure 38. Street containers

Based on data collected from municipalities, most containers are being regularly replaced. The containers are supplied by the municipalities and at their own expenses. A significant number of municipalities said that the available containers are not enough to handle all waste and/or are in bad condition. Some are even being stolen or broken during the waste collection because they are being emptied manually which is affecting their lifespan.

The majority of the municipalities are replacing the metal containers they have and they are replacing them by locally manufactured plastic containers.

The following table summarizes the current waste storage system in the municipalities of the three Districts of the study area.

Table 30. Existing Waste Storage system as per municipalities

No.	Municipality	Type	Volume	Number	Source of Funding
Municipalities of Koura					
1	Fee3	Plastic 2 Wheeled containers for organic waste	200	200	Municipality
		Metallic containers for recyclables	1000	200	
2	Qalhat	Metallic containers	1000	100	Municipality
3	Kaftoun	Plastic 4 Wheeled Containers	660	90	Municipality
4	Kfar Qahel	Metallic barrels	240	Unknown	Municipality
5	Kfar Hata	Metallic barrels	240	350	Municipality
6	Kfar Hazeer	Plastic 2 Wheeled containers	240	200	Municipality
		Plastic 4 Wheeled containers	1100	100	
7	Kfar Saroun	Plastic 2 Wheeled containers	240	Unknown	Municipality
		Plastic 4 Wheeled containers	800	Unknown	
8	Kfar Aqqa	Plastic 2 Wheeled containers	240	300	Municipality
9	Kifraya	Plastic 2 Wheeled containers	240	600	Municipality
10	Kosba	Plastic 4 Wheeled containers	660	30	Municipality
		Metal 4 Wheeled Containers	660	20	
11	Metreet	Plastic 2 Wheeled containers	160	60	Municipality
12	Majdel - Zakzouk - Wata Fares	Plastic 2 Wheeled containers for recyclables and regular waste	240	80	Municipality
13	Nakhle	Metallic barrels	240	200	UN & Municipality
14	Amyoun	Plastic 4 Wheeled containers	660	500	Municipality
15	Anfeh	-	-	-	-
16	Ajd Ebreen	Plastic 2 Wheeled containers	240	160	Municipality
17	Bkifteen	No bins	-	0	-
18	Btouratej	Plastic 2 Wheeled containers	240	150	Municipality
		Plastic 4 Wheeled containers	660	50	
19	betroumin	Plastic 2 Wheeled containers	240	200	Municipality
		Metallic containers (red for recyclables)	660	15	
20	bte3boura	Plastic 2 Wheeled containers	240	150	Municipality
		Metallic barrels	240	60	
21	behwayta - Afqa - bechnata	-	-	-	-
22	Bednayel	Plastic 2 Wheeled containers	240	250	Municipality
23	Bdebba	Plastic 2 Wheeled containers	240	100	Municipality

No.	Municipality	Type	Volume	Number	Source of Funding
		Metallic containers (red for recyclables)	660	4	
24	Bersa	-	-	-	-
25	Bzeeza	Plastic 2 Wheeled containers	240	350	Municipality
		Metallic containers (red for recyclables)	660	50	
26	Bshemzeen	Barrels for recyclables and different ones for the rest	NR	NR	Municipality
27	Bserma	Plastic 2 Wheeled containers	240	150	Municipality
28	Botram	-	-	-	-
29	Dar B3eshtar	Metallic barrels	240	300	Municipality
30	Dar Shemzeen	Plastic 2 Wheeled containers	240	90	Municipality
		Metallic containers (red for recyclables)	660	50	
31	Dede	Plastic 2 Wheeled containers	220	2000	Municipality
32	Dechdebbine	NR	NR	NR	Municipality
33	Ras Masqa	Metallic barrels	240	500	Municipality
34	Reshdebbine	Plastic 2 Wheeled containers	240	180	Municipality
35	Zekroun	Metallic barrels	240	12	Municipality
36	afsadeek	Plastic 2 Wheeled containers	240	100	Municipality
		Plastic 4 Wheeled containers	1100	10	
37	Ain Ekreen	Metallic barrels	240	100	Municipality
38	Abba	Plastic 2 Wheeled containers	240	150	Municipality
Municipalities of Bsharre					
39	Qnat	Plastic 2 Wheeled containers	240	200	Municipality
40	Bqaa Kafra	-	-	-	-
41	Bqar Qasha	Plastic 2 Wheeled containers	240	?	Municipality
42	Ban	Plastic 2 Wheeled containers & metallic barrels	200	50	Municipality
43	Barhalyoun	-	-	-	-
44	Bez3oun	Metallic barrels	240	40	Municipality
		Plastic 2 Wheeled containers	240	100	
		Receptacles	-	40	
45	Bcharre	-	-	-	-
46	Hadath El Jebbeh	Plastic 4 Wheeled containers	660	6	Municipality
		Metallic barrels	240	60	
		Metal Containers	660	8	
47	Hadchit	Plastic 2 Wheeled containers & metallic barrels	240	NR	Municipality

No.	Municipality	Type	Volume	Number	Source of Funding
48	Hasroun	-	-	-	-
49	Torza	-	-	-	-
50	Abdine	-	-	-	-
Municipalities of Zgharta					
51	Kfar Sghab	Plastic 2 Wheeled containers	240	200	Municipality
52	Qorah Bash	Plastic 2 Wheeled containers	240	36	Municipality
53	Kfar Fu	Plastic 4 Wheeled Containers	660	100	Municipality
54	Kfar Yachit - Bsebaal	Plastic 2 Wheeled containers	240	300	Municipality
55	Kfar Hatta	-	-	-	-
56	Kfar Dlaqous	Plastic 2 Wheeled containers	240	1000	Municipality
57	Kfar Zeina	Plastic 2 Wheeled containers	240	600	Municipality
58	Karm Saddeh	Plastic 2 Wheeled containers	120	10	Municipality
		Plastic 2 Wheeled containers	140	3	
59	Majdlayya (Zgharta)	Plastic 2 Wheeled containers	240	150	Unicef and Municipality
		Metallic barrels	240	100	
		Plastic 4 Wheeled Containers	660	50	
60	Maryata - Qadreyyah	-	-	-	-
61	Mezyara - Harf - Hmeis - Sakhra	Metallic barrels	240	100	Municipality
62	Mazraat Teffah	Metallic barrels	240	150	Municipality
63	Aytou	Metallic barrels	240	80	Municipality
64	Eaal	-	-	-	-
65	Arde	Plastic 2 Wheeled containers	240	300	Municipality
		Plastic 4 Wheeled Containers	660	30	
		Old Plastic 2 Wheeled containers	240	50	
66	Bneshay	Plastic 2 Wheeled containers	240	4	Municipality
		Plastic 4 Wheeled Containers	660	10	
67	Buheira (Zgharta)	Plastic 2 Wheeled containers	240	unknown	Municipality
68	Bsaloukit	Plastic 2 Wheeled containers	240	50-70	Municipality
69	Toula-Aslot	-	-	-	-
70	Haret Al Fouar	Metallic barrels	240	250	Municipality
71	Daraya-Bshennin	-	-	-	-
72	Ras Kifa	NR	NR	NR	NR
73	Rasheen	-	-	-	-
74	Zgharta - Ehden	-	-	-	-

No.	Municipality	Type	Volume	Number	Source of Funding
75	Seb'el	Plastic 4 Wheeled Containers	660	30	Municipality
76	Ser'el	Metallic barrels	240	30	Municipality
77	Alma	Metallic barrels	240	600	Municipality
78	Ain Tourin	Plastic 2 Wheeled containers	240	80	Municipality
79	Arabet Kizhaya	-	-	-	-
80	Arjes	Metallic barrels	240	500	Mercy Corps
81	Ashash	Plastic 2 Wheeled containers	240	150	MoE
		Plastic 4 Wheeled Containers	1000	30	

Municipalities that did not respond to the request for info by the team

In summary, there are:

Table 31. Summary of the available waste containers

No	Type of Container	Volume (L)	Number
1	Metallic Barrels	240L	3,432
2	Metallic Containers	1,000L	300
3	Metallic Containers	660L	147
4	4 Wheeled Plastic Containers	1,100L	110
5	4 Wheeled Plastic Containers	1,000L	30
6	4 Wheeled Plastic Containers	660L	896
7	2 Wheeled Plastic Containers	240L	6,440
8	2 Wheeled Plastic Containers	200L	250
9	2 Wheeled Plastic Containers	220L	2000
10	2 Wheeled Plastic Containers	160L	60
11	2 Wheeled Plastic Containers	140L	3
12	2 Wheeled Plastic Containers	120L	10
13.	**Total**	**-**	**13,678**

It can be noted that the two wheeled 220-240L Plastic Containers are the most used for storage in the area constituting 62% of the total number of available containers.

The assessment of the sufficiency of waste containers was carried out for the municipalities of the three Districts as it is demonstrated in the next table.

Table 32. Sufficiency of the available bins for municipalities

No.	Municipality	Available Storage volume (m^3)	Waste storage Needed on a Monday (2 days & 80% full) (m^3)		Efficiency (%)	
			Winter	Summer	Winter	Summer
1	Fee3	240	22.2	22.2	1,081	1,081
2	Qalhat	100	21.6	27.36	463	365
3	Kaftoun	59	3.15	4.59	1,886	1,294
4	Kfar Qahel	Not Available	14.7	14.7	-	-
5	Kfar Hata	84	20.58	22.5	408	373
6	Kfar Hazeer	158	31.2	31.2	506	506
7	Kfar Saroun	Not Available	22.734	27.534		
8	Kfar Aqqa	72	49.2	49.2	146	146
9	Kifraya	144	18.42	21.3	782	676
10	Kosba	33	84	84	39	39
11	Metreet	10	1.68	3.6	571	267
12	Majdel - Zakzouk - Wata Fares	19	12	12	160	160
13	Nakhle	48	91.8	111	52	43
14	Amyoun	330	105	153	314	216
15	Anfeh	-	-	-	-	-
16	Ajd Ebreen	38	13.92	13.92	276	276
17	Bkifteen	-	10.08	12.96	-	-
18	Btouratej	69	46.8	46.8	147	147
19	betroumin	58	7.26	8.7	798	666
20	bte3boura	50.4	5.28	5.76	955	875
21	behwayta - Afqa - bechnata	-	-	-	-	-
22	Bednayel	60	4.74	5.22	1,266	1,149
23	Bdebba	27	4.47	4.47	596	596
24	Bersa	-	-	-	-	-
25	Bzeeza	117	13.2	13.2	886	886
26	Bshemzeen	-	4.68	5.64	-	-
27	Bserma	36	10.2	11.16	353	323
28	Botram	-	-	-	-	-
29	Dar B3eshtar	72	41.52	49.2	173	146
30	Dar Shemzeen	55	3.3	4.26	1,655	1,282
31	Dede	440	120	120	367	367
32	Dechdebbine	-	8.22	8.22	-	-
33	Ras Masqa	120	212.4	222	56	54
34	Reshdebbine	43.2	6.36	6.36	679	679
35	Zekroun	3	4.188	4.38	69	66

No.	Municipality	Available Storage volume (m^3)	Waste storage Needed on a Monday (2 days & 80% full) (m^3)		Efficiency (%)	
			Winter	Summer	Winter	Summer
36	afsadeek	35	9.48	10.44	369	335
37	Ain Ekreen	24	20.4	25.2	118	95
38	Abba	36	7.8	7.8	462	462
-	**TOTAL KOURA**	**2,580**	**1,053**	**1,170**	**245**	**221**
39	Qnat	48	2.388	3.348	2,010	1,434
40	Bqaa Kafra	-	-	-	-	-
41	Bqar Qasha	Not Available	43.38	57.78	-	-
42	Ban	10	-	-	-	-
43	Barhalyoun	-	-	-	-	-
44	Bez3oun	34	6.18	22.02	544	153
45	Bcharre	-	-	-	-	-
46	Hadath El Jebbeh	24	6.774	24.054	349	98
47	Hadchit	Not Available	0.768	52.8	-	-
48	Hasroun	Not Available	31.8	70.2	-	-
49	Torza	-	-	-	-	-
50	Abdine	-	-	-	-	-
-	**TOTAL Bsharre**	**115**	**91**	**230**	**126**	**50**
51	Kfar Sghab	48	11.1	13.02	432	369
52	Qorah Bash	9	9.6	11.04	90	78
53	Kfar Fu	66	2.52	2.808	2,619	2,350
54	Kfar Yachit - Bsebaal	72	10.8	30	667	240
55	Kfar Hatta	-	0	0		
56	Kfar Dlaqous	240	47.4	47.4	506	506
57	Kfar Zeina	144	10.44	11.4	1,379	1,263
58	Karm Saddeh	2	13.02	13.02	12	12
59	Majdlayya (Zgharta)	93	289.8	309	32	30
60	Maryata - Qadreyyah	Not Available	168	168	0	0
61	Mezyara - Harf - Hmeis - Sakhra	24	28.8	38.4	83	63
62	Mazraat Teffah	36	4.11	5.55	876	649
63	Aytou	19	3.63	4.11	529	467
64	Eaal	Not Available	4.956	13.02	0	0
65	Arde	104	55.08	55.08	188	188
66	Bneshay	8	0.768	1.92	984	394
67	Buheira (Zgharta)	-	0.858	6.33	0	0

No.	Municipality	Available Storage volume (m^3)	Waste storage Needed on a Monday (2 days & 80% full) (m^3)		Efficiency (%)	
			Winter	Summer	Winter	Summer
68	Bsaloukit	14	0.192	6.72	7,500	214
69	Toula-Aslot	-	0	0		
70	Haret Al Fouar	60	75.6	75.6	79	79
71	Daraya-Bshennin	-	0	0		
72	Rass Kifa	-	2.352	2.64		
73	Rasheen	-	65.4	65.4		
74	Zgharta - Ehden	-	367.68	480		
75	Seb'el	20	10.05	11.97	197	165
76	Ser'el	7	4.8	4.8	150	150
77	Alma	144	51	51	282	282
78	Ain Tourin	19	0.1152	3.36	16,667	571
79	Arabet Kizhaya	-	3.36	5.28		
80	Arjes	120	6.84	7.32	1,754	1,639
81	Ashash	66	9.75	10.71	677	616
	TOTAL Zgharta	**1,314**	**1,258**	**1,455**	**104**	**90**
	GRAND TOTAL	**4,010**	**2,402**	**2,855**	**167**	**140**

Over storage capacity
Shortage in storage volume

The table is based on data provided by the municipalities in terms of the available number, type and volume of containers as well as the winter and summer population. As for the needed waste storage volume, we have calculated the waste tonnages for a typical Monday of a summer and winter season and assumed a two days storage volume with 20% availability of extra volume which is the typical design criteria for designing a waste storage system. The tonnage was divided by the waste density (0.20 ton/m^3) in order to get the volume/day.

As it is shown, the bins are sufficient for the majority of municipalities with availability of extra storage capacity. This implies that the bulk of the municipalities can afford a lower collection frequency. However, this would compromise the quality of recyclables to be recovered in the case where sorting activities are planned. Very few are those municipalities that have a deficiency in the availability of storage volume.

If we carry out an overall assessment at the level of the three Districts, i.e. the total available storage volume for the waste generated from the whole District, the following could be found:

Table 33. Sufficiency of the available bins at the level of the District [(a)]

No	District	Available Volume of containers (m^3)	Waste storage Needed on a Monday (2 days & 80% full)		Efficiency (%)	
			Winter	Summer	Winter	Summer
1	Koura	2,580	1,053	1,170	245	221
2	Bsharre	115	91	230	126	50
3	Zgharta	1,314	1,258	1,455	104	90
-	**TOTAL**	**4,010**	**2,402**	**2,855**	**167**	**140**

[(a)] Based on the database obtained from the municipalities

On the basis of the above, one can conclude that the sufficiency of the available bins is satisfactory and meets the needs of the study area. However, their distribution to municipalities could be optimized.

2.3.2. Waste collection

According to the current institutional arrangements for the MSW management sector, collection is under the responsibility of each municipality.

For the three Districts of the study area, the waste collection services are mostly decentralized and managed by the by the individual municipalities. The majority of the municipalities have contracted the waste collection service to the private sector (52 out of 65; i.e. 80%).

The below table summarizes the frequency of collection, the percent coverage, and the type of collection fleet.

Table 34. Summary of existing waste collection services

No.	Municipality	Responsibility	Coverage (%)	Frequency of collection	Available Machinery
Koura District Municipalities					
1	Fee3	Private Contractor	100%	Daily (organic) Weekly (recyclables)	Pickup
2	Qalhat	Private Contractor	100%	Daily	Pickup
3	Kaftoun	Private Contractor	100%	Daily	Pickup
4	Kfar Qahel	Private Contractor	100%	Daily	Pickup
5	Kfar Hata	Private Contractor	100%	Daily	Pickup
6	Kfar Hazeer	Municipality	100%	3 times a week	old pickup (1990s)
7	Kfar Saroun	Municipality	100%	Daily	Pickup
8	Kfar Aqqa	Private Contractor	100%	Daily	Pickup
9	Kifraya	Municipality	100%	Daily	Pickup
10	Kosba	Private Contractor	100%	Daily	Pickup
11	Metreet	Private Contractor	100%	Twice a week	Pickup
12	Majdel - Zakzouk - Wata Fares	Sub-contracted to a local family	100%	3 time a week (regular waste) Twice a week for recyclables	Pickup

No.	Municipality	Responsibility	Coverage (%)	Frequency of collection	Available Machinery
13	Nakhle	Municipality	100%	Daily except Sunday	Tractor
14	Amyoun	Private Contractor	100%	Daily	
15	Anfeh	-	-	-	-
16	Ajd Ebreen	Private Contractor	100%	2-3 times a week	Pickup
17	Bkifteen	Private Contractor	100%	3 times a week (door to door collection)	-
18	Btouratej	Private Contractor	100%	3 times a week	Pickup
19	betroumin	Private Contractor	100%	4 times a week (regular waste) Once a week (recyclables)	Pickup
20	bte3boura	Private Contractor	100%	2-3 times a week	Pickup
21	behwayta - Afqa - bechnata	-	-	-	-
22	Bednayel	Municipality	100%	2-3 times/week	Pickup
23	Bdebba	Private Contractor	100%	3 times/week regular waste and 1 time/week for recyclables	Pickup
24	Bersa	-	-	-	-
25	Bzeeza	Private Contractor	100%	Twice a week	Pickup
26	Bshemzeen	Municipality	100%	3 times a week (regular waste) Twice a week (recyclables)	3 Pickups
27	Bserma	Municipality	100%	3-4 times a week	4 Pickups
28	Botram	-	-	-	-
29	Dar B3eshtar	Private contractor	100%	3 times a week	Pickup
30	Dar Shemzeen	Private Contractor	100%	3 times a week	Pickup
31	Dede	Private Contractor	100%	daily except Sunday	Trucks
32	Dechdebbine	Private Contractor	100%	3 times a week	Trucks
33	Ras Masqa	Private Contractor	100%	4 times a week	Pickup
34	Reshdebbine	Private Contractor	100%	3 times a week	Compactor
35	Zekroun	Private Contractor	100%	Daily	Pickup
36	afsadeek	Municipality	100%	3 times a week	Pickup
37	Ain Ekreen	Private Contractor	100%	3 times a week	Pickup
38	Abba	Private Contractor	100%	3 times a week	Pickup
Bsharre District Municipalities					
39	Qnat	Private Contractor	100%	Daily	Compactor
40	Bqaa Kafra	-	-	-	-
41	Bqar Qasha	Private Contractor	100%	?	Compactor
42	Ban	Private Contractor	100%	3 times per week	Compactor
43	Barhalyoun	-	-	-	-
44	Bez3oun	Private Contractor	100%	4 times a week (summer) Twice a week (winter)	Compactor
45	Bcharre	-	-	-	-
46	Hadath El Jebbeh	Private Contractor	100%	Daily	Compactor
47	Hadchit	Private Contractor	100%	Daily	Compactor
48	Hasroun	-	-	-	-
49	Torza	-	-	-	-
50	Abdine	-	-	-	-

No.	Municipality	Responsibility	Coverage (%)	Frequency of collection	Available Machinery
Zgharta District Municipalities					
51	Kfar Sghab	Private Contractor	100%	3 times a week (regular waste) Twice a week (recyclables)	Pickup
52	Qorah Bash	Private Contractor	100%	3 times a week	Pickup
53	Kfar Fu	Private Contractor	100%	twice a week	Pickup
54	Kfar Yachit - Bsebaal	Private Contractor	100%	3 times a week (regular waste) Twice a week (recyclables)	Pickup
55	Kfar Hatta	-	-	-	-
56	Kfar Dlaqous	Private Contractor	100%	2-5 times a week	Pickup
57	Kfar Zeina	Private Contractor	100%	3 times a week (regular waste) Once a week (recyclables)	Pickup
58	Karm Saddeh	Private Contractor	100%	3 times a week (summer) Twice a week (winter)	Pickup
59	Majdlayya (Zgharta)	Private Contractor	100%	Daily	Pickup
60	Maryata - Qadreyyah	municipality	100%	Daily	pick up and compactor
61	Mezyara - Harf - Hmeis - Sakhra	Private Contractor	100%	Daily	Pickup
62	Mazraat Teffah	Private Contractor	100%	Twice a week in summer Once a week in winter	Pickup
63	Aytou	Private Contractor	100%	2-3 times a week	Pickup
64	Eaal	-	-	-	-
65	Arde	Municipality	100%	3-4 times a week	Truck
66	Bneshay	Private Contractor	100%	4 times a week in summer 3 times a week in winter	Pickup
67	Buheira (Zgharta)	Private Contractor	100%	Twice a week	Pickup
68	Bsaloukit	Private Contractor	100%	3 times a week	Pickup
69	Toula-Aslot	-	-	-	-
70	Haret Al Fouar	Municipality	100%	Daily	Pickup
71	Daraya-Bshennin	-	-	-	-
72	Rass Kifa	Municipality	100%	3 times a week (summer) Twice a week (winter)	Pickup
73	Rasheen	-	-	-	-
74	Zgharta - Ehden	-	-	-	-
75	Seb'el	Private Contractor	100%	Once a week	Pickup
76	Ser'el	Private Contractor	100%	3 times a week (summer) Twice a week (winter)	Pickup
77	Alma	Private Contractor	100%	Daily	Pickup
78	Ain Tourin	Private Contractor	100%	Twice a week (summer) Once a week (winter)	Pickup
79	Arabet Kizhaya	-	-	-	-
80	Arjes	Private Contractor	100%	2-3 times a week	Pickup
81	Ashash	Private Contractor	100%	Twice a week	Pickup

Municipalities that did not respond to the request for info by the team

All municipalities cover the whole municipal boundary. 75% of interviewed municipalities (52 out of 69) depend on the private sector for waste collection services. The remaining municipalities handle their own waste collection services.

In terms of frequency of waste collection services, only 30% of the interviewed municipalities (21 out of 69) collect their waste daily. For the rest of the municipalities, the frequency varied from a minimum of once a week to a maximum of 4 times a week. This frequency of collection could be afforded by the significantly high storage capacity made available by the containers distributed in the various municipalities.

With the exception of the municipalities of the District of Bsharre where the Contractor in charge of the waste collection services is equipped with a compactor, the majority of the municipalities of the study area are not equipped with vehicles that are specifically dedicated for waste collection. Most of the villages use normal pickups to collect their waste.

Based on the above analysis, the following key-points should be considered:

1. The level and the coverage of waste collection services are satisfactory;
2. Most of the municipalities performing waste collection services lack modern waste collection vehicles;

There is an urgent need to modernize the waste collection vehicles in the study area.

2.3.3. Street sweeping

Unlike the waste collection service which for the majority of the municipalities is provided by the private sector, street sweeping is an activity that is being undertaken and managed at the moment by the individual municipalities.

The following table summarizes the status of street sweeping in the three Districts of the study area based on the information provided by the different municipalities.

Table 35. Street sweeping summary

No	Municipality	Mechanical Sweepers availability	Manpower		Expenses	Frequency
			Lebanese	Syrians		
Koura District Municipalities						
1	Fee3	none	1	4	30,000LL/day	Daily
2	Qalhat	none	0	2	25,000LL/day	Daily
3	Kaftoun	none	0	30	30,000LL/day	Twice a year
4	Kfar Qahel	none	0	4	30,000LL/day	Once a week
5	Kfar Hata	none	0	3	35,000LL/day	5 days a week
6	Kfar Hazeer	none	2	6	30,000LL/day	Daily
7	Kfar Saroun	none	0	4	30,000LL/day	Daily
8	Kfar Aqqa	none	1	5	30,000LL/day	Daily
9	Kifraya	1 mechanical sweeper	1	4	30,000LL/day	Daily
10	Kosba	none	2	4	25000LL/day	Daily
11	Metreet	none	0	2	30,000LL/day	20 days per year
12	Majdel - Zakzouk - Wata Fares	none	0	6	35000LL/day	Once per month
13	Nakhle - Haret el Khassa	none	3	3	30,000LL/day	Daily except Sunday
14	Amyoun	none	4	4	30,000LL/day	Daily
15	Anfeh					
16	Ajd Ebreen	none	1	0	35000LL/day	Daily
17	Bkifteen	none	3	0	doesn't know	Upon Need
18	Btouratej	none	0	2	25000LL/day	Once per month
19	betroumin	none	0	3	35,000 LL/day	2 - 3 times a month
20	bte3boura	none	4	0	30,000LL/day	2 - 3 times a month
21	behwayta - Afqa - bechnata					
22	Bednayel	none	2	0	35,000 LL/day	Once a week
23	Bdebba	None	2	0	600,000 LL/month	2 - 3 times a week
24	Bersa					
25	Bzeeza	none	0	2	35,000 LL/day	Daily
26	Bshemzeen	none	5	0	30,000LL/day	Daily
27	Bserma	none	6	0	30,000LL/day	Once a week
28	Botram					
29	Dar B3eshtar	none	6	0	25,000 LL/day	Twice a month
30	Dar Shemzeen	none	1	0	600,000LL/month	Twice a week

No	Municipality	Mechanical Sweepers availability	Manpower		Expenses	Frequency
			Lebanese	Syrians		
31	Dede	none	2	0	600,000 LL/month	Daily except Sunday
32	Dechdebbine	none	1	0	35,000 LL/day	Daily
33	Ras Masqa	none	0	10	25,000 LL/day	Daily
34	Reshdebbine	none	1	0	30,000LL/day	5 times a week
35	Zekroun	none	0	4	30,000LL/day (workers) + 600,000LL/year for the grass cleaning	Twice a month (2-3 days each time)
36	afsadeek	none	0	1	600,000LL/month +residency	Once a week
37	Ain Ekreen	Rented for regular cleaning	0	0	400USD/month	1-2 times a week
38	Abba	none	0	2	30,000LL/day	Once every 2-3 weeks for a couple of days
Bsharre District Municipalities						
39	Qnat	1	0	1	30,000 LL/day	4 days per week
40	Bqaa Kafra					
41	Bqar Qasha	None	2	0	35,000 LL/day	Daily except for Sunday
42	Ban	none	2	0	30,000 LL/day	Once a week
43	Barhalyoun					
44	Bez3oun	1 used at the start of spring for agricultural areas	3	0	30,000 LL/day	Daily except for Saturdays and Sundays unless needed
45	Bcharre					
46	Hadath El Jebbeh	1 but not used because they don't have side walks	5(summer) 1(winter)	0	25,000LL/day	daily in summer and weekly in winter
47	Hadchit	none	2	0	40,000LL/day	Daily
48	Hasroun					
49	Torza					
50	Abdine					
Zgharta District Municipalities						
51	Kfar Sghab	None	2	3	30,000LL/day	Twice a week for the main streets

No	Municipality	Mechanical Sweepers availability	Manpower		Expenses	Frequency
			Lebanese	Syrians		
						and once a week for the rest
52	Qorah Bash	None	1	0	800,000LL/month	Daily
53	Kfar Fu	None	2	0	35,000 LL/day	1-2 times a week
54	Kfar Yachit - Bsebaal	None	0	6	30,000LL/day	Daily
55	Kfar Hatta					
56	Kfar Dlaqous	Responsibility of the Union			No fees	Upon need
57	Kfar Zeina	None	1	0	30,000LL/day	Once a week
58	Karm Saddeh	Union of Zgharta			No fees	Upon need
59	Majdlayya (Zgharta)	None	1	9	25,000LL/day for Syrians and 35,000LL/day for Lebanese	Daily
60	Maryata - Qadreyyah	None	3	0	600000 LL/month	Daily
61	Mezyara - Harf - Hmeis - Sakhra	None	3	0	1 Million per Month	daily except for Sunday
62	Mazraat Teffah	None	0	2-3 In Summer 1-2 in Winter	30,000 LBP/day	Summer: Twice a week Winter: Once a week
63	Aytou	None	4	0	30,000 LBP/day	Daily except weekend
64	Eaal	none				
65	Arde	Bobcat with a brush	4	0	35MLL/year	Daily
66	Bneshay	None	2	0	30,000LL/day	summer: twice a week and winter: 4 times a week
67	Buheira (Zgharta)	None	5	0	30,000LL/day	2-3 times in the summer only
68	Bsaloukit	None	1 permanent Lebanese / occasionally 2-7	0	35,000LL/day	Daily
69	Toula-Aslot					
70	Haret Al Fouar	None	2	2	700,000LL/month	Daily except Sundays

No	Municipality	Mechanical Sweepers availability	Manpower		Expenses	Frequency
			Lebanese	Syrians		
71	Daraya-Bshennin					
72	Rass Kifa	None	beginning of summer: 4 workers for 2 weeks - same $	2	25,000LL/day	Twice a week
73	Rasheen	None	6	2	30,000LL/day	Every other day
74	Zgharta - Ehden					
75	Seb'el	None	2	2	30,000LL/day	upon need (No specific frequency)
76	Ser'el	None	0	20-25	35,000LL/day	Every 2 month
77	Alma	None	2	0	30,000LL/day	Daily except for Sundays
78	Ain Tourin	None	3	0	40,000LL/day	Once every 10 days
79	Arabet Kizhaya	1 used on weed-ends	3	0	35,000LL/day	Every other day
80	Arjes	None	0	1	25,000LL/day	2-3 times a week
81	Ashash	None	3	0	30,000LL/month	4 times a week

Municipalities that did not respond to the request for info by the team

It is obvious that municipalities take care of their own street sweeping and cleaning. Cleaning frequency is high in comparison to other districts. A total of 272 workers dedicated to street sweeping and cleaning. This implies an average daily fee of the order of 5,440USD/day leading to an annual fee of the order of 2 Million USD/Year.

2.4. Waste Treatment

In terms of the existing infrastructure for municipal solid waste treatment in the three districts of the study area, it is at the moment composed of very few small scale facilities that serve a limited number of municipalities as listed below:

- A small scale facility in in the municipality of Bshmezzine that receives source separated waste from only 6 municipalities of the study area (mainly in Koura District);
- A bio-fuel production facility that uses part of the olive trees trimming produced in the Koura District to produce biofuel;

- A small scale sorting facility in Alma developed under the wash assistance program, funded by the UNHCR and implemented by the Rene Mouawad Foundation. None of the interviewed municipalities referred to this facility;
- A privately owned and operated company, the Lebanese Waste Solutions Sarl, a sorting and recycling factory based in Zgharta North Lebanon that is involved in sorting cardboard, nylon, PET, cans, aluminum, steel, bottles, glass & paper. Apparently, this facility is the end user of the recyclables recovered from the various source separation activities taking place in the District of Zgharta.

Before presenting a brief description of each of the above facilities, a summary table is presented hereafter to briefly describe the current waste management practices adopted by the various municipalities of the Districts of the study area as described by the municipalities during the various interviews held with each one of them.

Table 36. Current waste management practices in the Municipalities of the study area

No.	Municipality	Sorting Practices	Disposal Practices	
			Description	Associated Cost
Koura Municipalities				
1	Fee3	Manual sorting at source by 450 residences (dry and wet) Recyclables are further sorted in Bshmezzine facility	Non recyclables as well as comingled MSW is dumped in Srar Dumpsite in Akkar	Disposal fees included in the collection fees
2	Qalhat	-	The waste is dumped in Srar Dumpsite in Akkar	Disposal fees included in the collection fees
3	Kaftoun	-	The waste is dumped in Srar Dumpsite in Akkar	Disposal fees included in the collection fees
4	Kfar Qahel	-	The wastge is dumped outside the village (responsibility of collection contractor)	Disposal fees included in the collection fees
5	Kfar Hata	-	The waste is dumped in Srar Dumpsite in Akkar	Disposal fees included in the collection fees
6	Kfar Hazeer	Manual sorting at source. Recyclables are further sorted in Bshmezzine facility	Non recyclables as well as comingled MSW is dumped in Srar Dumpsite in Akkar	Disposal fees costs the Municplaity 2.5MLL/month
7	Kfar Saroun	Manual sorting at source at large producers like supermarkets (Mainly cardboad and plastic).	Non recyclables as well as comingled MSW is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
8	Kfar Aqqa	Manual sorting at source (10-15% of the residents). Recyclables are further sorted in Bshmezzine facility	Non recyclables as well as comingled MSW is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
9	Kifraya	Manual sorting of collected	Open Burning and dumping	1,200 USD/month as

No.	Municipality	Sorting Practices	Disposal Practices	
			Description	Associated Cost
		waste in a piece of land owned by the municpality	in Srar Dumpsite in Akkar	salaries for 2 workers on a full time basis
10	Kosba	-	Non recyclables as well as comingled MSW is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
11	Metreet	-	The waste is dumped outside the village (responsibility of collection contractor)	Disposal fees included in the collection fees
12	Majdel - Zakzouk - Wata Fares	Manual sorting at source	the waste is dumped in a Dumpsite in Majdel	Disposal fees included in the collection fees
13	Nakhle	-	Non recyclables as well as comingled MSW is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
14	Amyoun	-	The waste is dumped in Srar Dumpsite in Akkar	Disposal fees included in the collection fees
15	Anfeh	-	-	-
16	Ajd Ebreen	-	the waste is dumped within the village on a public domain piece of land that is far from residences. Open burning is practiced every now and then.	Disposal fees included in the collection fees
17	Bkifteen	-	Non recyclables as well as comingled MSW is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
18	Btouratej	-	The waste is dumped in Srar Dumpsite in Akkar	Disposal fees included in the collection fees
19	betroumin	Manual sorting at source. Recyclables are further sorted in Bshmezzine facility	Non recyclables as well as comingled MSW is dumped in Srar Dumpsite in Akkar	Disposal fees included in the collection fees
20	bte3boura	-	Non recyclables as well as comingled MSW is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
21	behwayta - Afqa - bechnata	-	-	-
22	Bednayel	-	The waste is sumped in an open Dumpsite in Bednayel	-
23	Bdebba	Manual sorting at source. Recyclables are further sorted in Bshmezzine facility	Non recyclables as well as comingled MSW is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
24	Bersa	-	-	-

No.	Municipality	Sorting Practices	Disposal Practices	
			Description	Associated Cost
25	Bzeeza	Manual sorting at source. Recyclables are further sorted in Bshmezzine facility	The waste is sumped in an open Dumpsite in Bsarma	Disposal fees included in the collection fees
26	Bshemzeen	Manual sorting at source. Recyclables are further sorted in Bshmezzine facility	Non recyclables as well as comingled MSW is dumped in an open Dumpsite in Bechmezzine (within a forest)	Disposal fees included in the collection fees
27	Bserma	Manual sorting at source. Recyclables are further sorted in Bshmezzine facility	Non recyclables as well as comingled MSW is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
28	Botram	-	-	-
29	Dar B3eshtar	Manual sorting at source. Recyclables are further sorted in Bshmezzine facility	Non recyclables as well as comingled MSW is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
30	Dar Shemzeen	Manual sorting at source. Recyclables are further sorted in Bshmezzine facility	Non recyclables as well as comingled MSW is dumped in Adwe Dumpsite in Minieh-Donniyeh District or Srar in Akkar	Disposal fees included in the collection fees
31	Dede	-	The waste is dumped in Adwe Dumpsite in Minieh-Donniyeh District or Srar in Akkar	included in the cost
32	Dechdebbine	-	The waste is dumped in Srar Dumpsite in Akkar	Disposal fees included in the collection fees
33	Ras Masqa	Manual sorting at source. Recyclables are further sorted in Bshmezzine facility	Non recyclables as well as comingled MSW is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
34	Reshdebbine	-	The waste is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
35	Zekroun	-	The waste is dumped in Srar Dumpsite in Akkar	Disposal fees included in the collection fees
36	Afsadeek	-	Waste is dumped in a valley next to Chekka cement factory	Disposal fees included in the collection fees
37	Ain Ekreen	-	The waste is dumped in Srar Dumpsite in Akkar	Disposal fees included in the collection fees
38	Abba	-	The waste is dumped in Srar Dumpsite in Akkar or Adwe Dumpsite in Minieh-Donniyeh District (responsibility go vollection contractor)	Disposal fees included in the collection fees
Bsharre Municipalities				

No.	Municipality	Sorting Practices	Disposal Practices	
			Description	Associated Cost
39	Qnat	-	The waste is dumped in an open dumpsite that serves a number of municipalities in the District of Koura	Disposal fees included in the collection fees
40	Bqaa Kafra	-	-	-
41	Bqar Qasha	-	The waste is dumped in an open dumpsite that serves a number of municipalities in the District of Koura	Disposal fees included in the collection fees
42	Ban	-	The waste is dumped in an open dumpsite that serves a number of municipalities in the District of Koura	Disposal fees included in the collection fees
43	Barhalyoun	-	-	-
44	Bez3oun	-	The waste is dumped in an open dumpsite that serves a number of municipalities in the District of Koura	Disposal fees included in the collection fees
45	Bcharre	-	-	-
46	Hadath El Jebbeh	-	The waste is dumped in an open dumpsite outside the village	Disposal fees included in the collection fees
47	Hadchit	-	Location by the contractor in charge	5.3 M LL/Month
48	Hasroun	-	-	-
49	Torza	-	-	-
50	Abdine	-	-	-
Zgharta Municipalities				
51	Kfar Sghab	Sorting at source as part of the Union source separation program	The waste is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
52	Qorah Bash	Sorting at source as part of the Union source separation program	The waste is dumped in an unknown open dumpsite	Disposal fees included in the collection fees
53	Kfar Fu	-	The waste is dumped in Srar Dumpsite in Akkar District	Disposal fees included in the collection fees
54	Kfar Yachit - Bsebaal	Sorting at source only for bulky items	The waste is dumped in Adwe Dumpsite in Minieh-Donniyeh District	800,000 LL/month
55	Kfar Hatta	-	-	-
56	Kfar Dlaqous	Sorting at source as part of the Union source separation program	The waste is dumped in Adwe Dumpsite in Minieh-Donniyeh District	6-7 Million LBP / Month
57	Kfar Zeina	Sorting at source as part of the Union source separation program	The waste is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
58	Karm Saddeh	Sorting at source as part of the Union source separation	The waste is dumped in Adwe Dumpsite in Minieh-	Disposal fees included in the collection fees

No.	Municipality	Sorting Practices	Disposal Practices	
			Description	Associated Cost
		program	Donniyeh District	
59	Majdlayya (Zgharta)	-	The waste is dumped in Mejdleya	-
60	Maryata - Qadreyyah	-	The waste is dumped in Adwe Dumpsite in Minieh-Donniyeh District	4 M LL/month
61	Mezyara - Harf - Hmeis - Sakhra	-	The waste is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
62	Mazraat Teffah	Sorting at source as part of the Union source separation program	The waste is dumped in an unknown open dumpsite	Disposal fees included in the collection fees
63	Aytou	Sorting at source as part of the Union source separation program	The waste is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
64	Eaal	-	-	-
65	Arde	-	The waste is dumped in Adwe Dumpsite in Minieh-Donniyeh District	3.5MLL/month
66	Bneshay	Sorting at source as part of the Union source separation program	The waste is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
67	Buheira (Zgharta)	Sorting at source as part of the Union source separation program	Responsibility of collection contractor	Disposal fees included in the collection fees
68	Bsaloukit	Sorting at source as part of the Union source separation program	The waste is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
69	Toula-Aslot	-	-	-
70	Haret Al Fouar	-	The waste is dumped in Adwe Dumpsite in Minieh-Donniyeh District	2.5 M LL/month
71	Daraya-Bshennin	-	-	-
72	Rass Kifa	Sorting at source as part of the Union source separation program	The waste is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
73	Rasheen	Sorting at source as part of the Union source separation program	The waste is dumped in an open dumpsite in the village	rental cost
74	Zgharta - Ehden	-	-	-
75	Seb'el	-	The waste is dumped in an unknown open dumpsite	Municplaity refrained from sharing this info
76	Ser'el	-	The waste is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
77	Alma	-	The waste is dumped in Adwe Dumpsite in Minieh-	Disposal fees included in the collection fees

No.	Municipality	Sorting Practices	Disposal Practices	
			Description	Associated Cost
			Donniyeh District	
78	Ain Tourin	-	The waste is dumped in an unknown open dumpsite	Disposal fees included in the collection fees
79	Arabet Kizhaya	Sorting at source as part of the Union source separation program	The waste is dumped in an open dumpsite (responsibility of contractor)	-
80	Arjes	-	The waste is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees
81	Ashash	Sorting at source as part of the Union source separation program	The waste is dumped in Adwe Dumpsite in Minieh-Donniyeh District	Disposal fees included in the collection fees

Municipalities that did not respond to the request for info by the team

As shown in the above table, the bulk of the waste generated from the various municipalities of the study area is currently dumped in various locations. Some of these locations are unknown to some of the municipalities.

While 23% (16 out of the 65) of the interviewed municipalities dump their waste in Srar Dumpsite in Akkar District, 45% (29 out of the 65) of them dump their waste in Adwe Dumpsite in Minieh-Doniyeh District.

The sorting activities are limited to the manual source separation that takes place in some municipalities of the study area.

The below sub-sections describe the existing infrastructure as well as those planned for implementation. Disposal related practices will be discussed in a separate section of the report.

2.4.1. Beshmezzine Facility

Beshmezzine is a small scale facility that receives recyclables that are sorted out at source. According to the operator of the facility, they receive recyclables from 6 municipalities including Beshmezzine, the village where the facility is located. However, 8 of the interviewed municipalities confirmed that they send their source separated materials to Beshmezzine.

Table 37. Municipalities served by Beshmezzine facility

No	Municipality	Reported to be served by the Facility by	
		Operator	Municipality
1	Fee3	✓	✓
2	Kfar Hazeer	✓	✓
3	Bdebba	✓	✓
4	Bzeeza		✓
5	Bshemzeen	✓	✓
6	Dar B3eshtar	✓	✓
7	Dar Shemzeen		✓
8	Betroumin	✓	✓

The operator of the facility indicated that a monthly average of 80tons of recyclables is sold out per month. There is no database record of how much recyclables are received from each of the municipalities served by the plant.

In addition to the source separated waste from the residential units of the beneficial municipalities, the facility also receives recyclables from schools, non-governmental institutions and/or organizations as well as privately owned organizations that implement source separation practices (Red Cross, supermarkets, etc.).

They collect recyclables from the municipalities listed in the above table once or twice a week. The main targeted products are plastics, cardboard, metals and glass.

The received materials are sorted out in the facility manually. According to the Head of the Municipality of Bshemzzine, the manpower of the facility consists of 12 workers as follows:

- 4 workers dedicated to the collection of source separated recyclables;
- 8 workers dedicated to the manual segregation of waste in the facility.

Figure 39. Source separated recyclables at the reception of the facility

Figure 40. Recovered cardboard

Figure 41. On site compactor

Figure 42. inside view of the facility

2.4.2. Koura Biofuel Production Facility

The Koura plant for biofuel production was initiated in 2015 and inaugurated by end of May 2018. The facility was implemented by the Environmental and Energy Economics program at Balamand University's Institute of the Environment, with a budget of nearly 750,000 euros ($875,000). The funding agency of the project was mainly the European Union in Lebanon with a contribution of 600,000 euros for the project through its regional Sustainable Urban Demonstration Projects (SUDEP) program. The rest of the capital investment was jointly allocated by the Koura Municipalities' Union and Balamand University.

The Koura plant proposal was one of the 12 that were accepted by SUDEP out of over 160 applications from Lebanon, Palestine, Jordan, Israel, Tunisia and Morocco. Lebanon got the biggest portion, securing four projects with funding from the EU.

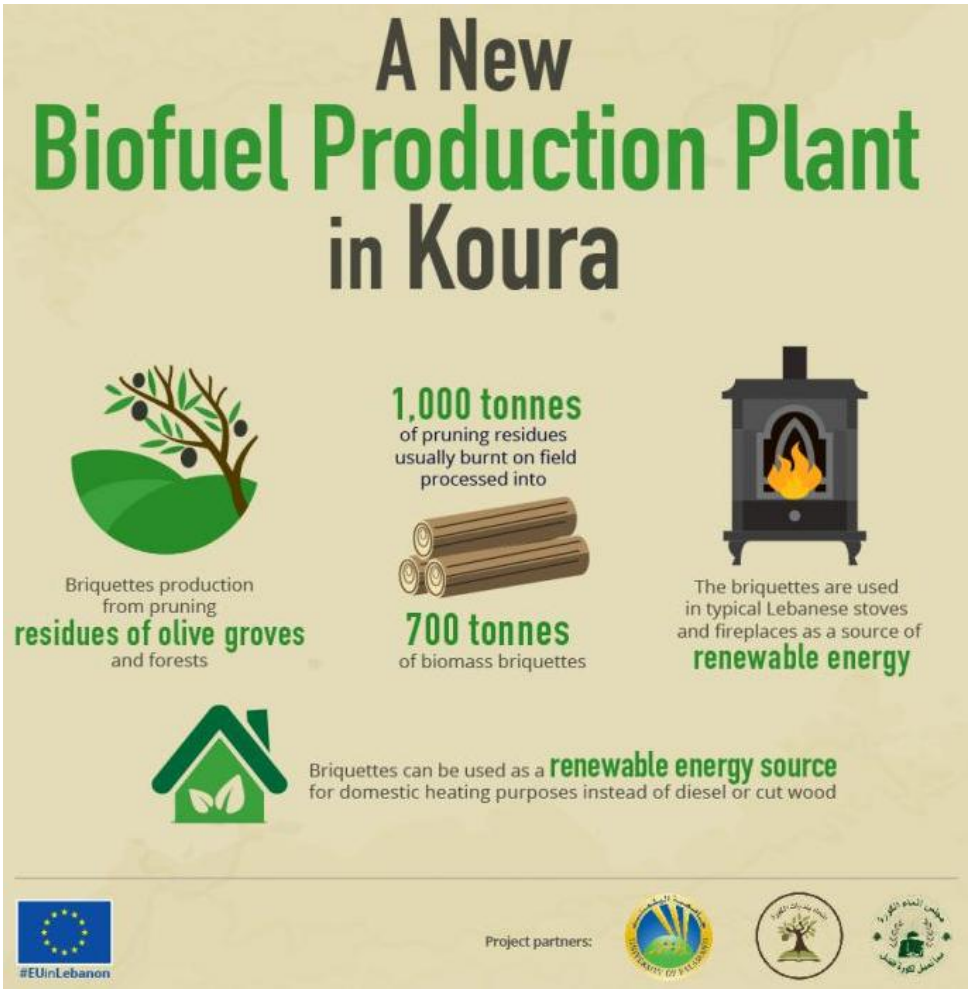


Figure 43. Koura Facility Leaflet

The development of the facility was driven by the facts that:

- **64%** of the Koura district is covered with olive trees;
- The trimmings of the olives trees are usually burned in open air thus imposing a significant risk to the environment and public health.

The plant will be able to accommodate around 1000 tonnes of pruning residue from the district of Koura per year and is designed to produce around 700 tonnes of “briquettes” that can replace fossil fuels as a means to heat households and businesses across the country.

According to the operator of the facility, the plant will cover the heating needs of 85,000 residents.

Figure 44. Koura Biofuel Production Facility

Figure 45. Koura Biofuel Production Facility

Figure 46. Koura Biofuel Production Facility

2.4.3. Alma Sorting facility

This facility is a very small scale facility that is developed under the WASH assistance program for Syrian refugees and affected population in North Lebanon. It was funded by the UNHCR and implemented by Rene Moawad Foundation.

None of the interviewed municipalities referred to this facility. By the time this report was submitted, no information was made available about the capacity of the facility and the type of operations it undertakes.

Figure 47. Photos taken during a school visit organized by RMF to the facility

Figure 48. Photos taken during a school visit organized by RMF to the facility

2.4.4. Lebanese Waste Solutions

The Lebanese Waste Solutions Sarl is a privately owned and operated sorting and recycling factory based in Zgharta North Lebanon. The facility is involved in sorting cardboard, nylon, PET, cans, aluminum, steel, bottles, glass & paper.

The Lebanese Waste Solutions receives the source separated materials collected by Al Midan, an active NGO in Zgharta that is in charge of collecting the source separated recyclables from the members of the Union of Municipalities of Zgharta who are participating in the source separation scheme implemented by the Union.

The facility has a capacity of 10tons/day and is equipped with conveyors and bailers. At the moment they are recovering an average of 70tons/month of recyclables.

2.4.5. Planned Facilities in the Study Area

A MBT facility is planned at the moment for the three districts of the study area as part of the EU funded SWAM II Project. The project shall have a capacity of 300tons/day. No further details are available at the moment.

2.5. Ultimate Means of Disposal

2.5.1. Existing dumpsites

Recently a Master Plan for the closure and rehabilitation of open and uncontrolled dumps in Lebanon was prepared by the Ministry of Environment (MoE) and the United Nations Development Program (UNDP) with the technical assistance of Earth Link and Advanced Resources Development s.a.l. (ELARD). The study was originally prepared in 2011 and was then updated in 2016 due to the Syrian refugee influx and the solid waste crisis that started in July 2015 with the closure of the Naameh Landfill.

The study covered the whole country and more specifically the following four survey areas:

- Area 1: Akkar and North Lebanon
- Area 2: Beirut and Mount Lebanon
- Area 3: Nabatieh and South Lebanon
- Area 4: Beqaa and Baalbek

Dumpsites of highest priority were identified for closure and rehabilitation in light of potential impacts on the environment as based on a prioritization model developed for this purpose. The surveyed dumpsites, whether operational or non-operational, were divided into two types:

- Municipal Solid Waste (MSW) Dumpsite: contains over 85% of MSW in addition to hospital waste, CDW and industrial waste;
- Construction and Demolition Waste (CDW) Dumpsite: contains over 85% of CDW including rubble, green waste, and construction and demolition debris.

According to the above study,

- Bcharre district witnessed a decrease of the order of 70.1% (2,960 m^3) in the volume of waste in both operational and non-operational MSW, and an increase of 11.7% (350 m^3) in that of CDW waste(see Table below).
- Koura district witnessed a decrease of the order of 43.3% (33,650 m^3) in the volume of waste in both operational and non-operational MSW, and an increase of 478% (70,543 m^3) in that of CDW waste(see Table below).
- Zgharta district witnessed a decrease of the order of 78.4% (29,145 m^3) in the volume of waste in both operational and non-operational MSW, and an increase of 36.7% (11,685 m^3) in that of CDW waste(see Table below).

Table 38. Number and Volume Variation of Different Dumpsites in the study area

Year	Operational		Non-Operational		Inaccessible		Grand Total	
	Number	Volume (m^3)	Number	Volume (m^3)	Number	Volume (m^3)	Number	Volume (m^3)
Municipal Solid Waste (MSW) Dumpsites								
2011	4	3,920	1	300	-	-	5	4,220
2011	17	69,920	2	7,680	-	-	19	77,600
2011	5	5,767	6	31,428			11	37,195
2016	39	245,065	27	132,170	-	-	66	377,235
2016	3	61,250	1	0	1	6,000	5	67,250
2016								
Construction and Demolition Waste (CDW) Dumpsites								
2011	1	225,000	-	-	-	-	1	225,000
2011	-	-	-	-	-	-	-	-
2011	27	140,300	-	-	-	-	27	140,300
2016	1	400	1	2,250	-	-	2	2,650
2016	8	14,763					8	14,763
2016	4	3,525	3	16,640			7	20,165

- *Bcharreh District*
- *Koura District*
- *……Zgharta District*

A Prioritization Decision Tool (PDT) was developed in order to prioritize dumpsites for rehabilitation based on a Risk Sensitivity Index (RSI). The RSI was calculated for each dumpsite by multiplying each sensitivity grade by its respective weight followed by an addition of all attributes. A site with a higher RSI indicates more risk to the environment, and thus requires a more urgent intervention. On the contrary, when the total RSI score of a dumpsite is low, its priority for rehabilitation decreases.

The below tables list all the MSW and CDW dumpsites that were identified in the District of Bcharreh, Koura and Zgharta in the 2016 survey along with their status, volume of waste, RSI score and priority rank.

Table 39. Lists of all MSW dumpsites identified in the study area

No.	Site ID	Status	Category	Volume (m^3)	MSWRSI	Priority Rank
Bcharreh District						
1.	O7-Hasroun-0	Non-operational	Rehabilitated	0	25.899	45
2.	O7-Bqarqasha-0	Non-operational	Not Rehabilitated	500	22.372	174
3.	O7-Bazoun-0	Non-operational	Rehabilitated	0	21.933	203
4.	O8-Bqaa Kafra-0	Non-operational	Not Rehabilitated	600	20.714	277
5.	P7-Torza-2	Non-operational	Not Rehabilitated	160	18.906	382
Koura District						
1.	P6-Bichmezzine-0	Non-operational	Rehabilitated-	4,000	26.225	39
2.	Q6-Ras Maska-1	Operational		13,500	22.763	163
3.	P6-Kaftoun-1	Non-operational	Not Rehabilitated	450	22.249	189
4.	Q6-Ras Maska-3	Non-operational	Not Rehabilitated	400	20.149	311
5.	P5-Kfarhata-1	Non-operational	Not Rehabilitated	1,000	20.069	315
6.	P6-Bsarma-0	Operational		4,350	19.583	342
7.	Q6-Btirram-0	Operational		1,400	19.208	366
8.	P6-Majdel-1	Operational		1,250	19.021	376
9.	P6-Aafsiddek-0	Operational		850	18.033	431
10.	P6-Amioun-0	Operational		1,800	17.624	449
11.	P6-Kosba-1	Non-operational	Not Rehabilitated	3,700	16.194	527
12.	P6-Majdel-2	Non-operational	Rehabilitated	0	16.128	529
13.	P6-Kfarhazir-0	Non-operational	Not Rehabilitated	1,100	15.673	545
14.	P5-Kifraya-1	Operational		1,500	15.599	552
15.	P5-Btaaboura-1	Non-operational	Not Rehabilitated	750	14.931	577
16.	P6-Kfar Aaqqa-0	Non-operational	Not Rehabilitated	7,350	14.759	584
17.	P5-Bidneyel-0	Operational		550	14.620	588
Zgharta District						
1.	P7-Kfarsghab-0	Non-operational	Rehabilitated	0	25.661	53
2.	P7-Ijbaa-0	Non-operational	Not Rehabilitated	400	23.705	122
3.	P7-Karm Sadde-2n	Operational		800	23.224	142
4.	P7-Karm Sadde-1n	Operational		1,650	23.211	143
5.	P7-Aintourine-0	Non-operational	Not Rehabilitated	400	22.245	189
6.	Q7-Marh Kfarsghab-1	Non-operational	Rehabilitated	0	21.177	247
7.	P7-Ayto-2	Non-operational	Not rehabilitated	800	20.393	296
8.	Q7-Kfaryachit-0	Non-operational	Rehabilitated	0	19.968	325
9.	P7-Ehden-0	Non-operational	Rehabilitated	0	19.514	345
10.	Q7-Miziara-0	Non-operational	Rehabilitated	0	17.542	452
11.	Q7-Kfarzaina-0	Non-operational	Not Rehabilitated	4,000	13.146	606

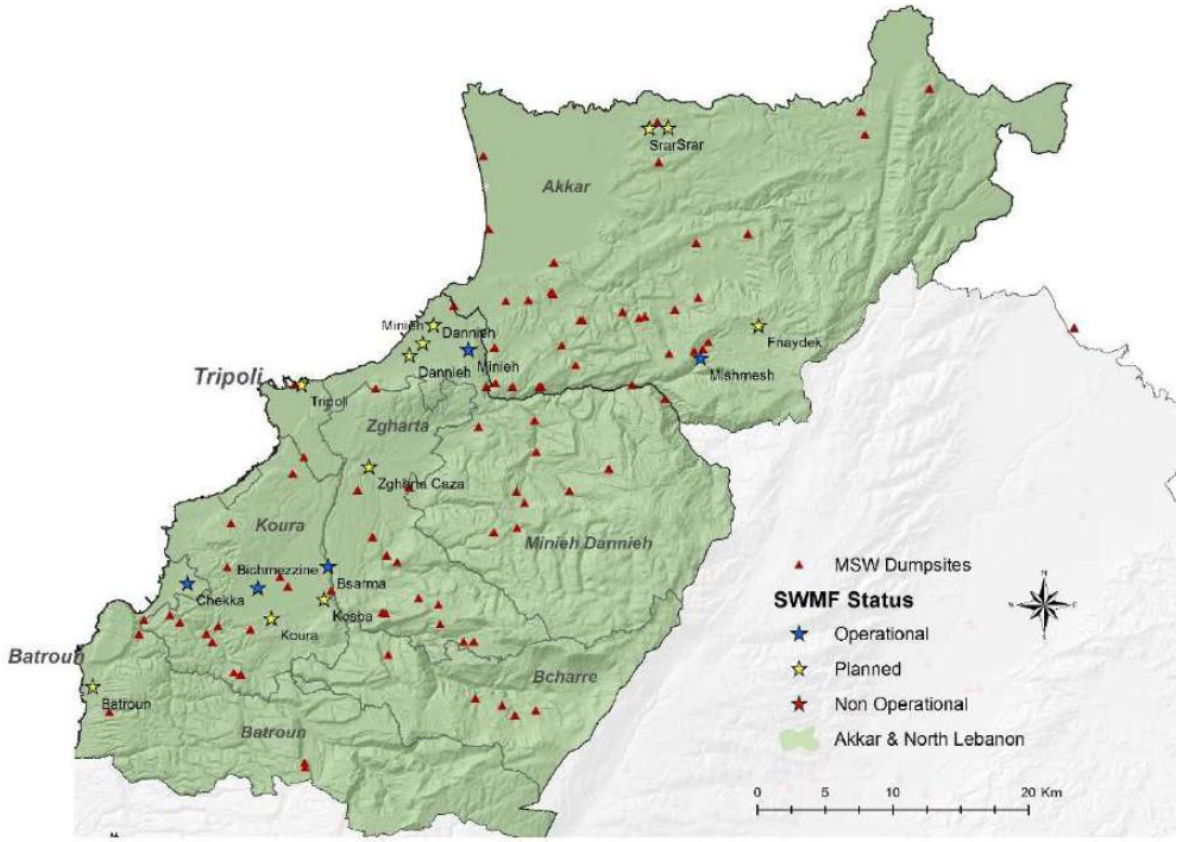


Figure 49. MSW dumpsites in the study area

Table 40. Lists of all CDW dumpsites identified in Baalbek El-Hermel Governorate

No.	Site ID	Status	Category	Volume (m^3)	DRSI	Priority Rank
Bcharreh District						
1.	L8-Chmestar-01	Operational	-	10,000	22.150	11
2.	P7-Hadchit-0	Non-operational	Not Rehabilitated	1,800	17.316	123
3.	O8-Bqaa Kafra-1n	Operational	-	1,200	12.877	271
4.	P7-Torza-1	Non-operational	Rehabilitated	0	9.062	321
Koura District						
1.	P6-Kosba-2	Operational	-	57,700	23.187	5
2.	P5-Heri-2	Operational	-	8,000	19.041	56
3.	P5-Bidneyel-1	Operational		3,700	17.610	110
4.	Q6-Ras Maska-4	Non-operational	Not Rehabilitated	2,000	17.314	124
5.	P6-Qalhaat-0n	Non-operational	Not Rehabilitated	450	17.054	130
6.	P5-Kifraya-2	Non-operational	Not Rehabilitated	5,700	16.437	150
7.	P5-Btaaboura-2	Operational		2,400	15.937	172
8.	P6-Kaftoun-2	Operational		1,000	14.547	224
9.	P6-Kosba-3	Non-operational	Not Rehabilitated	456	13.926	243
10.	P6-Kaftoun-3	Operational		700	13.566	254
11.	Q6-Ras Maska-2	Non-operational	Not Rehabilitated	3,400	13.131	264
Zgharta District						
1.	Q7-Morh Kfarsghab-2	Operational	-	15,200	23.533	1

No.	Site ID	Status	Category	Volume (m^3)	DRSI	Priority Rank
2.	R7-Aachach-0	Operational	-	6,300	20.997	23
3.	P7-Ayto-1	Non-operational	Not Rehabilitated	2,200	18.143	91
4.	P7-Beslouqit-1	Non-operational	Not Rehabilitated	3,000	17.700	108
5.	P7-Beslouqit-2	Non-operational	Not Rehabilitated	150	16.738	138
6.	P7-Karm Sadde-0	Operational	-	1,400	16.343	153
7.	Q7-Aarjis-0	Operational	-	2,000	16.086	165
8.	Q7-Iaal-1	Non-operational	Not Rehabilitated	1,600	15.779	179
9.	Q7-Iaal-2	Non-operational	Rehabilitated	0	10.455	311

2.5.2. Planned Sanitary Landfill

An engineered sanitary landfill is planned at the moment for the three districts of the study area as part of the EU funded SWAM II Project. The project shall have a capacity of 150tons/day. No further details are available.

2.6. Waste Flow Diagram of current system

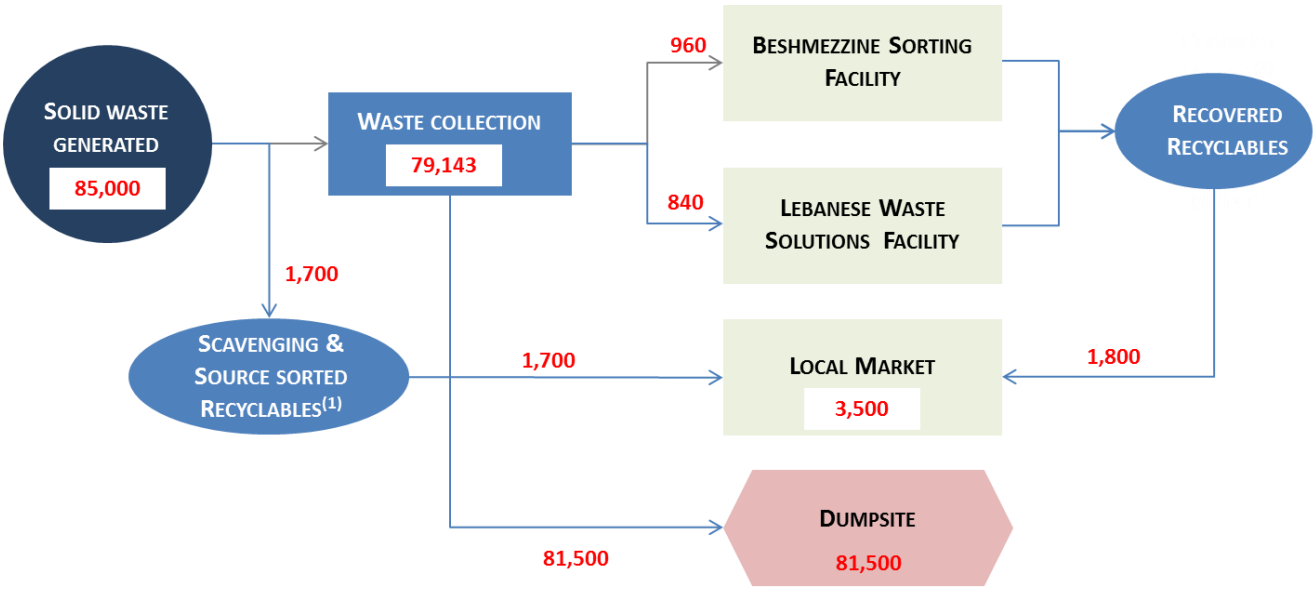
On the basis of what has been presented above, it is apparent that the bulk of the waste is at the moment dumped with a little amount being sorted out through source separation and/or informal recycling by scavengers.

In brief, the following amounts of recyclables are being collected:

- 80tons/month by Beshmezzine facility from the source separated waste in the District of Koura (960 tons/year);
- 10 tons/week in winter season and 20 tons per week in summer season from the source separated recyclables collected by Al Midan NGO from the Municipalities of the District of Zgharta (630tons/year);

We have also assumed that 2% of the total amount of waste is recovered by scavengers that are active on the various dumpsites where the waste of the study area is disposed of.

The current mass flow diagram of the waste is presented in the below chart which reveals a 96% disposal rate.



(1) We assumed a 2% informal recovery by scavengers
All numbers are in tons/year

Figure 50. Current waste flow diagram in the study area

3. FINANCIAL ANALYSIS OF EXISTING MSWM SYSTEM

The Municipal Solid Waste (MSW) financial sustainability entails a cost stream being covered by a revenue stream over the management service lifetime.

On the cost side, the MSW cradle to grave costs vary according to the level and nature of collection (household vs. side-street; bulk vs. separation at source)/street sweeping, transformation (volume and quality of compostable and recyclables) and burial (dump, sanitary dump, landfill).

On the revenue side, a panoply of MSW fees, taxes and incentives and recovery options (linking the fee collection to the mobile bill collection) could be introduced while climbing up the compost and recycling supply chain (quality and quantity) with the aim to reduce the residual landfilling. This could help cover both the capital cost expenditures (CAPEX) and operations and maintenance expenditures (OMEX) of MSW or at least reduce the gap.

3.1. Sources of financing

At the local level, MSW revenues are covered through a direct tax levied at the Municipality level called Arsifa wa Majerir (street clean-up, waste collection as well as cleaning drains and septic tanks) which is equivalent to 30% of the annual rent or rent assessment if the household head is the owner. Municipal budgets were aggregated at the central level thanks to the USAID-University of Albany-supported municipal budget automation program, where it was possible to obtain the total municipal direct revenues by region from 2003 till 2007. Since the end of the program, municipal budget stopped being aggregated. Moreover, municipalities usually remain reluctant to release their budgets.

At the central level, the government and public entities collect numerous fees on behalf of municipalities. These fees are divided into two main categories: (i) Fees collected and directly redistributed to each municipality including arrears; and (ii) Fees collected and deposited into the Independent Municipal Fund (IMFU) including arrears. As for payments for solid waste management, the IMFU bears the brunt of the cost of their respective services in the perimeter of some municipalities.

The IMFU payments, which constitute an important part of the municipal fiscal revenues, are usually backlogged putting some municipalities in precarious situations. The IMFU is distributed as follows:

- 75% to be distributed to municipalities of which 30 percent are earmarked for local development projects and 70 percent for budgetary support: 40 percent is proportional to the population, which is allocated on the basis of the registry office's civil status and

not effective residence and remains a serious issue especially in larger municipalities; and 60 percent is based on the direct taxes/fees amount collected by the municipality over the preceding 2 previous years; and

- 25 % to be distributed to Federations of Municipalities, of which 75 percent are earmarked for local development projects with a priority to under developed areas and 25 percent for budgetary support.

This distribution is in theory but in practice the resulted allocation is not followed. Moreover, the share of MSW in total transfers has been increasing over the year except in 2015 where the solid waste crisis broke out. In 2013 and 2014, they accounted for almost half the transfers hence increasingly forgoing municipal development investments.

The cost recovery with regards to MSW in Lebanon is quite an impossible task and the most recent percentage of cost recovered to total cost of MSW services figures was calculated in the World Bank, 2011. Except for Beirut – Mount Lebanon area that the fee is estimated to cover almost 30% of the sweeping and collection cost, the other regions barely cover 10% of the sweeping and collection cost.

3.2. Cost of Operation of existing system

Information about the operation of the existing waste management system is limited to the operation of the systems in the municipalities that were interviewed which constitute 80% of the total number of municipalities. This shall address the following activities:

- The cost of operation of the street sweeping activities;
- The cost of operation of the waste collection and disposal activities which for most municipalities are managed and handled as one single activity. Few are those municipalities that pay independently for each sub-activity (collection & disposal);

The cost of operation of the existing Beshmezzine sorting facility and the Lebanese Waste Solution Company has not been tackled in the report.

3.2.1. Street Sweeping cost

The Consultant interviewed a significant number of the municipalities of the study area to understand the cost aspects of the street sweeping activities they are handling. The outcome is summarized in the below table:

Table 41. Current cost of the street sweeping activities in the Municipalities of the District

No.	Municipality	Street Sweeping Cost (LL/year)	Waste Quantities (Tons/year)	Unit rate for street sweeping (USD/ton)
Koura District Municipalities				
1	Fee3	54,750,000	584	62.47
2	Qalhat	18,250,000	620	19.62
3	Kaftoun	18,000,000	97	124.19
4	Kfar Qahel	5,760,000	438	8.77
5	Kfar Hata	25,200,000	538	31.23
6	Kfar Hazeer	87,600,000	731	79.93
7	Kfar Saroun	43,800,000	614	47.53
8	Kfar Aqqa	65,700,000	1,315	33.32
9	Kifraya	54,750,000	515	70.93
10	Kosba	54,750,000	2,337	15.62
11	Metreet	1,200,000	27	29.96
12	Majdel - Zakzouk - Wata Fares	7,560,000	292	17.25
13	Nakhle	46,928,571	2,457	12.73
14	Amyoun	87,600,000	3,221	18.13
15	Anfeh	-	-	-
16	Ajd Ebreen	12,775,000	351	24.29
17	Bkifteen	-	252	0
18	Btouratej	1,800,000	878	1.37
19	betroumin	3,780,000	184	13.67
20	bte3boura	4,320,000	134	21.41
21	behwayta - Afqa - bechnata	-	-	-
22	Bednayel	10,950,000	134	54.30
23	Bdebba	7,200,000	131	36.53
24	Bersa	-	-	-
25	Bzeeza	25,550,000	292	58.27
26	Bshemzeen	54,750,000	94	389.33
27	Bserma	-	225	-
28	Botram	-	-	-
29	Dar B3eshtar	10,800,000	1,129	6.38
30	Dar Shemzeen	7,200,000	79	60.7
31	Dede	7,200,000	2,922	1.64
32	Dechdebbine	12,775,000	234	36.45
33	Ras Masqa	91,250,000	5,611	10.84
34	Reshdebbine	7,821,429	175	29.75
35	Zekroun	8,640,000	83	69.32
36	afsadeek	7,200,000	240	20.02
37	Ain Ekreen	7,200,000	614	7.82
38	Abba	4,692,857	219	14.28
Bsharre District Municipalities				
39	Qnat	6,257,143	73	57.01
40	Bqaa Kafra	-	-	-

No.	Municipality	Street Sweeping Cost (LL/year)	Waste Quantities (Tons/year)	Unit rate for street sweeping (USD/ton)
41	Bqar Qasha	21,900,000	1,404	10.40
42	Ban	9,385,714	-	-
43	Barhalyoun	-	24	-
44	Bez3oun	23,464,286	274	57.04
45	Bcharre	-	-	-
46	Hadath El Jebbeh	5,303,082	283	12.48
47	Hadchit	29,200,000	349	55.85
48	Hasroun	-	1,116	-
49	Torza	-	-	-
50	Abdine	-	-	-
Zgharta District Municipalities				
51	Kfar Sghab	15,642,857	304	34.29
52	Qorah Bash	9,600,000	301	21.26
53	Kfar Fu	7,300,000	46	106.51
54	Kfar Yachit - Bsebaal	65,700,000	412	106.28
55	Kfar Hatta	-	-	-
56	Kfar Dlaqous	-	1,169	-
57	Kfar Zeina	1,564,286	269	3.88
58	Karm Saddeh	-	351	-
59	Majdlayya (Zgharta)	109,500,000	8,298	8.80
60	Maryata - Qadreyyah	7,200,000	4,382	1.10
61	Mezyara - Harf - Hmeis - Sakhra	12,000,000	936	8.55
62	Mazraat Teffah	4,158,904	126	22.03
63	Aytou	33,642,857	105	252.80
64	Eaal	-	156	-
65	Arde	35,000,000	1,548	15.07
66	Bneshay	12,250,098	31	267.236
67	Buheira (Zgharta)	3,214,286	58	37.22
68	Bsaloukit	51,100,000	47	730.42
69	Toula-Aslot	-	-	-
70	Haret Al Fouar	876,000,000	1,754	333.05
71	Daraya-Bshennin	-	-	-
72	Rass Kifa	6,414,286	52	83.02
73	Rasheen	43,800,000	1,753	16.66
74	Zgharta - Ehden	-	11,303	-
75	Seb'el	-	304	-
76	Ser'el	15,750,000	146	71.925
77	Alma	18,771,429	1,460	8.57
78	Ain Tourin	4,380,000	24	122.78
79	Arabet Kizhaya	19,162,500	114	111.86
80	Arjes	3,910,714	164	15.92
81	Ashash	18,771,429	298	41.99

Municipalities that did not respond to the request for info by the team

As shown in the above table, higher unit rates could be seen for municipalities that produce a small quantity of waste. In such municipalities, the unit rate is as high as 730USD/ton which is quite a surprising figure. The average unit rates for street sweeping activities in the study area are summarized in the below table:

Table 42. Average Street Sweeping unit rates

No	District	Average street sweeping rate (USD/Ton)
1.	Koura	1.11
2.	Bsharre	7.69
3.	Zgharta	25.52
4	Average Study ARea	23.10

3.2.2. Cost of collection & Disposal services

The Consultant interviewed almost all the municipalities of the District to understand the cost aspects of the collection and disposal services they are handling. The outcome is summarized in the below table:

Table 43. Current cost of the collection & Disposal in the Municipalities of the District

No.	Municipality	Collection & Disposal Cost (LL/year)	Waste Quantities (Tons/year)	Unit rate for collection & disposal (USD/ton)
Koura District Municipalities				
1	Fee3	54,000,000	584	61.62
2	Qalhat	49,200,000	620	52.89
3	Kaftoun	15,600,000	97	107.64
4	Kfar Qahel	15,600,000	438	23.74
5	Kfar Hata	32,400,000	538	40.16
6	Kfar Hazeer	36,000,000	731	32.85
7	Kfar Saroun	82,125,000	614	89.13
8	Kfar Aqqa	90,000,000	1,315	45.64
9	Kifraya	-	515	0.00
10	Kosba	108,000,000	2,337	30.81
11	Metreet	12,000,000	27	299.63
12	Majdel - Zakzouk - Wata Fares	14,400,000	292	32.85
13	Nakhle	46,928,571	2,457	12.73
14	Amyoun	114,000,000	3,221	23.60
15	Anfeh	-	-	-
16	Ajd Ebreen	18,000,000	351	34.23
17	Bkifteen		252	0.00
18	Btouratej	72,000,000	878	54.70
19	betroumin	36,000,000	184	130.20

No.	Municipality	Collection & Disposal Cost (LL/year)	Waste Quantities (Tons/year)	Unit rate for collection & disposal (USD/ton)
20	bte3boura	24,000,000	134	118.98
21	behwayta - Afqa - bechnata	-	-	-
22	Bednayel	12,000,000	134	59.51
23	Bdebba	14,400,000	131	73.05
24	Bersa	-	-	-
25	Bzeeza	36,000,000	292	82.11
26	Bshemzeen	21,600,000	94	153.60
27	Bserma	36,000,000	225	106.55
28	Botram	-	-	-
29	Dar B3eshtar	48,000,000	1,129	28.35
30	Dar Shemzeen	12,000,000	79	101.17
31	Dede	114,000,000	2,922	26.01
32	Dechdebbine	27,600,000	234	78.75
33	Ras Masqa	22,440,000	5,611	2.67
34	Reshdebbine	27,600,000	175	104.99
35	Zekroun	18,000,000	83	144.43
36	afsadeek	18,000,000	240	50.05
37	Ain Ekreen	18,000,000	614	19.54
38	Abba	24,000,000	219	73.04
Bsharre District Municipalities				
39	Qnat	21,600,000	73	196.79
40	Bqaa Kafra	-	-	-
41	Bqar Qasha	21,600,000	1,404	10.26
42	Ban	21,600,000	-	-
43	Barhalyoun	-	24	0.00
44	Bez3oun	23,400,000	274	56.89
45	Bcharre	-	-	-
46	Hadath El Jebbeh	51,600,000	283	121.43
47	Hadchit	63,600,000	349	121.64
48	Hasroun	-	1,116	0.00
49	Torza	-	-	-
50	Abdine	-	-	-
Zgharta District Municipalities				
51	Kfar Sghab	8,300,000	304	18.19
52	Qorah Bash	12,000,000	301	26.58
53	Kfar Fu	13,200,000	46	192.60
54	Kfar Yachit - Bsebaal	24,000,000	412	38.83
55	Kfar Hatta	-	-	-
56	Kfar Dlaqous	-	1,169	-
57	Kfar Zeina	24,000,000	269	59.49
58	Karm Saddeh	21,600,000	351	41.08
59	Majdlayya (Zgharta)	18,000,000	8,298	1.45
60	Maryata - Qadreyyah	30,000,000	4,382	4.56

No.	Municipality	Collection & Disposal Cost (LL/year)	Waste Quantities (Tons/year)	Unit rate for collection & disposal (USD/ton)
61	Mezyara - Harf - Hmeis - Sakhra	108,000,000	936	76.92
62	Mazraat Teffah	14,400,000	126	76.30
63	Aytou	18,000,000	105	114.04
64	Eaal	-	156	-
65	Arde	66,000,000	1,548	28.42
66	Bneshay	21,600,000	31	471.20
67	Buheira (Zgharta)	8,458,333	58	97.95
68	Bsaloukit	12,000,000	47	171.53
69	Toula-Aslot	-	-	-
70	Haret Al Fouar	44,400,000	1,754	16.88
71	Daraya-Bshennin	-	-	-
72	Rass Kifa	13,800,000	52	178.64
73	Rasheen	-	1,753	-
74	Zgharta - Ehden	-	11,303	-
75	Seb'el	-	304	-
76	Ser'el	19,800,000	146	90.41
77	Alma	10,800,000	1,460	4.93
78	Ain Tourin	12,000,000	24	336.36
79	Arabet Kizhaya	-	114	-
80	Arjes	13,800,000	164	56.19
81	Ashash	24,000,000	298	53.69

Municipalities that did not respond to the request for info by the team

Similarly to the street sweeping cost analysis, the lower the quantity of generated waste, the higher the cost of collection and disposal. Indeed, a unit rate as high as 471USD/ton was observed in the municipality of Bneshay.

The average unit rates for collection and disposal services in the study area are summarized in the below table:

Table 44. Average collection & disposal unit rates

No	District	Average collection & disposal rate (USD/Ton)
1.	Koura	30.49
2.	Bsharre	38.48
3.	Zgharta	9.99
4	Average Study Area	19.96

3.2.3. Overall System Cost

Considering the whole picture of the study area, the following issues should be noted:

- Since most of the manpower working on the waste management services in the municipalities consists of non-full time employees, the recent increases of the public-sector workers salaries are not expected to affect current collection costs.
- The municipalities handling their own waste collection services have an efficient waste collection system with an acceptable average collection cost. However, for small municipalities the cost is high reaching a maximum as high as 471USD/ton.
- Most of the waste is dumped in open uncontrolled dumpsites outside the study area and mainly in the Districts of Akkar and Minieh-Doniyeh. The cost of disposal is include within the collection cost;
- Source separation is active in the study area and is expected to improve with time if properly followed up;
- According to the interviewed municipalities, scavenging is active at the dumpsites where the waste is disposed of and that it is forbidden in the municipalities. Because the dumping of the bulk of waste is outside the geographic limit of the study area, the informal recovery of recyclables is practiced there. In addition, the project team did not witness any scavenging activity during the various sites visits made.

Based on the data collected and the **waste flow diagram** that has been already presented, next table presents the costs of waste management in 80% of the municipalities of the study area.

Table 45. Cost of operation of the current MSWM scheme

Component	tons/year	US $/ton	Total (US $/y)
Street Sweeping	85,000	23.10	1,963,500
Collection*		19.96	1,696,600
Disposal	81,500		
TOTAL	**-**	**43.06**	**3,660,100**

* Excluding the fees paid by the municipalities for the continuous replacement of the waste storage containers which takes place every now and then according to the municipalities

Roughly 54% of the total cost is for street sweeping while the rest goes for waste collection and disposal services.

Considering the permanent Lebanese population (240,000 people), the average cost per capita and year is estimated at ***15.25 USD/Capita/Yr*** or about ***1.27 USD/Capita/month*** which is very low.

Using as benchmarking the annual expenditures of individuals in North Lebanon Area (5,976 US $/yr) as they are analyzed in the 2012 household survey, the cost of waste management is just 0.26% of the individuals annual expenditures. For a quick comparison, the annual expenses for waste is equivalent to 1/3 of the expenses for coffee, tea and cocoa (49 US $/y).

3.3. External costs

3.3.1. Environmental damages

The environmental cost of dumpsites is the cost due to environmental damages to atmosphere, CO2 emissions, water, soil, flora, fauna and of course of general environmental degradation. Since the polluters, under the current market and public policy conditions in Lebanon, do not pay for those damages, they are called externalities.

Dumpsites externalities split into fixed (independent of the quantity of waste) or variable (depending on the quantity of waste) costs. Most waste externalities such as emissions to air, water and soil are variable external costs. Disamenity effects of dumpsites mostly fixed external costs.

Regarding dumpsites most of the available information is on air emissions and less information exists on the emissions to soil and water. There is substantial literature and research on the quantification and valuation of the impacts of conventional air emissions and their resulting damage. The dispersion and impact patterns are relatively uniform once pollutants are emitted. Therefore, it is relatively easy to generalize the damage estimates and to apply such estimates widely. It can thus be concluded that valuation results in this field can be considered to be quite comprehensive and fairly robust although they are of course still subject to uncertainties. These uncertainties are reflected in relatively wide ranges of estimates. Other air emissions such as heavy metals and dioxins are, however, quantified relatively rarely.

Pollution pathways of emissions to soil and water are quite site-specific and difficult to measure. They depend largely on the quality of the soil, and on the specific location of the dumpsite with respect to for example groundwater reservoirs and receiving waters. Therefore, calculations on soil and water externalities must be considered as relatively uncertain.

Furthermore, the knowledge of the long-term effects from dumpsites in Lebanon is highly limited today due to the mere fact that such sites have not been studied in details, with appropriate methodologies. But it is more than sure, that damages may happen several decades

after the emission has occurred. This raises the question of discounting and intergenerational distribution. How should a damage that occurs today be valued compared to a damage that happens in the future? Discounting is continuously subject of debate and the choice of the discount factor is very important for the results of our assessment.

For all those reasons, in our effort to assess the cost of environmental damages of dumpsites in Lebanon, it was decided to use the most conservative approach. This means that the results that are presented below are probably on the low side of the real damages, or in other words the cost of the environmental damages is probably underestimated. The methodology used is based on the EU study "Economic Valuation of Environmental Externalities from Landfill Disposal and Incineration of Waste", which was implemented by EU DG ENVIRONMENT in 2000. Justification of the valuation techniques have been made based on the more recent study on the cost of landfilling and dumpsites "The full cost of landfilling in Australia", published at 2009 by the Department of the Environment, Water, Heritage and the Arts.

The table below summarizes the environmental cost components (externalities) that were identified as most suitable for the Lebanese conditions, in unit costs ($ per ton).

Table 46. Monetization of dumpsites environmental impacts

Component	Cost ($ / ton of waste disposed of)
Global warming	3.9 – 8.5
Air pollution	0.5 - 1
Leachate	3.5 - 8
Disamenity	3.5-7
TOTAL	**11.4 – 24.5**

Applying the previous to the specific area in which **81,500** tons are dumped annually, the following figures are provided.

Annual Cost of environmental damages: 0.93 – 1.99 USD million

Average Cost of environmental damage per ton of waste dumped: 18.00 USD/ton

Cost per capita: 4.79 USD/capita/year

The average cost of the environmental damage for the next 10 years, if the current uncontrolled disposal practice will not change, is going to be around 14.7 million USD.

3.3.2. Health damages

The health cost can be assessed through the benefits lost due to the health impacts, direct and indirect, that are caused by dumpsites - those benefits include the direct healthcare system costs, the losses of working time due to health problems as well as the psychological impacts of living nearby the dumpsites.

One of the most important challenges is to assess the economic burden posed to national and local health systems by dumpsites. Environmental pollutants can have direct and indirect effects on human health. Moreover, there are economic effects, e.g. on health care, productivity, recreation and intrinsic losses through disruption of ecosystems. National and international organizations increasingly request monetization of such effects for cost-effectiveness or cost-benefit evaluations. While some environmental health professionals regard the valuation of human health as unethical, it seems that the majority considers it a natural (though utilitarian) extension of burden of disease assessments.

Although the scientific and technical challenges involved in such an effort are high, the relevant concepts are under development and some key concepts should be taken into consideration. For the assessment of health costs related to dumpsites in Lebanon, we followed the methodology proposed by Carla Guerriero & John Cairns at "The potential monetary benefits of reclaiming hazardous waste sites in the Campania region: an economic evaluation", Environmental Health 2009. The costs per disease were assessed using the data provided by OECD at Environment Working Paper nr. 35 "Policy Interventions to Address Health Impacts Associated with Air Pollution, unsafe Water Supply and Sanitation, and Hazardous Chemicals", written by Prof. Alistair Hunt at 2011.

To apply this methodology, we made a rather conservative assumption that only 1% of the population of the study area is affected by health impacts. Thus, the assumption means that the health impacts posed by dumpsites are affecting about 3,060 people, an approach which is also rather conservative. In practice, this could be anything between 1-5%, as we know from international experiences.

The benefits lost (or the health costs related to dumpsites) by each person affected have been assessed between 350 - 500$ per year.

Applying the previous, the results are as follows:

Annual cost of health damages: 1.07 – 1.5 USD million

Average health cost per ton of waste dumped: 15.96 USD/ton

Average health cost/cap/y: 4.25 USD/y

3.4. Total costs

The next table presents the total cost of waste management for the study area per ton of waste managed and per capita.

Table 47. Total cost of waste management in the study area

Component	Average Cost	
	(USD/ton)	(USD/Capita/yr)
Direct Cost	43.06	11.96
Environmental cost	18.00	4.79
Health cost	15.96	4.25
Total	**77.02**	**21.00**

The main conclusion is that including the environmental and health costs involved from the current practice of uncontrolled dumpsites, the real cost of waste management goes much higher (between 61 and 77 USD/ton) comparing to the direct cost which assessed at 43.06 USD/ton.

The environmental and health cost of continuing the current business model, with the dominance of the uncontrolled dumpsites for the next 10 years, is around 28 million USD. Although this is not a direct cost, it is better understood through the costs for closing the dumpsites and rehabilitating them which is just a part of the total environmental and health damage.

4. Existing Public Awareness & Education Programs on MSWM

In comparison to other districts, source separation is quite active in the study area and mainly in the districts of Zgharta and Koura.

As far as Zgharta District is concerned, sorting at source was initiated two years ago (2016), using a pilot area of 10 municipalities encompassing around 2,000 households. The main stakeholders involved in the planning and implementation of the source separation are:

- Union of Municipalities of Zgharta as the main beneficiary and the managing entity;
- Al Midan, a local NGO, that initiated and implemented the whole campaign and is still involved in the collection of the source separated recyclables;
- Mercy Corps, an international NGO, that allocated the necessary fund for the implementation of the project.

Awareness campaigns were originally initiated in schools tackling the future generations followed by town halls' meetings in churches and mosques to target everyone. Many individual

meetings were held with the municipalities to further explain the planned source separation activities and highlight the environmental and financial benefits of the project.

The campaign was done on a door-to-door basis. The training was assured by 10 groups of trainers, comprising 4 people each who used to explain to every single household how the sorting at source takes place, providing them with the necessary bins. Follow-up visits were maintained to evaluate the efficiency and highlight any drawbacks and/or difficulties encountered.

The first pilot campaign received a high success and positive feedback. The union then decided to fund the continuum of this project to another 8,000 households in the District. Nowadays, 21,000 households in the Zgharta District are sorting at source. The Union is planning a future campaign to target 20,100 additional households.

At the moment, 52% of the villages of the District of Zgharta are part of the project. The efficiency varies for as low as 10-15% to as high as 90%.

The target of the Union is to become the first District to apply sorting at source in Lebanon within the next 2 months.

Figure 51. Leaflet of the source separation campaign

In Koura District, on the other hand, the source separation scheme under implementation was not organized at the level of neither the union nor the District. The initiative came from the individual municipalities. At the time this report was drafted 20% of the Municipalities of Koura were practicing source separation.

For the rest of municipalities and based on the interviews held with them, attempts for sorting at source initiatives have been taken in many villages. Most of the times, the progress was hindered by absence of necessary funds.

The below table summarizes the information obtained from the different municipalities in relation to previous, current or planned awareness campaigns for sorting at source:

Table 48. Existing sorting at source practices

No.	Municipality	Description
Koura District Municipalities		
1	Fee3	Source separation was already initiated in the Municipality. A total of 450 residences are efficiently participating. The recyclables are collected by the operator of Bshemzzine facility.
2	Qalhat	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
3	Kaftoun	-
4	Kfar Qahel	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
5	Kfar Hata	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
6	Kfar Hazeer	A source separation scheme is already in place. The NGO, Mercy corps, provided residences with 80L plastic containers dedicated for the storage of recyclables (plastic, metals, glass, and cardboard). One container is supplied per residence (a total of 650Residences). These containers are emptied in big red 4 wheeled containers that are distributed in the village (100 pieces). The containers are collected every Wednesday by the operator of Bshmezzine facility. This separate collection service costs the municipality 500USD/month. If impurities or organic/mixed waste is thrown in the red containers, they are not collected by Bshmezzine facility operator.
7	Kfar Saroun	The municipality collects recyclables form large producers like supermarkets (Mainly cardboard and plastic). However, this activity is limited because of the lack of storage area The Municipality is interested in implementing source separation schemes at the level of residences if the necessary technical and financial means are made available.
8	Kfar Aqqa	10-15% of the residents practice sorting at source. The sorted materials are collected by the operator of Bshmezzine facility by a pickup that is supplied by the municipality of Kfar Akka.

No.	Municipality	Description
		The Municipality is interested in expanding the extent of the source separation scheme but this is hindered by the lack of financial means.
9	Kifraya	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
10	Kosba	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
11	Metreet	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
12	Majdel - Zakzouk - Wata Fares	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
13	Nakhle	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
14	Amyoun	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
15	Anfeh	-
16	Ajd Ebreen	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
17	Bkifteen	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
18	Btouratej	The Municipality is currently working on awareness campaigns for source separation
19	betroumin	Mercy Corps conducted awareness campaigns for sorting at source 1.5 years ago. The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
20	bte3boura	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
21	behwayta - Afqa - bechnata	-
22	Bednayel	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
23	Bdebba	The Municipality is implementing sorting at source. Recyclables are taken to Beshmezzine facility.
24	Bersa	-
25	Bzeeza	The Municipality is implementing sorting at source. Recyclables are collected by the operator of Beshmezzine facility once per week.
26	Bshemzeen	The Municipality is implementing sorting at source. Recyclables are collected by the operator of Beshmezzine facility.
27	Bserma	No sorting at source

No.	Municipality	Description
		The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
28	Botram	-
29	Dar B3eshtar	The Municipality is implementing sorting at source. Recyclables are collected and transported to Beshmezzine facility. An additional cost of 1,500,000 LL/month is paid by the municipality for the collection of recyclables (including workers, oil, fuel…)
30	Dar Shemzeen	The Municipality is implementing sorting at source. Recyclables are collected by the operator of Beshmezzine facility once per week.
31	Dede	-
32	Dechdebbine	An awareness campaign for source separation was organized but the residents were not responsive
33	Ras Masqa	Awareness campaigns for source separation were organized and implemented in a pilot area (Tallet Naji) around 1 year ago. As part of the campaign, barrels and plastic bags of different colors were distributed to residents for the storage of recyclables.
34	Reshdebbine	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
35	Zekroun	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
36	afsadeek	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
37	Ain Ekreen	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
38	Abba	There was a plan to initiate a sorting at source in coordination with Mercy Corps. However, the plan was not executed for lack of funding.
Bsharre District Municipalities		
39	Qnat	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
40	Bqaa Kafra	-
41	Bqar Qasha	-
42	Ban	-
43	Barhalyoun	-
44	Bez3oun	An awareness campaign for source separation organized. However, nothing was implemented for lack of funding
45	Bcharre	-
46	Hadath El Jebbeh	A source separation scheme is currently under study by the municipality
47	Hadchit	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
48	Hasroun	-
49	Torza	-

No.	Municipality	Description
50	Abdine	-
Zgharta District Municipalities		
51	Kfar Sghab	They are participating in the source separation scheme implemented by the Union and described earlier
52	Qorah Bash	They are participating in the source separation scheme implemented by the Union and described earlier
53	Kfar Fu	-
54	Kfar Yachit - Bsebaal	Source separation is practiced only for bulky items which are picked up once a week
55	Kfar Hatta	-
56	Kfar Dlaqous	They are participating in the source separation scheme implemented by the Union and described earlier
57	Kfar Zeina	They are participating in the source separation scheme implemented by the Union and described earlier
58	Karm Saddeh	They are participating in the source separation scheme implemented by the Union and described earlier
59	Majdlayya (Zgharta)	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
60	Maryata - Qadreyyah	-
61	Mezyara - Harf - Hmeis - Sakhra	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
62	Mazraat Teffah	They are participating in the source separation scheme implemented by the Union and described earlier
63	Aytou	They are participating in the source separation scheme implemented by the Union and described earlier
64	Eaal	-
65	Arde	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
66	Bneshay	They are participating in the source separation scheme implemented by the Union and described earlier
67	Buheira (Zgharta)	They are participating in the source separation scheme implemented by the Union and described earlier
68	Bsaloukit	They are participating in the source separation scheme implemented by the Union and described earlier
69	Toula-Aslot	-
70	Haret Al Fouar	-
71	Daraya-Bshennin	-
72	Rass Kifa	They are participating in the source separation scheme implemented by the Union and described earlier
73	Rasheen	They are participating in the source separation scheme implemented by the Union and described earlier
74	Zgharta - Ehden	-

No.	Municipality	Description
75	Seb'el	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
76	Ser'el	The Union of Municipality organized and implemented a recent awareness campaign in preparation for the implementation of source separation. Necessary bins were distributed to the residents.
77	Alma	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
78	Ain Tourin	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
79	Arabet Kizhaya	They are participating in the source separation scheme implemented by the Union and described earlier
80	Arjes	No sorting at source The Municipality is interested in implementing source separation schemes if the necessary technical and financial means are assured.
81	Ashash	They are participating in the source separation scheme implemented by the Union and described earlier

Municipalities that did not respond to the request for info by the team

5. PUBLIC PRIVATE PARTNERSHIPS

The Lebanese Parliament ratified the Public Private Partnership (PPP) law in August 16, 2017. The Law was officially published under Law No 48 in the Lebanese gazette No 42 on the 14th of September 2017 and was effective since then.

This Law has been long awaited for despite the history of existing different types and forms of PPP contracts in Lebanon (management contracts, BOT contracts, Lease Contracts and Concession contracts). Examples include Electricity of Zahle (Concession, 1960), Liban Post (BoT, 1998), Beirut International Airport (Concession, 2000), Mobile Operators (Management Contract, 2004), Power Generation Ships (Lease, 2012), etc.

In the absence of this Law, a lot of planned investments for infrastructure development projects have been delayed and even cancelled. Indeed, there is a competition amongst countries to attract international developers and lenders who usually have preference for countries with a clear and supportive legal framework for such developments. Prior to the PPP Law enactment, the existing legal framework in Lebanon did not offer the customary guarantees that foreign investors and international financial institutions often seek in order to have visibility on the rules of the game and reduce the project risks. The absence of these parameters has impeded the success rate of PPP projects to date.

It is believed that the recent passing Law will put Lebanon in a more competitive position not only to attract investments (mainly from international financial institutions) but also to bring international expertise to the country, create thousands of job opportunities while eventually increasing revenues and stimulating the economic growth.

For the specific case of the solid waste management sector in Lebanon where the majority of the municipalities lack the financial resources as well as a qualified and motivated human resources base, the Public-private partnerships is a promising alternative to improve MSW management performance with privately owned enterprises.

This section of the baseline report presents a brief overview of the main provisions of Law No 48.

Table 49. Main provisions of Law No 48

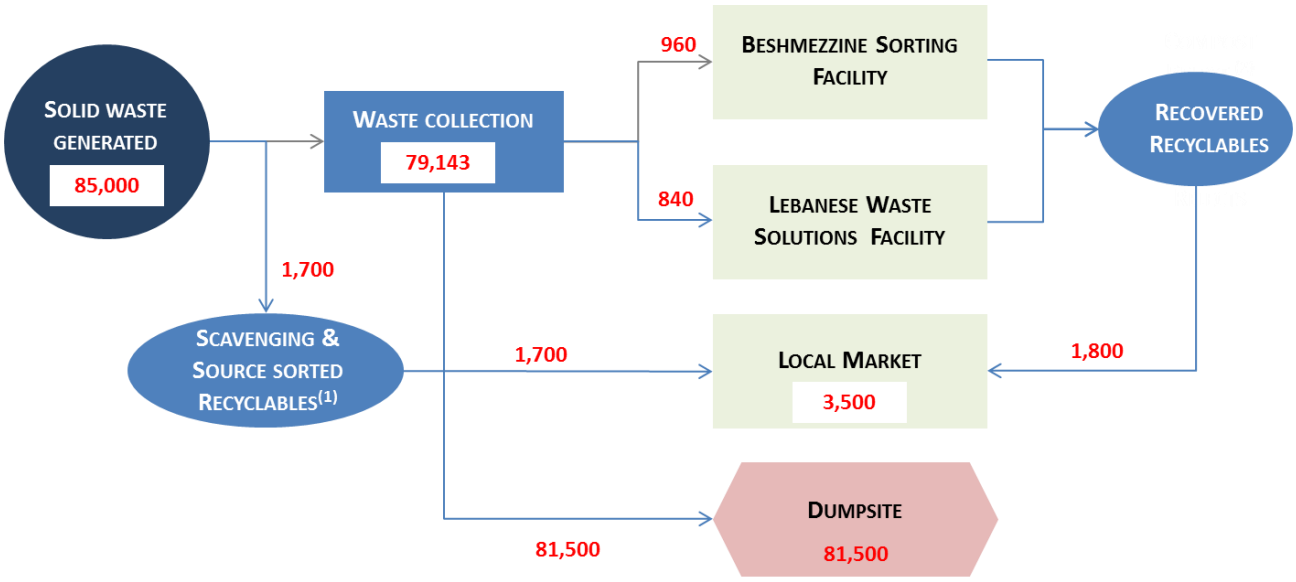
No	Provision	Description
1.	General	The Law defines a clear mechanism for tendering for PPP projects; It sets the general institutional framework; It calls for the creation of a project committee and supporting working groups for each project It defines the key elements of the PPP project agreement
2.	Definition	PPP projects are projects of public nature in which the private sector will finance, administer and provide at least one of the following services: design, build, construction, restoration, equipment, maintenance, rehabilitation and operation
3.	Beneficiaries	The PPP Law covers all projects carried out by the Government or state, the public institutions, and any public entity. It covers sectors such as telecommunications, electricity, civil aviation, etc. The scope of the Law could be expanded to cover PPP projects carried out by municipalities and /or union of municipalities
4.	Project agreement	The project agreement is the main contract that governs the contractual relationship between all stakeholders including the public authority, the project company, international financial institutions, foreign investors, others. The Law specifies the key provisions to be integrated and accounted for in the project agreement including without being limited to obligations and rights, financing basis, duration (cannot exceed 35 years), revenues, KPIs, reporting requirements, guarantees, transfer procedures, dispute settlement procedures, etc.
5.	Authorities	Based on the stipulations of the new Law, the “High Council for Privatization” instituted by virtue of the Privatization Law No.228 dated 31st of May 2000 is renamed as the “High Council for Privatization and PPP” and is granted the authority to: Assess and evaluate PPP proposals Establish a PPP Project Committee for every approved PPP project Decide on the outcome of Pre-qualification evaluations Approve the tender documents Confirm the winning of any tendering process
6.	PPP Project Committee	The project committee, having the Secretary General of the High Council for Privatization and PPP as a President, is in charge of the following: Preparing a comprehensive study of the PPP project

No	Provision	Description
		Setting the pre-qualification criteria Assessing investors interest Management and administration of the application process Evaluation of prequalification applications Preparation of tender documents Review of bids Negotiation with retained bidder
7.	PPP Project Company	The winning bidder private partner is required to incorporate a Lebanese joint stock company, the PPP project Company, which will be in charge of executing the PPP project. The Company will benefit from exemptions from nationality related restrictions imposed by the Lebanese code of commerce. The Law further differentiates between the establishment phase of the company and the operation phase.

The procedure that every PPP project will undergo is illustrated in the form of a flowchart as shown in Annex 2.

6. THE BASELINE OF THE STUDY AREA IN BRIEF

This section describes the current waste management conditions in the study area using proper indicators that cover both the technical, environmental and financial aspects of the existing waste management system. The calculations are based on the waste flow diagram that describes the current waste management system in the area.



(1) We assumed a 2% informal recovery by scavengers
All numbers are in tons/year

Figure 52. Waste flow diagram in the study area

The waste flow diagram shows that the biggest and most urgent problem of the District is to stop the disposal of waste without treatment in open dumps.

The next table presents the main indicators that describe the system in brief. In all first five indicators, the percentages are calculated with the total waste generated as the denominator. The final three indicators are qualitative ones and their ranking is based on the information that has been already presented in this baseline.

Table 50. Waste Management in the study area in brief

INDICATORS	MEANING	VALUE	COMMENTS
PUBLIC HEALTH PROTECTION		**LOW**	
Waste Collection Coverage %	The indicator shows how much of the population is served by regular collection services	100%	Collection covers all the population, but it is inefficient and not well organized
Uncontrolled disposal rate	The indicator shows how much of the waste is dumped in uncontrolled dumpsites	96%	This is an alarming signal that demonstrates serious public health and environmental risks. Closing the dumpsites and ensuring safe disposal to sanitary landfills is the number one priority.
ENVIRONMENTAL PROTECTION		**LOW**	
Diversion rate	The indicator shows how much of the waste generated is not dumped (recovered plus moisture losses)	4.1%	51% of this diversion is due to source separation by residents and the rest by the informal recyclers
RESOURCE MANAGEMENT		**LOW-MEDIUM**	
Recovery rate	The indicator shows how much materials are recovered	4.1%	51% of this diversion is due to source separation by residents and the rest by the informal recyclers
Waste streams managed by the informal recyclers	The indicator shows what part of the waste generated is managed outside the formal waste management system	2%	
INSTITUTIONAL DEVELOPMENT	The indicator shows if there are sound institutions and pro-active policies in place	**LOW-MEDIUM**	The unions in the district are strong but there are still problems with the overall cooperation of the municipalities and the planning efforts in place, while the technical and legal capacity is limited.

INDICATORS	MEANING	VALUE	COMMENTS
SOCIAL INCLUSION	The indicator shows if the current system is inclusive, providing transparent spaces for stakeholders to contribute as users, providers and enablers	**LOW**	There is a need for more specific and detailed procedures for stakeholders engagement as well as for detailed reporting on the results of the current waste management system.
FINANCIAL SUSTAINABILITY		**LOW**	The cost recovery rate is very low. The financial stability of the system in place is questionable. There is a complete lack of accountability in financial issues. The overall cost is not low and a serious upgrade of the system is possible within the affordability levels of the population.

SUB-ACTIVITY 1.1

ANNEXES

ANNEX 1 – HEALTH IMPACTS OF DUMPSITES

Introduction

Several population studies document (scientifically) that dumpsites can have serious effects on the health and well being of the population[1]. A wide range of toxic substances can be released into the environment from uncontrolled waste disposal, for example, methane, carbon dioxide, benzene and cadmium. Many of these pollutants have been shown to be toxic for human health. The International Agency for Research on Cancer[2] classifies exposure to cadmium and benzene as highly carcinogenic for humans. In addition, dumpsites are likely to contain highly hazardous compounds resulting from industrial production, for example asbestos and lead. Previous epidemiological studies have found that two main health outcomes – cancer and congenital malformations – are statistically associated with waste exposure in dumpsites.

But before going into the details, the conceptual framework that describes the heath risks and impacts associated with dumpsites will be outlined. Understanding this conceptual framework is necessary in order to put all the other elements in the right place. The health impacts related to dumpsites are directly linked with the types of the different waste streams that are disposed off. Different waste streams involve different health and safety risks. Besides the usual municipal waste, hazardous waste, health-care waste and e-waste are going to be discussed.

Dumpsites' on-site activities might increase or decrease the related health risks. Uncontrolled scavenging and open burning of waste, either for volume reduction or for metal recovery, are two of the most usual causes for increased health risks. Occupational health risks and impacts to dumpsites workers and informal sector recyclers (ISR) will be addressed, as this is a key-issue for a big part of the world and an important component of the on-going research.

Conceptual framework

The health risks and impacts by dumpsites are associated to some of the pollutants (or hazardous substances) that are found in waste streams or to pollutants that are created at the dumpsite environment through physic-chemical interactions.

In general terms, pollutants can move through air, soil, and water. They can also be on plants or animals, and can get into the air, the food chain and the water.
The different ways a person can come into contact with pollutants are called exposure pathways. There are three basic exposure pathways: inhalation, ingestion, and skin contact. Inhalation is breathing or inhaling into the lungs. Ingestion is taking something in by mouth. Skin contact occurs when something comes in direct contact with the skin. Ingestion can be a secondary exposure pathway after skin contact has occurred.

[1] Carla Guerriero and John Cairns, The potential monetary benefits of reclaiming hazardous waste sites in the Campania region: an economic evaluation, *Environmental Health* 2009, **8**:28 doi:10.1186/1476-069X-8-28

[2] IARC: Monographs on the Evaluation of Carcinogen Risks to 29. Humans. Beryllium, Cadmium, Mercury and the Glass Manufacturing Industry. Volume 58. Lyon: International Agency for 30. Research on Cancer; 1993.

Exposures can be either acute or chronic. An acute exposure is a single exposure to a hazardous substance (pollutant) for a short time. Health symptoms may appear immediately after exposure; for example, a burn when exposed to a strong acid such as from a leaking battery.

Chronic exposure occurs over a much longer period of time, usually with repeated exposures in smaller amounts. For example, people who lived near Love Canal[3], a leaking hazardous waste dump, did not notice the health effects of their chronic exposure for several years. Chronic health effects are typically illnesses or injuries that take a long time to develop, such as cancer, liver failure, or slowed growth and development. One reason chronic exposure to even tiny amounts of hazardous substances can lead to harm is bioaccumulation. Some substances are absorbed and stay in human bodies rather than being excreted. They accumulate and cause harm over time.

Adverse health effects are dependent on the factors of the exposure. Factors that play a part in whether or not adverse health effects may result from an exposure are:

- The type of pollutant;
- The amount or dose (the amount or level of a pollutant a person was exposed to);
- The duration (how long did exposure occur) and
- The frequency (how many times the person was exposed).

Consequently, any effort to associate dumpsites with health risk and impacts will certainly involve evaluation of the following parameters[4]:

- Mass rate of release of both waterborne and airborne pollutants.
- Areal extent of contamination, and persistence and transformation of the pollutants and their transformation products.
- Concentrations and gradients of those pollutants that adversely impact air, water and land resources.
- Number of people and especially sensitive populations that could be influenced by the release of pollutants from the site.
- Total period of time over which pollutant release will occur.
- Duration of exposure.
- Synergistic and antagonistic impacts of other pollutant releases or adverse health conditions that might cause an exposed population to be more susceptible to pollutants derived from the site.
- Characteristics of the site such as the depth of solid waste and degree of compaction.
- Characteristics of the wastes accepted by the site owner/operator during the dumpsites' active life.
- Size of the site as defined by the total amount of solid waste disposed of and the areal extent.

The whole process of assessing the health risks and impacts of a dumpsite is really difficult and requires high expertise, time and financial resources in order to be completed. Its successful

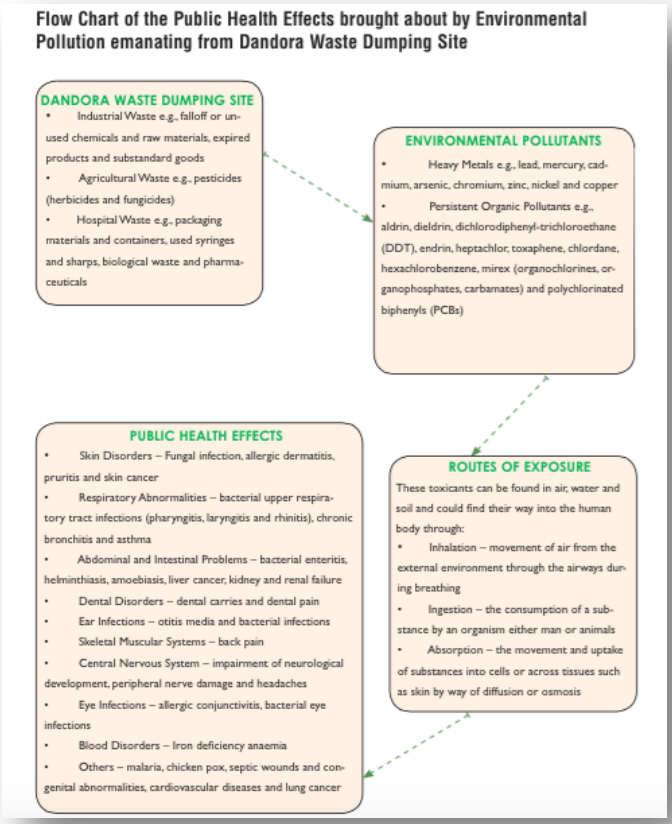
[3] Goldman LR et al. (1985). Low birth weight, prematurity and birth defects in children living near the hazardous waste site, Love Canal. *Hazardous Waste and Hazardous Materials*, 2:209-223.

[4] Kurian Joseph et al, A decision making tool for dumpsite rehabilitation in developing countries, Proc. Sardinia, Tenth International Waste Management and Landfill Symposium. Cagliari, Italty, October 2005

implementation requires to manage the non-availability of specific data on the dose response relationship for some of the chemicals of concern and to make a number of suitable assumptions and interpretations.

For a better understanding of what is more or less required, it is useful to outline the study that UNEP implemented regarding the public health impacts of the Dandora dumpsite in Nairobi, Kenya.[5]

For the implementation of the study, environmental samples (soil and water) were analyzed to determine the content and concentrations of various pollutants (heavy metals, polychlorinated biphenyls and pesticides) that are known to affect human health. Soil samples from the dumpsite were compared to samples taken from another site, which is a peri-urban residential area on the outskirts of Nairobi. A medical camp, located next to the dumpsite, was also set. A total of 328 children and adolescents living and schooling adjacent the dumpsite were examined and treated for various ailments. Of these, 40 were referred for further laboratory tests that entailed blood and urine sampling to assess the impact of exposure to environmental pollutants from the dumpsite on human health. Below, the flow chart of the study shows the link between the environmental pollutants from the dumpsite and public health impacts on the adjacent communities. This flow chart is characteristic for any similar effort and describes the conceptual framework between health and dumpsites.



[5] UNEP, Environmental Pollution and Impacts on Public Health: Implications of the Dandora Municipal Dumping Site in Nairobi, Kenya, 2007

Figure 1. The flow chart of the Dandora study[6] shows the conceptual framework for health & dumpsites

The waste streams disposed off at a dumpsite are one of the most important factors that determine its health risks. Besides municipal waste, healthcare waste, hazardous and e-waste are common streams found in dumpsites. The problem is that in most dumpsites all the previous waste streams are usually present in unknown quantities and with roughly unknown interactions.

Municipal waste

Organic wastes in dumpsites are biodegraded and thus they create conditions favorable for the survival and growth of microbial pathogens. These conditions can be further enhanced if the waste is disposed off with pathogens from human body fluids such as faeces, urine, blood and sputum. All are present in typical municipal waste through nappies, sanitary pads and the general discards from vomiting and human secretions. Organic wastes also provide a food source for carriers of enteric pathogens such as rodents, insects, birds and larger wild mammals. Subsequently, the diffuse airborne emissions from biologically and chemically decomposing municipal solid wastes at dumpsites are considered as a health risk. Decomposition of organic fraction in dumpsites results in the generation of gases and contributes to leachate formation. Thus the main sources of pollutant emissions from a dumpsite are as follows:

a. The wastes as they are brought onto site, normally in heavy vehicles,
b. Emissions from transport and bulldozers, compactors etc.
c. Waste blown by the wind as it is tipped or deposited at the dumpsite,
d. Dust generated from the surface of the dumpsite and when waste is tipped or unloaded,
e. Waste materials which have previously been deposited in the dumpsite,
f. Any gas generated as the waste breaks down (if not collected and treated),
g. Any leachate produced as the waste breaks down,
h. The discharges from any processes used to treat the leachate (if any at all).

While in modern sanitary landfills all those emissions are eliminated or under complete control (due to the use of advanced environmental protection measures like liners, top covers, biogas and leachate management system, continuous monitoring), in dumpsites those emissions are uncontrolled and they are actually associated with serious health hazards.

The main pollutants associated with health risks in dumpsites are the following ones.

Persistent Organic Pollutants

POPs, such as dioxins and furans (PCDDs and PCDFs) are persistent non-biodegradable organic compounds produced though uncontrolled burning waste, natural generation of methane gas and low temperature burning of waste to recover metals. POPs trigger a biological response to humans

[6] UNEP, Environmental Pollution and Impacts on Public Health: Implications of the Dandora Municipal Dumping Site in Nairobi, Kenya, Summary Report, 2007

that results in neurological, immunologic and reproductive problems[7]. POPs have been also considered responsible for respiratory disorders[8], and elevated cancer risk[9].

Heavy Metals

Heavy metals can be found in dumpsites leachate, air and soil produced either from plastic burning or smelting of scrap metals and e-waste. Lead, mercury, cadmium and arsenic are the main heavy metals causing neurological impairments, anemia, kidney failure, immunosuppression, gastrointestinal and respiratory irritation, abnormalities of skeletal system, inflammation of liver, cancer of liver, cardiovascular diseases after chronic exposure[10].

Volatile organic compounds (VOCs)

Volatile organic compounds are harmful to humans and also contribute to ground-level ozone pollution, also known as smog. Inhaling certain VOCs can lead to eye, nose, and throat irritation, headache, loss of coordination, nausea, and damage to liver, kidney, and central nervous system[11].

Polynuclear Aromatic Hydrocarbons (PAHs)

The PAHs are a class of compounds composed of two or more aromatic rings and they are present in dumpsites[12]. Hundreds of them have been identified and found as complex mixtures. They are generated by incomplete combustion, forest fire and volcanic eruptions or by other anthropogenic sources such as industrial production, transportation and waste incineration. They are classified as environmentally hazardous organic compounds by European Community (EC) and United States Environmental Protection Agency (US EPA), and are included in the priority pollutant list[13]. Several PAHs are known to be potential human carcinogens, some examples include benz[a]anthracene, chrysene, benzo[b]flouranthene, benzo[a]pyrene and benzo[g,h,i]perylene [14].

Hydrogen Sulfide (H_2S)

Hydrogen sulphide is a colorless, flammable gas with a characteristic odor of rotten eggs. It is produced in dumpsites when high sulphate bearing materials (such as gypsum and plasterboard) are mixed with biodegradable waste. The composition of the waste material and the practices followed of the site will determine the amount of H2S produced. At low concentrations, H2S may result in irritation to the mucous membranes of the eye and respiratory tract. Exposure to high concentrations

[7] S.S. White and L.S. Birnbaum, An Overview of the Effects of Dioxins and Dioxin-Like Compounds on Vertebrates, as Documented in Human and Ecological Epidemiology, Journal of Environmental Science and Health, Part C.,2009, 27(4), 197-211p

[8] K.O. Boadi and M. Kuitunen, Environmental and health impacts of household solid waste handling and disposal practices in third world cities: the case of the Accra Metropolitan Area, Ghana,Journal of environmental health,2005. 68(4), 32-36p

[9] J. Krajcovicova and A.Q. Eschenroeder, Comparative Health Risks of Domestic Waste Combustion in Urban and Rural Slovakia. Environmental Science & Technology, 2007, 41(19), 6847-6853p

[10] United Nations Environment Programme, Environmental Pollution and Impacts on Public Health: Implications of the Dandora Municipal Dumping Site in Nairobi, Kenya, 2007

[11] EPA, Human Health,25 June 2014, Available at http://www.epa.gov/osw/nonhaz/municipal/backyard/health.htm, access on 22 January 2015

[12] J. K. Nduka et al, Polyaromatic Hydrocarbons (PAHs) and Inorganic Chemical Contaminants at Refuse Dumpsites in Awka, South Eastern Nigeria: A Public Health Implication, Journal of Scientific Research and Reports, ISSN: 2320–0227,Vol.: 2, Issue.: 1 (January-June). P. 173-189, 2013

[13] Guillen MD, Sopelana P, Partearroyo MA. Determination of polycyclic aromatic hydrocarbons in commercial liquid flavouring of different composition by gas chromatography-mass spectrometry. Journal of Agricultural and Food Chemistry. 2000;48:126-131.

[14] Nieva-Cano MJ, Rubio-Barroso S, Santos-Delgado MJ. Determination of PAH in food samples by HPLC with flourimetric detection following sonication extraction without sample clean-up. The Analyst. 2001;126:1326–1331.

results in depression of the central nervous system, loss of consciousness and respiratory paralysis15. Other health effects have been reported, although data on the effects in humans following

Particulates

Dumpsites activities produce both fine and coarse particulates, the make-up of which will depend on the activities undertaken on-site and the types of waste being handled[16]. Exposure to particles that can enter the respiratory system is known to be associated with a range of adverse effects on health. Particles of greater than 10 m in diameter (particulate matter, PM10) are unlikely to penetrate beyond the nose and larynx but, as the diameter of particles falls, the likelihood of their entering the lungs and being deposited in the airways increases. Particles of less than about 2.5 m diameter (PM2.5) are referred to as 'fine' particles and are deposited relatively efficiently in the deeper parts of the lung – for example, in the alveolar spaces. Particles between 2.5 and 10 m in diameter are referred as comprising the 'coarse' fraction of PM10. These particles may also have effects on health. Dust emitted from dumpsites will include particles, which fall into both the PM10 and PM2.5 categories. People with pre-existing lung and heart disease, the elderly and children are particularly sensitive to particulate air pollution.

Dusts from dumpsites can become airborne and move off site by a number of mechanisms. The amount of dust lifted from the surface of the dumpsite is dependent upon the speed of the wind, the condition of the surface and the size of the dust particles. The distance travelled by dust emissions will depend on the particle size and on the wind speed and turbulence. Smaller dust particles will stay airborne for longer and disperse over a wider area. Strong and turbulent winds will also keep larger particles airborne for longer.

Odors

Odors are frequently a key issue for dumpsites, especially those receiving biodegradable waste. Odors are typically associated with activities such as the handling of odorous wastes and the covering of biodegradable wastes or with the presence of trace components in gas or leachates. Odorous emissions are often accompanied by reports of ill-health from communities[17]. Individuals may report a wide range of non-specific health symptoms, attributing these to odor exposure, including nausea, headaches, drowsiness, fatigue and respiratory problems. Health symptoms reported in association with odorous emissions can arise at olfactory detectable concentrations well below the levels associated with toxic effects or thresholds for mucous membrane irritation. Individual responses to odors are highly variable and are influenced by many factors including sensitivity, age and prior exposure to the odor. Psychological and social factors, in addition to an individual's level of concern about the potential harm to their health, will also play an important role in an individual's response. There are published studies that show strong correlation between perceived odor annoyance and subjective symptoms[18].

Leachate

[15] HPA (Health Protection Agency), Compendium of Chemical Hazards. Hydrogen Sulphide. Available at http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1246260029655 , 2009

[16] HPA (Health Protection Agency), Impact on health of emissions of landfill sites, 2011

[17] Steinheider B, Environmental odours and somatic complaints. Zentralblatt für Hygiene und Umweltmedizin [International Journal of Hygiene and Environmental Medicine], **202,** 101–19, 1999

[18] Dalton P., Upper airway irritation, odour perception and health risk due to airborne chemicals. Toxicol Lett, 140–141, 239–48, 2003

The nature of landfill leachate is a function of waste types, solubility, the state of decomposition and degradation. Rainfall input can serve to dilute and flush contaminants in addition to assisting in the degradation process by wetting the wastes. A wide range of substances may potentially be present in leachate, some of which are potentially harmful to human health. Table 2 shows the most important leachate substances that can be associated with health risks.

Table 1: Leachate substances associated with health risks

TABLE 3 Priority substances in landfill leachate (taken from EA, 2010a)

Aniline	Fluoride	Organotin compounds
Arsenic	Mecoprop	Pentachlorophenol
Biphenyl	Methyl chlorophenoxy acetic acid	Phenols
Cyanide	Methyl tertiary butyl ether	Phosphorus
Di(2-ethyl hexyl) phthalate	Naphthalene	Polycyclic aromatic hydrocarbons
Dichloromethane	Nitrogen	Toluene
Ethylbenzene	Nonylphenol	Xylenes

In fact, the health risks posed by leachate demonstrate the huge difference between a dumpsite and a modern landfill. Any modern landfill is located through a proper site allocation and Environmental Impact Assessment procedure that takes into account environmental vulnerability. Leachate in a modern landfill is discharged following treatment in an on-site process, and/or at an off-site sewage works. Modern landfill liners are also very effective in containing leachate and a tiny amount of leachate will be released via the landfill lining system to land or groundwater. Modern landfills also impose continuous monitoring procedures, which identify leakages as soon as they happen. For all those reasons, it can be documented that leachate releases to surface or groundwater are unlikely to pose a significant risk of adverse effects on health[19].

In contrast, leachate releases by dumpsites are uncontrolled and surface and groundwater pollution should be considered as an almost certain consequence of the dumpsites operation. Taking into account that dumpsites are located without any proper procedures that take into consideration environmental vulnerability, it is not a surprise that serious surface and groundwater pollution is the rule in dumpsites[20],[21].

Biogas

Biogas formation to dumpsites can result in explosion risks and several similar accidents have been reported, some of them with lethal consequences (see relevant paragraph). Carbon dioxide and methane are the two major components of biogas. The health effects of exposure to methane and carbon dioxide are well known.

Both are colorless, odorless gases which act as asphyxiants. Carbon dioxide is non-flammable and, at low concentrations or low levels of exposure, it increases the depth and rate of respiration, blood pressure and pulse[22]. At increasing concentrations, a depressive phase develops which can culminate in cardiorespiratory failure. Concentrations above 6% by volume can give rise to headache, dizziness,

[19] EA (Environment Agency), Updating the Landfill Leachate Pollution Inventory Tool. R&D Technical Report No. PI-496/TR(2). Shrewsbury, Enviros Consulting Ltd. , 2003

[20] David, O. M., & Oluyege, A. O , Effect of Open Refuse Dumpsite on the Quality of Underground Water Used for Domestic Purposes in Ado-Ekiti, Nigeria - A Public Health Awareness Study, Journal of Environment and Ecology, Vol. 5, No. 2, ISSN 2157-6092 2014

[21] Glenn Sia Su, Water-borne illness from contaminated drinking water sources in close proximity to a dumpsite in Payatas, The Philippines, Journal of Rural and Tropical Public Health 4: 43-48, 2005

[22] HPA (Health Protection Agency), Carbon Dioxide. Incident Management. Available at http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1279889001588 , 2010

mental confusion, palpitations, increased blood pressure, difficulty breathing and central nervous system depression. Humans cannot breathe air containing more than 10% carbon dioxide without losing consciousness.

In contrast to carbon dioxide, methane is a flammable gas, which is explosive in air at concentrations between 5 and 15% by volume. Inhalation can cause nausea, vomiting, headache and loss of coordination. At very high concentrations it may cause coma and death due to respiratory arrest[23].

In addition, municipal waste usually includes limited quantities of harmful substances like:

- Chemicals (pesticides, garden products, batteries, bleach, paint, varnishes, cleaning products)
- Biologicals (human waste, green waste, animal infestations, dead animal carcasses, animal waste, used needles/syringes, drugs etc.)

In a dumpsite, health risks from those harmful substances can occur via the following routes (for both workers and informal recyclers)[24]:

- Skin contact, especially through cuts and abrasions or contact with the eye's mucus membrane;
- Skin penetration through sharps injuries;
- Ingestion through hand-to-mouth contact (usually when eating, drinking or smoking);
- Breathing in infectious aerosols/droplets from the air.
- Sharp items, such as broken glass and tin cans, may increase the risk of exposure.

Hazardous waste

Hazardous wastes in dumpsites are a real threat for the lives of the workers and the nearby residents. WHO has estimated that environmental exposures contribute to 19% of cancer incidence worldwide.[25] Additionally, a WHO Global Health Risks report looked at five environmental exposures, (unsafe water, sanitation and hygiene, urban outdoor air pollution, indoor smoke from solid fuels, lead exposure and climate change), and estimated they account for nearly 10% of deaths and disease burden globally and around one quarter of deaths and disease burden in children under the age of five[26].

Hazardous wastes are by-products of human activities that could cause substantial harm to human health or the environment if improperly managed. As an example, the United States Environmental Protection Agency (EPA) classifies liquid, solid, and gaseous discarded materials and emissions as hazardous if they are poisonous (toxic), flammable, corrosive, or chemically reactive at levels above specified safety thresholds. The term hazardous waste generally refers to potentially dangerous or polluting chemical compounds, other potentially hazardous industrial, military, agricultural, and

[23] HPA (Health Protection Agency), Compendium of Chemical Hazards. Methane. Available at http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1287147970726 , 2009
[24] HSE, Health and hazardous substances in waste and recycling, UK, 2014
[25] Vineis, P. and W. Xun. "The emerging epidemic of environmental cancers in developing countries." Annals of Oncology 20: 205–212, 2009.
[26] WHO, Global health risks: mortality and burden of disease attributable to selected major risks.", 2009.

municipal byproducts, including biological contaminants.

Chemical manufacturing, primary metal production, metal fabrication, and petroleum processing are some of the most usual industrial hazardous waste generators. However, businesses of all sizes generate dangerous chemicals; as an example, USA EPA currently lists more than 250,000 facilities as "small-quantity generators" of hazardous waste. These diverse, smaller producers account for about 10% of the potentially harmful substances produced each year.

Obsolete pesticides, stored in leaking drums or torn bags, can directly or indirectly affect the health of anyone who comes into contact with them. During heavy rains, leaked pesticides can seep into the ground and contaminate the groundwater. Poisoning can occur through direct contact with the product, inhalation of vapors, drinking of contaminated water, or eating of contaminated food. Other hazards may include the possibility of fire and contamination as a result of inadequate disposal such as burning or burying. Chemical residues discharged into the sewerage system may have adverse effects on the operation of biological sewage treatment plants or toxic effects on the natural ecosystems of receiving waters.

Asbestos is another usual hazardous waste, directly linked with serious health impacts. Asbestos refers to a family of fibrous minerals found all over world. When the fibers break off and become airborne, they can create a health risk if inhaled. Asbestos exposure is associated with certain types of lung cancer, and long time occupational exposure can also cause the lung disease asbestosis. In the past, asbestos was used in many household products and building materials because of its heat-resistant and structural properties. As a result, building remodeling and demolition projects produce much of the asbestos waste available today.

A recent report published by Blacksmith Institute[27] estimates that hazardous industrial / municipal waste dumpsites rank fifth in the Top-Ten Industrial Pollution sources, while the first and second are lead battery recycling and lead smelting. There are almost 150 industrial or municipal dumpsites in the Blacksmith Institute's database that are polluting local communities, potentially putting almost 3.5 million people at risk. The largest shares of these dumpsites are in Africa and in Eastern European and Northern Asian countries. Combined, these regions make up more than half of the total at risk population in the Blacksmith investigations of dumpsites. However, industrial and municipal dumpsites are prevalent throughout the developing world including in South and Central America and South and Southeast Asia.

At properly run municipal solid waste landfills, hazardous materials considered carcinogenic, corrosive, toxic, or flammable are not accepted and are directed to special treatment or disposal sites[28]. At informal or improperly run sites, all these items are disposed together, creating a toxic stew of waste exposed to heat, rain and air, causing the materials to break down and easily enter the environment. Industrial waste is one of the most toxic wastes at dumpsites and makes up a large portion of the pollution problem at the dumpsites investigated by Blacksmith.

[27] BLACKSMITH INSTITUTE, The World's Worst Pollution Problems: Assessing Health Risks at Hazardous Waste Sites, 2012

[28] Allen, A.R., Taylor, R. 'Waste disposal and landfill: Control and protection." Protecting Groundwater for Health: Managing the Quality of Drinking- water Sources, WHO Drinking Water Quality Series Monograph, IWA Publishing. 2006.

The main sources of pollutants from dumpsites are either leachate (contaminated liquids leaching into the groundwater), dust from poorly covered dumpsites and gases. Leachate can contain heavy metals, VOCs or hazardous organic compounds. These pollutants are carried into aquifers or surface waters. Dust from dumpsites may contain metals and human pathogens that come into contact with this pollution through contaminated groundwater and soil, or direct contact with the waste site.

Children often are seen playing in and around dumpsites, introducing direct exposure with hazardous waste through dermal contact, inhalation of dust or accidental ingestion. Informal neighborhoods are often built on top of previous dumpsites where the soil, groundwater and nearby surface waters are contaminated, indirectly exposing the local population to leached pollutants. A notable issue with dumpsites in the developing world is the presence of scavengers - workers and their families at dumpsites who make their living by recovering economically valuable materials in the waste. In such situations, people come into direct contact with the hazardous waste.
In the Blacksmith Institute's database of industrial or municipal dumpsites the most pervasive and harmful pollutants are lead and chromium. Combined they are the key pollutants in a third of the sites, potentially affecting almost 1.2 million people. The health impacts of these pollutants include lung cancer, neurological problems and cardiovascular disease. Other pollutants in the database of dumpsites include cadmium, multiple types of pesticides, and arsenic and VOCs.

Researchers analyzed 373 toxic waste sites in India, Indonesia and the Philippines, where an estimated 8.6 million people are at risk of exposure to lead, asbestos, hexavalent chromium and other hazardous materials. Among those people at risk, the exposures could cause a loss of around 829,000 years of good health as a result of disease, disability or early death[29]. In comparison, malaria in these countries, whose combined population is nearly 1.6 billion, causes the loss of 725,000 healthy years while outdoor air pollution claims almost 1.5 million healthy years, according to the World Health Organization. In fact this is a shocking finding: it seems that dumpsites are a more serious health risk than malaria at least for the 1.6 billion people of India, Indonesia and Philippines.

[29] K. Chatham-Stephens et al, Burden of Disease from Toxic Waste Sites in India, Indonesia, and the Philippines in 2010, http://dx.doi.org/10.1289/ehp.1206127, Environmental Health Perspectives, 2013

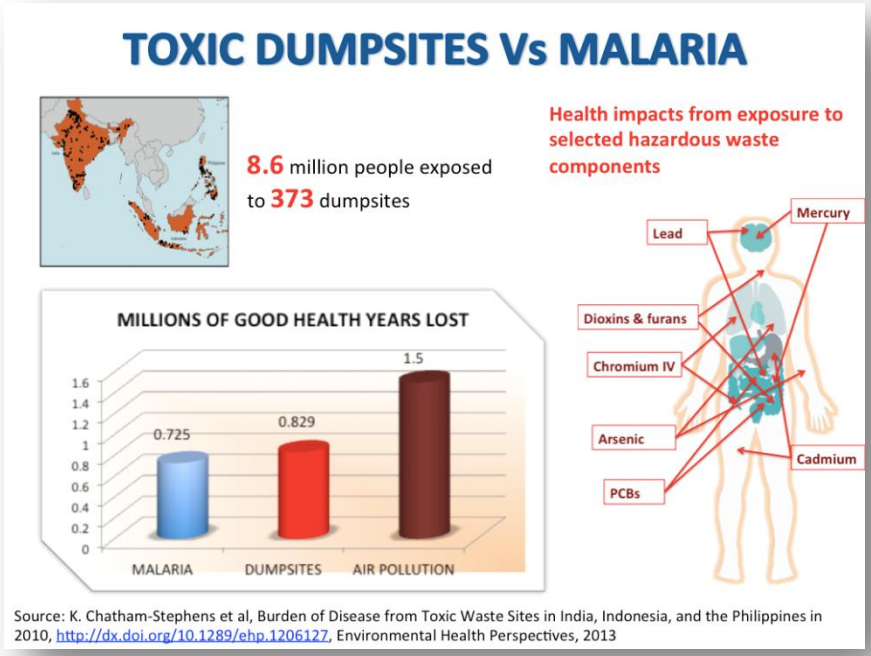


Figure 2: Dumpsites Vs Malaria as a health risk in India, Indonesia and Philippines[44]

Health-care waste

Health-care waste (HCW) are usually found in almost all the dumpsites in the developing world. Health-care facilities, microbiological research laboratories, diagnostic laboratories, pharmaceutical firms and funeral homes have always generated a wide variety of waste components that have the potential of transmitting infectious agents to humans. These include discarded materials or equipment from the diagnosis, treatment and prevention of disease, assessment of health status or identification purposes, that have been in contact with blood and its derivatives, tissues, tissue fluids or excreta, or wastes from infection wards.

Typical elements of the HCW are the following:

- Cultures and stocks of infectious agents and associated biologicals, including: cultures and stocks of infectious agents generated in research or clinical laboratories; wastes from the production of biologicals including vaccines, antigens and antitoxins, and sera.
- Pathological waste, including tissues, organs, and body parts; body fluids that are removed during surgery, autopsy, or other medical procedures; specimens of body fluids.
- Blood and blood products including discarded liquid human blood; discarded blood components (e.g., serum and plasma); containers with free flowing blood or blood components.
- Items or materials contaminated with blood or blood products.

- Sharps from health care, research, clinical laboratories and blood banks, including but not limited to: needles and syringes, scalpel blades, and broken or unbroken glassware, which were in contact with blood or blood derivatives.
- Animal waste including carcasses, body parts, body fluids, blood originating from animals from veterinary clinics or research institutes.

The hazardous components of HCW pose physical, chemical, radiological and/or microbiological risks to the public and those involved in their handling, treatment and disposal. In most cases, the concentration of hazardous chemicals present in HCW is generally too low to be considered an occupational problem or a danger to the public.

Physical injuries caused by discarded sharps are a more significant risk associated with HCW and may directly contribute to the transmission of microbial infectious agents. In addition, health risks may be generated through the release of toxic pollutants during dumpsite open burning or accidental fires[30].

The most common and most investigated cause of the microbiological risks associated with HCW are injuries due to needles. Other sharps wastes presenting similar risks include glass and plastic ware employed in clinical and anatomic laboratories, blood collection systems for obtaining specimens, and scalpel blades from surgical procedures. These sharps may all have been in contact with microbial pathogens. More importantly, sharps can cause percutaneous injuries and thereby create an opening for infectious agents to enter the body. The latter is one of the five essential elements in the acquisition of microbial infections.

Most exposures to biological hazards from health-care wastes occur when workers or informal recyclers are trying to recover useful elements like metals. Workers may be exposed to blood and body fluids from leaking containers as well as airborne pathogens as the waste enters the dumpsite.

Health-care waste components may also create microbiological risks as a source of infectious aerosols, i.e. droplets of less than 1- 3 microns in diameter, which contain etiologic agents of human and animal diseases. Cultures and stocks from the clinical laboratory contain high concentrations[31] of many infectious agents, e.g. Mycobacterium tuberculosis, which is naturally transmitted to their hosts through inhalation, although generally all infectious laboratory waste is treated at the source. Human and animal tissues, organs, and body parts have also been reported in scientific literature as sources of infectious aerosols. Finally, animal bedding materials, which have been saturated with body fluids, blood and excrement, can generate aerosols, which are a potential microbiological risk.

Blood and blood products, as well as various types of body fluids may be capable of transmitting pathogens[32] when brought into direct contact with the mucosal lining of the mouth and nose, the eyes, and areas of the skin containing cuts and abrasions.

It should be also noted that many of the chemicals and pharmaceuticals used in health-care establishments are hazardous[33] (e.g. toxic, genotoxic, corrosive, flammable, reactive, explosive,

[30] WHO, Review of Health Impacts from Microbiological Hazards in Health-Care Wastes, 2004
[31] Weber, AM, Boudereau, Y, Mortimer VD. Health hazard evaluation report 98-0027-2709, Stericycle, Inc, Morton, Washington. Cincinnati, National Institute for Occupational Safety and Health, 1999.
[32] Leese KE et al, Assessment of blood-splash exposures of medical-waste treatment workers. Enviro Health, January/February 1999, 8-11.
[33] WHO, Safe management of wastes from health-care activities, Chapter 3 - Health impacts of health-care waste

shock-sensitive). These substances are commonly present in small quantities in health-care waste; larger quantities may be found when unwanted or outdated chemicals and pharmaceuticals are disposed of. They may cause intoxication, either by acute or by chronic exposure, and injuries, including burns. Intoxication can result from absorption of a chemical or pharmaceutical through the skin or the mucous membranes, or from inhalation or ingestion. Injuries to the skin, the eyes, or the mucous membranes of the airways can be caused by contact with flammable, corrosive, or reactive chemicals (e.g. formaldehyde and other volatile substances). The most common injuries are burns. Disinfectants are particularly important members of this group: they are used in large quantities and are often corrosive. It should also be noted that reactive chemicals might form highly toxic secondary compounds.

E-waste

E-waste describes waste electronic goods, such as computers, televisions and cell phones, while WEEE also includes traditionally non-electronic goods such as refrigerators and ovens. Computers and mobile telephones are disproportionately abundant because of their short lifespan. Components of electrical and electronic equipment such as batteries, circuit boards, plastic casings, cathode-ray tubes, activated glass, and lead capacitors are also classified as e-waste.

According the most recent statistics by STEP (Solving The E-waste Problem) initiative (http://www.step-initiative.org/overview-world.html), in 2014 roughly 42 million tones of e-waste were generated.

E-Waste is chemically and physically distinct from other forms of municipal or industrial waste; it contains both valuable and hazardous materials that require special handling and recycling methods to avoid environmental contamination and detrimental effects on human health. Recycling can recover reusable components and base materials, especially Cu and precious metals. However, due to lack of facilities, high labor costs, and tough environmental regulations, rich countries tend not to recycle E-waste. Instead, it is either landfilled, or exported from rich countries to poor countries, where it may be recycled using primitive techniques and little regard for worker safety of environmental protection.

The chemical composition of E-waste varies depending on the age and type of the discarded item. However, most E-waste is composed of a mixture of metals, particularly Cu, Al, and Fe, attached to, covered with, or mixed with various types of plastics and ceramics.

Heavy WEEE items, such as washing machines and refrigerators, which are mostly composed of steel, may contain fewer potential environmental contaminants than lighter E-waste items, such as laptop computers, which may contain high concentrations of flame-retardants and heavy metals.

Virtually all E-waste contains some valuable components or base materials, especially Cu. These are environmentally important, because they provide an incentive for recycling, which occurs predominantly in poor countries, and may result in a human health risk or environmental pollution. Platinum group metals are included in electrical contact materials due to their high chemical stability and conductance of electricity. The precious metal concentrations in printed circuit boards are more

than tenfold higher than commercially mined minerals[34].

The concentrations of environmental contaminants found in E-waste depend on the type of item that is discarded and the time when that item was produced. The potential environmental contaminants associated with E-waste and their typical concentrations are presented in Table 3[35]. Some contaminants, such as heavy metals, are used in the manufacture of electronic goods, while others, such as polycyclic aromatic hydrocarbons (PAHs) are generated by the low-temperature combustion of E-waste. The burning of insulated wire, which typically occurs in open iron barrels, generates 100 times more dioxins than burning domestic waste[36].

Table 2: Environmental contaminants and their typical concentrations in E-Waste[48]

Contaminant	Relationship with E-waste	Typical E-waste concentration (mg/kg)[a]
Polybrominated diphenyl ethers (PBDEs) polybrominated biphenyls (PBBs) tetrabromobisphenol-A (TBBPA)	Flame retardants	
Polychlorinated biphenyls (PCB)	Condensers, transformers	14
Chlorofluorocarbon (CFC)	Cooling units, insulation foam	
Polycyclic aromatic hydrocarbons (PAHs)	Product of combustion	
Polyhalogenated aromatic hydrocarbons (PHAHs)	Product of low-temperature combustion	
Polychlronated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs)	Product of low-temperature combustion of PVCs and other plastics	
Americium (Am)	Smoke detectors	
Antimony	Flame retardants, plastics (Ernst et al., (2003))	1700
Arsenic (As)	Doping material for Si	
Barium (Ba)	Getters in cathode ray tubes (CRTs)	
Beryllium (Be)	Silicon-controlled rectifiers	
Cadmium (Cd)	Batteries, toners, plastics	180
Chromium (Cr)	Data tapes and floppy disks	9900
Copper (Cu)	Wiring	41,000
Gallium (Ga)	Semiconductors	
Indium (In)	LCD displays	
Lead (Pb)	Solder (Kang and Schoenung, (2005)), CRTs, batteries	2900
Lithium (Li)	Batteries	
Mercury (Hg)	Fluorescent lamps, batteries, switches	0.68
Nickel (Ni)	Batteries	10,300
Selenium (Se)	Rectifiers	
Silver (Ag)	Wiring, switches	
Tin (Sn)	Solder (Kang and Schoenung, (2005)), LCD screens	2400
Zinc (Zn)		5100
Rare earth elements	CRT screens	

Although recycling may remove some contaminants, large amounts may still end up concentrated in landfills or E-waste recycling centers, where they may adversely affect human health or the environment.

Polybrominated diphenyl ethers (PBDEs) are flame-retardants that are mixed into plastics and components. There are no chemical bonds between the PBDEs and the plastics and therefore they may leach from the surface of E-waste components into the environment[37]. PBDEs are lipophilic, resulting in their bioaccumulation in organisms and biomagnification in food chains. PBDEs have endocrine disrupting properties[38].

[34] Betts K., Producing usable materials from e-waste. Environ Sci Technol 2008a; 42:6782–3.

[35] Brett H. Robinson, E-waste: An assessment of global production and environmental impacts, Science of the Total Environment 408 (2009) 183–191

[36] Gullett BK, Linak WP, Touati A, Wasson SJ, Gatica S, King CJ. Characterization of air emissions and residual ash from open burning of electronic wastes during simulated rudimentary recycling operations. J Mater Cycl Waste Manag 2007;9:69–79.

[37] Deng WJ, Zheng JS, Bi XH, Fu JM, Wong MH. Distribution of PBDEs in air particles from an electronic waste-recycling site compared with Guangzhou and Hong Kong, South China. Environ Int 2007;33:1063–9.

[38] Tseng LH, Li MH, Tsai SS, Lee CW, Pan MH, Yao WJ, et al. Developmental exposure to decabromodiphenyl ether (PBDE 209): Effects on thyroid hormone and hepatic enzyme activity in male mouse offspring. Chemosphere 2008;70:640–7.

Obsolete refrigerators, freezers and air conditioning units contain ozone-depleting Chlorofluorocarbons (CFCs). These gases may escape from items disposed in landfills.

Dust is a significant environmental media that can provide information about the level, distribution, and fate of contaminants present in the surface environment. As an example, recent studies have demonstrated elevated body loadings of heavy metals[39] and persistent toxic substances in children[40] and e-waste workers, respectively, at Guiyu, China.

E-waste pollutants are released as a mixture, and the effects of exposure to a specific compound or element cannot be considered in isolation. However, a more complex understanding of the interactions between the chemical components of e-waste is needed. Exposure to e-waste is a complex process in which many routes and sources of exposure, different lengths of exposure time, and possible inhibitory, synergistic, or additive effects of many chemical exposures are all important variables. Exposure to e-waste is a unique variable in itself and the exposures implicated should be considered as a whole. Sources of exposure to e-waste can be classified into three sectors: informal recycling, formal recycling, and exposure to hazardous e-waste compounds remaining in the environment (ie, environmental exposure).

Exposure routes can vary dependent on the substance and the informal recycling process. Table 3[41] provides the routes of exposure according the pollutants and the e-waste components. Generally, exposure to the hazardous components of e-waste is most likely to arise through inhalation, ingestion, and dermal contact. In addition to direct occupational (formal or informal) exposure, people can come into contact with e-waste materials, and associated pollutants, through contact with contaminated soil, dust, air, water, and through food sources, including meat.9–21 Children, fetuses, pregnant women, elderly people, people with dis- abilities, workers in the informal e-waste recycling sector, and other vulnerable populations face additional exposure risks. Children are a particularly sensitive group because of additional routes of exposure (eg, breastfeeding and placental exposures), high-risk behaviors (eg, hand-to-mouth activities in early years and high risk-taking behaviors in adolescence), and their changing physiology (e.g. high intakes of air, water, and food, and low rates of toxin elimination). The children of e-waste recycling workers also face take- home contamination from their parents' clothes and skin and direct high-level exposure if recycling is taking place in their homes.

In a recent study of health risks posed by e-waste, 23 published epidemiological studies were reviewed, all from southeast China[54]. The project recorded plausible outcomes associated with exposure to e-waste including change in thyroid function, changes in cellular expression and function, adverse neonatal outcomes, changes in temperament and behavior, and decreased lung function. Boys aged 8–9 years living in an e-waste recycling town had a lower forced vital capacity than did those living in a control town. Significant negative correlations between blood chromium concentrations and forced vital capacity in children aged 11 and 13 years were also reported. Findings from most studies showed increases in spontaneous abortions, stillbirths, and premature

39 Huo,X.;Peng,L.;Xu,X.J.;Zheng,L.K.;Qiu,B.;Qi,Z.L.;Zhang, B.; Han, D.; Piao, Z. X. Elevated blood lead levels of children in Guiyu, an electronic waste recycling town in China. Environ. Health Perspect. 2007, 15, 1113–1117.

40 Bi, X. H.; Thomas, G. O.; Jones, K. C.; Qu, W. Y.; Sheng, G. Y.; Martin, F. L.; Fu, J. M. Exposure of electronics dismantling workers to polybrominatetd diphenyl ethers, polychlorinated biphenyls, and organochlorine pesticides in South China. Environ. Sci. Technol. 2007, 41, 5647–5653

41 Kristen Grant, Fiona C Goldizen, Peter D Sly, Marie-Noel Brune, Maria Neira, Martin van den Berg, Rosana E Norman, Health consequences of exposure to e-waste: a systematic review , LancetGlobHealth 2013; 1: e350–61, Published Online October 30, 2013 http://dx.doi.org/10.1016/ S2214-109X(13)70101-3

births, and reduced birth weights and birth lengths associated with exposure to e-waste. People living in e-waste recycling towns or working in e-waste recycling had evidence of greater DNA damage than did those living in control towns.

Table 3: Routes of exposure for e-waste[54]

	Component of electrical and electronic equipment	Ecological source of exposure	Route of exposure
Persistent organic pollutants			
Brominated flame retardants Polybrominated diphenyl ethers	Fire retardants for electronic equipment	Air, dust, food, water, and soil	Ingestion, inhalation, and transplacental
Polychlorinated biphenyls	Dielectric fluids, lubricants and coolants in generators, capacitors and transformers, fluorescent lighting, ceiling fans, dishwashers, and electric motors	Air, dust, soil, and food (bio-accumulative in fish and seafood)	Ingestion, inhalation or dermal contact, and transplacental
Dioxins			
Polychlorinated dibenzodioxins and dibenzofurans	Released as combustion byproduct	Air, dust, soil, food, water, and vapour	Ingestion, inhalation, dermal contact, and transplacental
Dioxin-like polychlorinated biphenyls	Released as a combustion byproduct but also found in dielectric fluids, lubricants and coolants in generators, capacitors and transformers, fluorescent lighting, ceiling fans, dishwashers, and electric motors	Released as combustion byproduct, air, dust, soil, and food (bioaccumulative in fish and seafood)	Ingestion, inhalation, and dermal absorption
Perfluroalkyls	Fluoropolymers in electronics	Water, food, soil, dust, and air	Ingestion, dermal contact, inhalation, and transplacental
Polyaromatic hydrocarbons			
Acenaphthene, acenaphthylene, anthracene, benz[a] anthracene, benzo[a]pyrene, benzo[e]pyrene, benzo[b]fluoranthene, benzo[g,h,i]perylene, benzo[j] fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, fluoranthene, fluorene, indeno[1,2,3-c,d]pyrene, phenanthrene, and pyrene	Released as combustion byproduct	Released as combustion byproduct, air, dust, soil, and food	Ingestion, inhalation, and dermal contact
Elements			
Lead	Printed circuit boards, cathode ray tubes, light bulbs, televisions (1·5–2·0 kg per monitor), and batteries	Air, dust, water, and soil	Inhalation, ingestion, and dermal contact
Chromium or hexavalent chromium	Anticorrosion coatings, data tapes, and floppy disks	Air, dust, water, and soil	Inhalation and ingestion
Cadmium	Switches, springs, connectors, printed circuit boards, batteries, infrared detectors, semi-conductor chips, ink or toner photocopying machines, cathode ray tubes, and mobile phones	Air, dust, soil, water, and food (especially rice and vegetables)	Ingestion and inhalation
Mercury	Thermostats, sensors, monitors, cells, printed circuit boards, and cold cathode fluorescent lamps (1–2 g per device)	Air, vapour, water, soil, and food (bioaccumulative in fish)	Inhalation, ingestion, and dermal contact
Zinc	Cathode ray tubes, and metal coatings	Air, water, and soil	Ingestion and inhalation
Nickel	Batteries	Air, soil, water, and food (plants)	Inhalation, ingestion, dermal contact, and transplacental
Lithium	Batteries	Air, soil, water, and food (plants)	Inhalation, ingestion, and dermal contact
Barium	Cathode ray tubes, and fluorescent lamps	Air, water, soil, and food	Ingestion, inhalation and dermal contact
Beryllium	Power supply boxes, computers, x-ray machines, ceramic components of electronics	Air, food, and water	Inhalation, ingestion, and transplacental

Table 1: Chemical classification of e-waste components and sources and routes of exposure

In other studies[42], researchers have linked e-waste to adverse effects on human health, such as inflammation and oxidative stress – precursors to cardiovascular disease, DNA damage and possibly cancer.

Although the toxicology of many e-waste components is well characterized, some newer materials, such as gallium and indium arsenides found in newer semiconductors, are less well understood. Their incorporation into nanomaterials may increase bioavailability in unanticipated ways. Developing children and fetuses may be particularly vulnerable to toxins found in e-waste, and early epidemiological studies near informal e-waste recycling sites indicate potential developmental neurotoxicity. Understanding the hazards of e-waste, the impacts of its disposal, and the dangers of informal or careless recycling will help reduce or prevent disease outcomes associated with exposure to e-waste components.

[42] Fangxing Yang et al, Comparisons of IL-8, ROS and p53 responses in human lung epithelial cells exposed to two extracts of PM2.5 collected from an e-waste recycling area, China 2011, Environ. Res. Lett. **6** 024013 doi:10.1088/1748-9326/6/2/024013

Open burning

"Open burning" of waste is a usual practice in many dumpsites, as a mean to reduce the waste volume. The practice of open burning results in many harmful public health and environmental effects.

Worldwide scientific research has conclusively demonstrated that burning of waste at dumpsites produces air toxins. Typically, burning occurs at low temperatures (250 ^{o}C to 700 ^{o}C) in oxygen-starved conditions. Hydrocarbons, chlorinated materials and pesticide compounds under these conditions produce a wide range of toxic gases harmful to the environment and public health. These gases contain dioxins / furans, volatile organic compounds, particulate matter (PM), hydrogen chloride (HCl), carbon monoxide (CO) and oxides of sulfur and nitrogen and liberate metals including antimony, arsenic, barium, beryllium, cadmium, chromium, lead, manganese, mercury, phosphorus and titanium[43].

The United States Environmental Protection Agency estimates[44] that mixed garbage burning is a larger source of dioxins than coal combustion, ferrous metal smelting, hazardous waste incineration or bleached pulp mill operations.

The burning of waste produces two types of ash, bottom and fly ash. Fly ash is made of light particles which is carried out by combustion gas and is laden with toxic metals, dioxin / furan and other products of incomplete combustion which can travel thousands of kilometers before they drop out where enter the human food chain. Open burning emissions are troubling from a public health perspective because of several reasons:

- Open burning emissions are typically released at or near ground level instead of through tall stacks, which aid dispersion;
- Open burning emissions are not spread evenly throughout the year; rather, they are typically episodic in time or season and localized/regionalized;
- Open burning sources are non-point sources and are spread out over large areas;
- Compliance to any bans on open burning are difficult to enforce.
- Open burning is a transient combustion phenomenon, frequently with heterogeneous fuels; it is difficult to attribute emissions to a single component of the fuel.

One of the most harmful pollutants released during open burning is dioxin. Dioxin is a known carcinogen and is associated with birth defects. Dioxin can be inhaled directly or deposited on soil, water and crops where it becomes part of the food chain.

Burning MSW can release hexchlorobenzene (HCB) to the environment. This compound is a highly persistent toxin that degrades slowly in the air. Therefore, it can travel long distances in the atmosphere. It bioaccumulates in fish, marine animals, birds, lichens, and animals that feed on fish and lichens. HCB is a probable human carcinogen, and based on animal studies, long-term, low-level exposures to HCB can damage a developing fetus, lead to kidney and liver damage, and cause fatigue

[43] Nammari, D.R., Hogland, W., Marques, M., Nimmermark, S. and Moutavtchi, V. (2004) Emissions from a Controlled Fire in Municipal Solid Waste Bales. Waste Management, 24, 9-18

[44] United States Fire Administration (USFA), "Landfill fires, their magnitude, characteristics and mitigation," TriData Corporation, Arlington, Virginia, USFA Tech. Rep. FA-225, 2002.

and skin irritation.

Formaldehyde is released when pressed wood products, paints, coatings, siding, urea-formaldehyde foam, and fiberglass insulation are burned. Exposure to formaldehyde can result in watery eyes, a burning sensation in the eyes and throat, nausea, difficulty in breathing (i.e., coughing, chest tightness, wheezing), and skin rashes. Prolonged exposure to formaldehyde may cause cancer.

Burning of plastics, or polyvinyl chloride (PVCs), can produce hydrogen chloride gas, or hydrochloric acid, which can cause fluid buildup in the lungs and possible ulceration of the respiratory tract.

The visible smoke from burning is composed of tiny particles (particulates), which contain toxic pollutants. If inhaled, these microscopic particles can reach deep into the lungs and remain there for months or even years. Breathing particulates increases the chances of respiratory infection, can trigger asthma attacks, and causes other problems such as coughing, wheezing, chest pain, and shortness of breath. Carbon monoxide is generated from the incomplete combustion of waste. Carbon monoxide is a colorless, odorless gas that prevents oxygen from being absorbed by the blood and lungs. It is especially dangerous when breathed by young children with immature lungs, the elderly, and people with chronic heart conditions or lung diseases.

Of particular health concern are the Tyr fires. Tyrs are composed of natural rubber from rubber trees, synthetic rubber made from petrochemical feedstock, carbon black, extender oils, steel wire, up to 17 heavy metals, other petrochemicals and chlorine. A coal and Tyr chlorine content comparison showed that Tyrs might contain as much as 2 to 5 times the chlorine level of western coal. Tyr fires burn for a long time allowing the build up of the by-products of combustion around surrounding areas. Burning Tyrs are known to emit dioxins and benzene derivatives, which have been linked with reproductive impairment and cancer in humans[45]. Tyr fires releases a dark, thick smoke that contains carbon monoxide, sulphur dioxide and products of butadiene and sTyrne. Further, Tyr fires can be extremely difficult to contain and extinguish and therefore burn and smolder for a long period of time. Even after they are extinguished, Tyr fires can flare up again weeks, even months later. This can cause a build up of the by-products of combustion in confined areas such as surrounding homes, which creates an additional health hazard. Table 4 presents typical open burning emissions of pollutants included in the plumes emitted.

[45] Adeolu O. Aderemi, Adebayo A. Otitoloju An Assessment of Landfill Fires and Their Potential Health Effects- A Case Study of a Municipal Solid Waste Landfill in Lagos, Nigeria # IJEP Vol. 2 No. 2 February 2012 PP.22-26 www.ij-ep.org

Table 4: Emissions from burning dumps and landfill fires (ng/m^3)[46]

Class	Compound	Controlled landfill fire	Uncontrolled landfill fire
PAHs	Acenaphthylene	90	60
	Acenaphthene	50	30
	Fluoranthene	100	50
	Phenanthrene	520	30
	Anthracene	160	85
	Fluorene	120	180
	Pyrene	120	170
	Benzo[*a*]anthracene	60	60
	Chrysene	80	70
	Benzo[*b*&*k*]fluoranthene	50	20
	Benzo[*a*]pyrene	20	15
	Indeno[1,2,3-*cd*]pyrene	10	10
	Dibenz[*a*,*h*]anthracene	10	10
	Benzo[*g*,*h*,*i*]perylene	10	10
	Total PAHs	1480	810
	Total PCBs	15.5	590

[46] Paul M. Lemieux, Christopher C. Lutes, Dawn A. Santoianni' Emissions of organic air toxics from open burning: a comprehensive review, Progress in Energy and Combustion Science 30 (2004) 1–32

ANNEX 2: PPP PROCEDURE

Step	Description	Party in Charge	Notes
1.	PPP Project Proposal initiated by the preparation of a Preliminary Study	- Minister or Head of Relevant Public Authority; - Mayor or Head of Union of Municipalities	-
2.	Review of the proposed PPP project preliminary study and issuance of recommendations to the High Council for privatization and PPP	- General Secretariat of the High Council for privatization and PPP	-
3.	**Rejection** / **Approval**	- The High Council for privatization and PPP	The rejection notification of the project is sent to the public authority submitting the proposal
4.	Establishment of a PPP Project Committee which will be headed by the General Secretary of the High Council for Privatization and PPP and will include as members the Minister of the relevant Authority, Representative from the Ministry of Finance, the Mayor or the head of the Union of Municipalities for Municipal projects	- The High Council for privatization and PPP	-
5.	Signing Contracts with consultants to advise in technical, financial, legal aspects / Establishment of a Project Team including a representative of all stakeholders	- The PPP project committee to propose specialized consultants contracts - The High Council for privatization and PPP for the signature of the contracts - General Secretary of the High Council for privatization and PPP for the Project Team establishment	-
6.	Preparation of a comprehensive study for the PPP project addressing all aspects (technical, legal, financial, financing sources, interested investors, prequalification criteria, etc.)	- The PPP project committee - The assigned Consultants - The Project Team	The Study is prepared by the PPP committee assisted by the Project Team and the assigned advisors (consultants)
7.	**Rejection** / **Approval**	- The High Council for privatization and PPP	The procedure stops here for rejected projects
8.	Approval of the Council of Ministers for non-municipal projects or Municipal Council for Municipal projects	- Council of Ministers - Mayor or the Head of the Union of Municipalities	The President of the High Council for privatization and PPP issues the study for the Council of Ministers approval
9.	Issuance of Prequalification Documents to select the Private enterprise	- The PPP project committee	This is done in accordance to a well detailed procedure specified in the Law
10.	Evaluation of the pre-qualification application and issuance of the results	- The PPP project committee - The Project Team	-
11.	**< 3 Qualified** / **≥ 3 Qualified**	- The High Council for privatization and PPP	If less than three bidders are pre-qualified, the prequalification process is repeated
12.	Preparation of a draft Tender Documents	- The PPP project committee	-
13.	**Rejected** / **Approved**	- The High Council for privatization and PPP	Rejected draft tender documents are returned to the PPP committee to redraft and resubmit
14.	Council of Ministers Approval of the Tender Docs	- Council of Ministers	-
15.	Launching the Tender Documents	- The High Council for privatization and PPP	-
16.	**< 3 Offers** / **≥ 3 Offers**	- The pre-qualified bidders	If less than three offers are submitted, the tendering process is repeated. If after repetition at least 2 offers are submitted, evaluation is initiated
17.	Evaluation of submitted technical proposals	- The PPP project committee - The project Team	-
18.	**< 2 technically acceptable** / **≥ 2 technically acceptable**	- The PPP project committee - The project Team	If less than 2 offers are technically compliant, the procedure is to be repeated
19.	Public Financial Bids Opening Session	- The PPP project committee - Bidders representatives	The session is headed by the PPP committee
20.	Evaluation of the financial offers & recommendations	- The PPP project committee - The Project Team	-
21.	Approval of the report and authorization of the PPP Project committee to negotiate with the winner	- The PPP project committee - The Project Team	-
22.	Contract signature & establishment of a Lebanese joint stock company (the PPP project Company)	- The PPP project committee - The Project Team	The PPP Company benefits from some exemptions

ANNEX 3: LIST OF DATABASE USED IN THE BASELINE REPORT

No	Document	Date
1.	Administrative Divisions of Lebanon (Localiban)	-
2.	Awareness Campaign on Waste Sorting Brochure in Arabic	-
3.	Lebanon PPP Law - English Translation	-
4.	Regional Technical Offices Improving Municipal Planning & Enhancing Local Governance Brochure (UNHABITAT)	-
5.	Assessment of Solid Waste Management Practices in Lebanon in 2015 (Sep) - EU (Support to Reforms – Environmental Governance, Beirut, Lebanon) GFA Consulting Group GmbH / Umweltbundesamt / Mott Mac Donald	2017
6.	Land Use and Environment (Some info) (CDR)	2017
7.	INVESTMENT OPPORTUNITIES in North Lebanon (IDAL)	2018
8.	Migration Profile: Lebanon (EUI - Françoise De Bel-Air, Research Consultant)	2017
9.	MoE L to CoM August with annexes (SW)	2017
10.	MoE L to CoM SG July with annexes (SW)	2017
11.	MoE Memo 7-1 of 16 Nov (ISWM Guidelines)	2017
12.	MoEW decision regarding the next steps in the Waste management including the number of WTE sites CoM-2013-Reg.No.4293-28-12-2017	2017
13.	Open waste burning and health (human rights Watch)	2017
14.	Promotion of Green Entrepreneurship and Grassroots Ecological and Social Innovations in Lebanon (switchmed)	2017
15.	Solid Waste Management in Lebanon: Challenges and Recommendations (Journal of Environment and Waste Management)	2017
16.	SW-Draft Law Comparison-Table Jan 29 2014 - F Jan	2017
17.	SWM in leb challenges and recommendations (journal of environment and waste management)	2017
18.	Trash Crisis and Solid Waste Management in Lebanon Analyzing Hotels' Commitment and Guests' Preferences (Journal of Tourism Research & Hospitality)	2017
19.	Updated Master Plan for the closure and rehabilitation of uncontrolled dumpsites throughout the country of Lebanon (June) (Volume A - ELARD)	2017
20.	Waste Management Systems in Lebanon (Thesis: Elias Azzi)	2017
21.	Achievements of the Ministry of Environment (2014-2016 - MoE)	2016
22.	Economic instruments for Recycling (streg)	2016
23.	Lebanon Garbage Report (Global impact strat)	2016
24.	MoE Dec 189-1 13.04.2016 Audit Review Procedures	2016
25.	Ramboll pre-qualification for WtE	2016
26.	The National Renewable Energy Action Plan for the Republic of Lebanon 2016-2020 (LCEC)	2016
27.	COED BML (Sweepnet)	2014
28.	Cost of environmental degradation due to solid waste management practices in beirut and mount lebanon (BML) (GIZ-SWEEP-Net)	2014
29.	Country report on the solid waste management in Lebanon (Sweepnet)	2014

No	Document	Date
30.	e-watse practice in the MENA (Sweepnet)	2014
31.	ISWM Draft Law (Jan 10 - MoE in Arabic)	2014
32.	Lebanon Environmental Assessment of the Syrian Conflict & Priority Interventions (Sep) (MoE-UNDP-EU)	2014
33.	Millenium-Development-Goals-Lebanon-Report (2013-2014) (UNDP + CDR)	2014
34.	Proposed Master Plan Report (Dar El Handasah)	2014
35.	North Governorate Profile (UNOCHA)	2014
36.	National Strategy for SWM in Lebanon (in Arabic Samir Moqbel Letter)	2013
37.	Ramboll feasibility study for the integration of WtE into the solid waste management sector in big cities in Lebanon	2013
38.	Decree 8003 (ISWM)	2012
39.	OMSAR - Policies, Programs and Procedures Towards a distinctive public service (2010-2012)	2012
40.	Financing of Municipal Investment Projects in Solid Waste Management (OMSAR - Farouk El Merhebi)	2011
41.	Lebanon Urban Profile (UNHABITAT)	2011
42.	Management of Recyclable Material for Lebanese Municipalities - Manual (cooperation with OMSAR - MoE)	2011
43.	Public–Private Partnerships in Lebanon (Credit Libanais)	2011
44.	Republic of Lebanon Country Environmental Analysis (WB)	2011
45.	Roadmap for Modernizing Municipal Finance (ICMA)	2011
46.	Strategic Framework (ICMA)	2011
47.	Country report on the solid waste management in Lebanon (Sweepnet)	2010
48.	Tender Documents for the 2006 SWM National solid waste master Plan	2006
49.	CAS Demographic Characteristics of residents (National Survey of Household Living Conditions 2004-2005)	2005
50.	National Physical Master Plan of the Lebanese Territory (DAR - IAURIF)	2005
51.	Legal framework for solid waste management in Lebanon (ELARD - ENVIROTECH - TEBODIN)	2004
52.	Public–Private Partnerships for Solid Waste Management Services (M. MASSOUD and M. EL-FADEL - Journal Environmental Management)	2002
53.	Ghaleb Faour Evaluating Urban Expansion Using Remotely-Sensed Data in Lebanon	2014
54.	Ghassan Dibeh, Ali Fakih, Walid Marrouch Decision to Emigrate Amongst the Youth in Lebanon	2017
55.	ESCWA International Migration and Development in the ESCWA Region: Challenges and Opportunities	2011
56.	OCHA Humanitarian Bulleting Lebanon	2016
57.	FAO FAO Plan of Action for Resilient Livelihoods	2017
58.	UN Habitat Lebanon Urban Profile – A Desk Review Report	2011
59.	MoPH Statistical Bulletin	2016

No	Document	Date
60.	Jad Chaaban, Nisreen Salti, Hala Ghattas, Alexandra Irani, Tala Ismail and Lara Batlouni Survey on the socio-economic status of Palestine refugees	2016
61.	Dr. Paul Tabar Lebanon: A Country of Emigration and Immigration	2010
62.	ESCWA The Agricultural Sector of Lebanon	2013
63.	UNHCR The situation of Palestinian Refugees in Lebanon	2016
64.	UNDP Improving Living Conditions in Palestinian Gatherings Host Communities	2016
65.	UN-HABITAT Urban Profiles and Strategies Presentation	2015
66.	CDR Urban Transportation	2014
67.	Water Supply master plan for north Lebanon, North Lebanon Water Establishment, a study by Khatib & Alami	2016
68.	Olive oil: the bittersweet taste of Lebanon (Blominvest Bank, 2015)	2015
69.	Aerobic and anaerobic biotreatment of olive oil mill waste water – LAU	2016
70.	Management of olive solid waste in Lebanon: from mill to stove – Elias Kinab, Georges Khoury	2015