



Survey on Solid Waste Management in the Southern Governorates of Iraq

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Background

In April 2006, UNEP launched an extension to its initial project titled *_Support for the Environmental Management of the Iraqi Marshlands._* The project extension (Phase II-A), with funding by the Government of Italy, supports data collection and analysis of water, environment, and socio-economy parameters, data sharing on a uniform platform, and providing hardware, software, and necessary training to utilize such information sharing platform.

UNEP-DTIE-IETC organized a Technical Meeting on data gaps needed to support suitable environmental management of the Iraqi Marshlands, during 27-30 June 2006. Officials from Ministry of Municipalities and Public Works (hereinafter *_MMPW_*) in consultation with UNEP-DTIE-IETC developed the terms of reference for data collection on solid waste management data, basic socio-economic and demographic data and Marshland Information Network (MIN) updating during the Technical Meeting. UNEP-DTIE-IETC and MMPW concluded a Memorandum of Understanding on 22 August 2006 and, MMPW developed Terms of Reference for an implementing agency to carry out the above-mentioned activities.

1. To conduct two field surveys within designated areas inside the Marshlands on (1) Solid Waste Management and (2) Demographic and Socio-economic data.
2. To perform analysis of data collected from field surveys and present data in user-friendly manner in order to upload onto to the Marshlands Information Network to share data.
3. To utilize survey as pilot studies to establish a system to preserve, document, and comprehensively modernize a full database that will enable and facilitate the process of socio-economic development in the Marshlands region.

A memorandum of understanding was concluded between UNEP and Thi-Qar University in April 2007 to carryout the above surveys in nine cities and towns identified by MMPW. Surveys were carried-out during June to September 2007 under the overall coordination and supervision of UNEP-DTIE-IETC.

OBJECTIVES OF THE SOLID WASTE SURVEY

Survey was conducted with the following objectives.

1. To collect and analyze current solid waste management practices in the nine cities and towns identified by MMPW
2. To analyze and determine the quantity of solid wastes generated by households, industries, commercial entities, hospitals, and their methods of disposal in each of the survey areas
3. To provide recommendations for addressing current problems associated with solid waste management
4. To share the results and findings on the Marshland Information Network (MIN)

SURVEY METHODOLOGY

The nine survey areas identified by MMPW in Thi-Qar, Basrah and Missan governorates represented large, medium and small urban areas in each governorate. Figure 1 shows outline of the survey consisting of two main components, which were carried-out in each of the city/town surveyed. The two main survey components are as follows and are described in the subsequent sections:

1. Information collection on current solid waste management practices
2. Solid waste characterization surveys.

Survey Areas

Location map of the surveyed areas is as shown in Figure 2. Basic information of

these cities and towns are as shown in Table (1).

Information Collection on Current Solid Waste Management Practices

For the management of wastes from households, commercial/institutional entities, industries and clinics, information on sources of waste generation, waste collection and transport and on final disposal were obtained through interviews of local officials using questionnaires designed for the purpose and by field observation. Annex 3 shows the questionnaire used. Following are the list of salient information that was obtained for each stage of waste management that is currently being practiced.

- **Waste generation sources**

Urbanized area, population, number of households, number of commercial, institutional, industrial and clinical entities
Waste collection and transport. Institution responsible, method and frequency of collection, recovery of valuables and equipment available.

- **Waste disposal**

Method and location of final disposal, waste quantity and equipment used. For other categories of waste such as construction and demolition waste, sludge from sanitation facilities, hazardous household waste, electrical appliances from households and war related debris, qualitative information on the institution responsible for collection and disposal, methods for collection/ transport/

disposal and the problems encountered was collected.

Solid Waste Characterization Surveys

For waste generated by households, data was obtained through sample collection, measurements and analysis in each of the city/town surveyed for a continuous period of seven days to determine waste generation rate, waste composition and waste density. Figure 3 shows the schematic of sampling, measurements and analysis for household waste generation and characterization.

There was no prior data available on the solid waste generation or characteristics for the city/town surveyed. Therefore number of samples was determined using the equation below for a given confidence level and acceptable error level. Table 2 shows the number of samples for required confidence level.

$$n = k\alpha^2 p (1-p)/e^2$$

Where:

p= value of the proportion in the population,
e = the acceptable error and $k\alpha$ = coefficient dependent on the confidence level.

Total numbers of samples were therefore set to minimum of 100 households for each of the city/town surveyed to achieve at least 90-95% confidence level and within an error level of 10%.

Stratified sampling: To determine the generation rate and characteristics of high-income, middle-income and low-income households in each city/town, total number of samples was distributed between each of the three income level category nearly in proportion to population ratio of income level. In each city/town, high-income, middle-income and low-income sub-areas were identified and required number of households was randomly selected in each of the selected sub-area. Table (3) shows sub-area sampled in each income category and with the number of samples in the surveyed areas. Total number of samples for the survey in all surveyed area was 997.

Appendices 4 through 12 show the location of areas surveyed on the urban land use maps for each city/town.

Sample Collection : Plastic bags were distributed to the selected households to collect its waste and number of occupants was recorded. Bags were collected each day and replaced by another; and so on for seven days in each of the studied areas. Collection crews transferred the plastic bags of wastes from nominated houses, weighed individually and labeled according to its socio-economic classification.

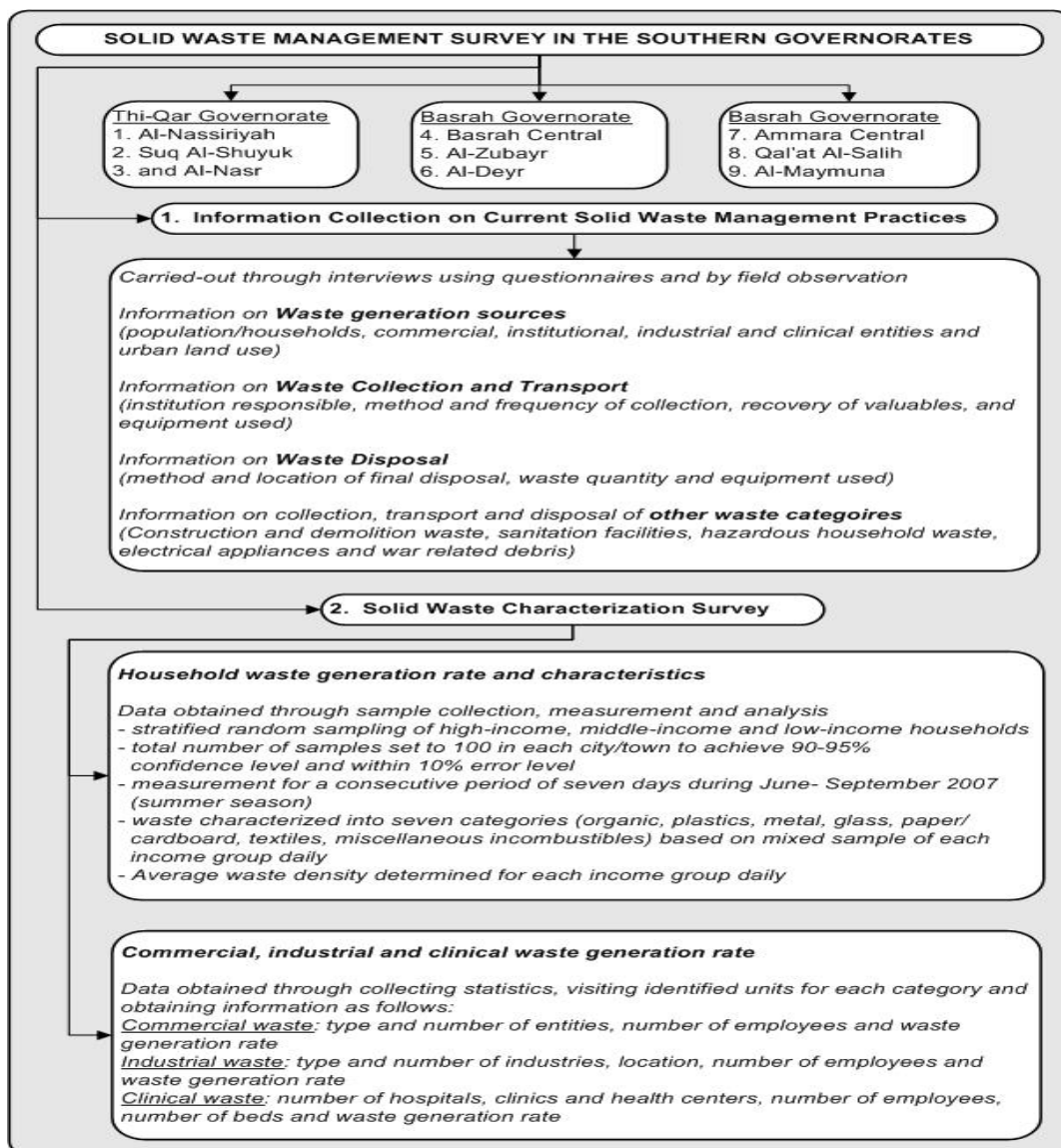
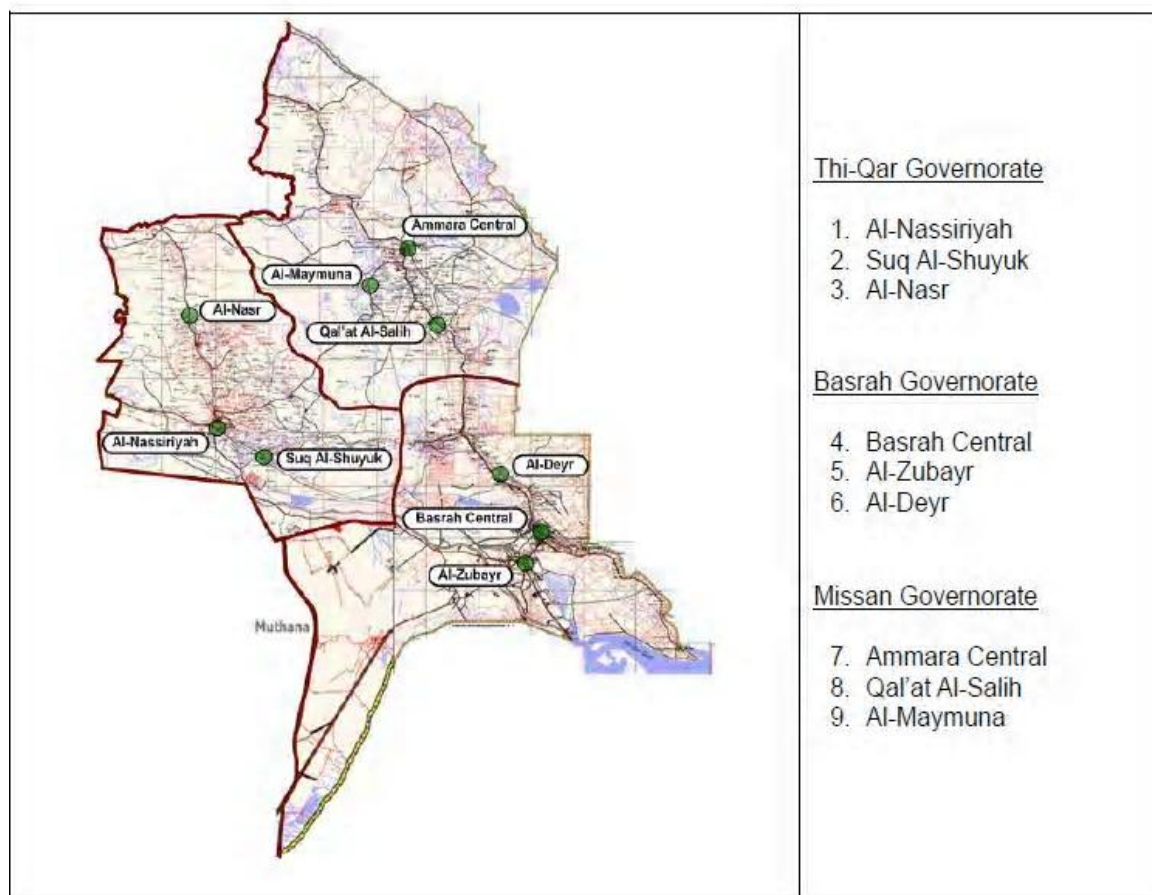


Figure 1 Outline of Solid Waste Management Survey in the Southern Governorates

Table 1 Basic Data on Surveyed Areas

Survey Area	Administrative Level	Area, km ²	Population	No. of Households	No. of Institutions	No. of Industries
Thi-Qar Governorate		12,900	1,616,200	N/A		
Al-Nassiriya	Marka	57	325,000	35,000	325	7
Suq Al-Shuyuk	Kada	11	97,500	10,100	50	---
Al-Nasr	Nahia	7	33,500	3,580	36	---
Basrah governorate		19,070	1,907,308	N/A		
Basrah Central	Marka	165	802,600	97,600	950	16
Al-Zubayr	Kada	25	168,500	19,700	130	---
Al-Deyr	Nahia	6	25,500	2610	38	---
Missan Governorate		16,072	824,100	N/A		
Ammara Central	Marka	52	345,450	37,500	465	8
Qal'at Salih	Kada	10.5	26,850	3,675	34	---
Al-Maymuna	Kada	5.5	13,400	1,650	28	---

Note: Data on area is based on the land use master plan. Population is estimate for year 2007 based on the census data of 1997 with net annual growth rate of 3.78%. Data on number of households were from municipality/local council. N/A - Not available.

**Figure (2) Location Map of Surveyed Town and Cities**

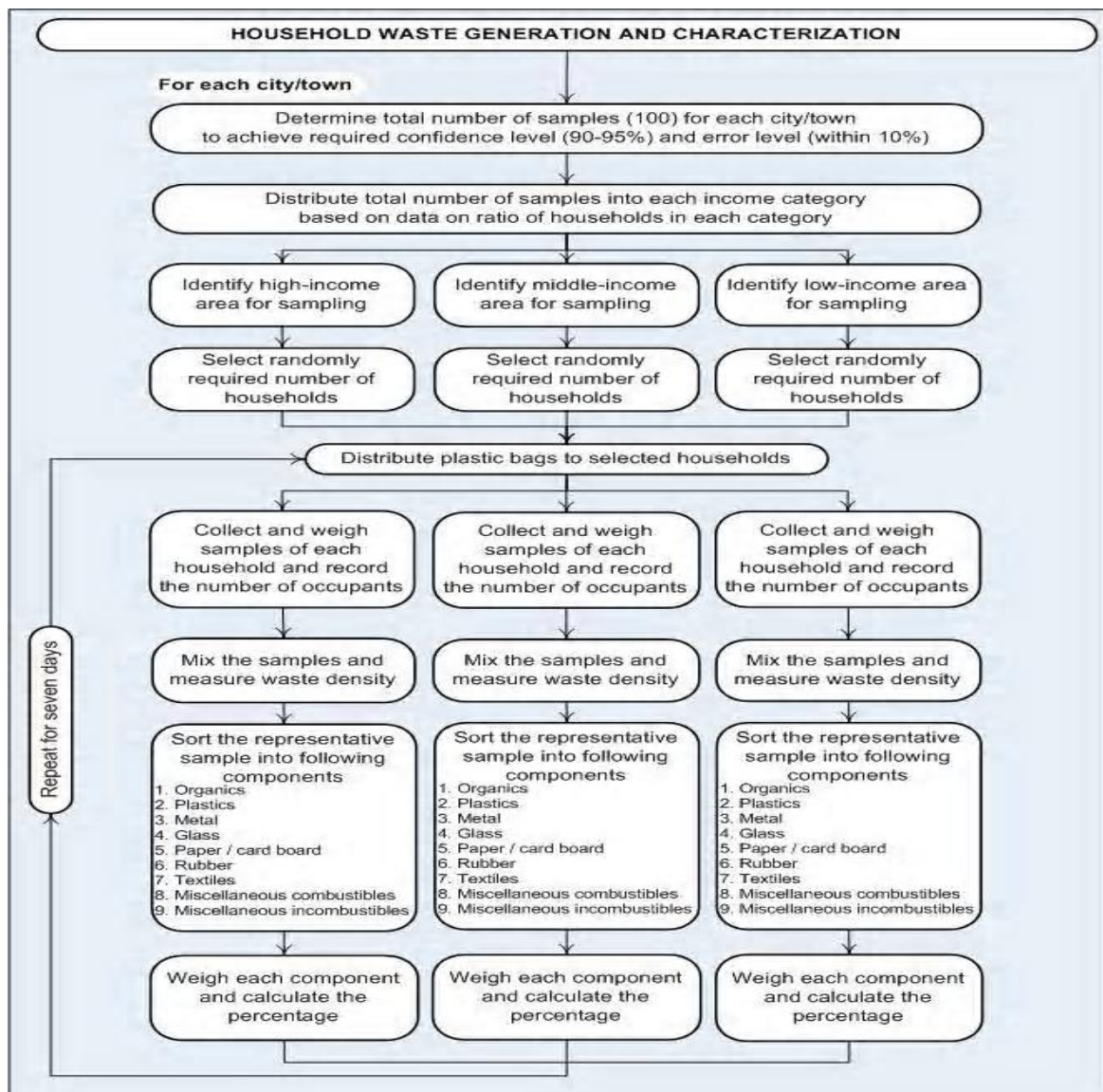


Figure (3): Household waste generation and characterization methodology

Table (2) Sample Size Determination

Confidence level	Number of samples	
	Maximum Error Level	Maximum Error Level
	5%	10%
85 %	208	52
90 %	271	68
95 %	385	97

Table (3) Sub-areas Surveyed for Households Waste Generation and Characterization

Survey Area	High-income Sub-area	Middle-income Sub-area	Low-income Sub-area	Total Number of samples
Thi-Qar Governorate				
Al-Nassiriya	Al-Edara Al-Mahlya 20 samples (17%)	Arido 45 samples (42%)	Al-Mensuria 45 samples (41%)	110
Suq Al-Shuyuk	Al-Zhraa 20 samples (16%)	Al-Esmayeeyiya 35 samples (36%)	Al-Hassen Al-Askri 55 samples (48%)	110
Al-Nasr	Al-Meshrooa 18 samples (15%)	Al-Sader 1 45 samples (40%)	Al-Hakeem 45 samples (45%)	108
Basrah governorate				
Basrah Central	Al-Abassieya 25 samples (22%)	Al-Muwfekeya 46 samples (37%)	Al-Jumhuriya 45 samples (41%)	116
Al-Zubayr	Al-Mualmeen 20 samples (15%)	Al-Jumhuriya 45 samples (35%)	Al-Usra 50 samples (50%)	115
Al-Deyr	Al-Zuhoor 17 samples (16%)	Al-Zhraa 40 samples (40%)	Al-Kzeya 45 samples (44%)	102
Missan Governorate				
Ammara Central	Awasha 25 samples (24%)	Al-Husseien Al-Jedeyed 50 samples (37%)	Al-Hassaen Al-Askri 40 samples (39%)	115
Qal'at Salih	Al-Uruba 21 samples (20%)	Al-Zehraa 40 samples (35%)	Al-Husseyneya 50 samples (45%)	111
Al-Maymuna	Al-Zhraa 20 samples (19%)	Al-Sedreyen 40 samples (32%)	Al-Kassem 50 samples (49%)	110
Grand total				997

Note: Percentages shown in brackets are % of households of the respective income-level in the Survey Area.

Waste Characterisation: Each day, waste collected for each income group was mixed separately and a representative portion was taken for measurement of the waste density and for waste characterization. Waste density was measured by filling a fixed volume of container without compacting and weighing and then the contents of waste were hand-sorted into the following individual components.

1. Organic (putrescible) materials: including all wastes from preparation, cooking, and serving food.
2. Plastics: all varieties
3. Metals: Tins, cans and metal: ferrous and non-ferrous
4. Glass: non-returnable bottles, soft drink

bottles, broken glass, ceramics, ..etc.

5. Paper and cardboard: all kind of waste paper, newspapers, and cardboard.
6. Rubber:
7. Textiles and Rugs: all textiles, synthetics, wood, leather
8. Miscellaneous combustibles
9. Miscellaneous incombustibles

After sorting, weight of each component was measured and the percentage of each component was calculated.

Current solid waste management practices

In all the cities and towns surveyed, municipal solid waste is managed by the respective municipality except in Basrah governorate where a formal private sector

system has been recently introduced in large cities and towns that governorate. Commercial and institutional wastes are collected together with household wastes while industrial wastes are managed by the respective industry.

Table 4 summarizes the main results of the survey on collection, transport and disposal of municipal solid wastes in the cities/towns surveyed.

Municipal Waste Collection and Transport

Various types of collection services are now used and the most common municipal collection systems are curb, alley and backyard collection. The collection service provided to large apartment buildings, residential complexes, commercial and institutional activities typically is centered on the use of large movable and stationary containers. There are two systems of collection as follows:

1. The Formal system

This system is operated by the municipalities and normally restricted to collection from common bins. Common bins are available in large cities or towns like Al-Nassiriya, Basrah Central, Al-Zubayr and in Ammara Central and are not available in other five towns surveyed.

2. The Informal system (*Zaballeen*)

This is a private system offering door side collection service in high-income and middle-income areas. The private sector system introduced recently in large cities and towns of Basrah governorate is a refined model of *Zaballeen* system retaining its scope but utilizing upgraded equipment and

facilities.

Waste collection frequency varies between daily, five times a week or three times a week. Daily collection of waste is practiced in Al-Nassiriya, Al-Nasr and Qal_at Al-Salih. However, the above services are available mostly to major centers, while peri-urban areas do not have such services. This results in infrequent or no waste collection in low-income neighborhoods. In low-income areas, wastes are dumped in open areas and drainage ways, and workers spend much time cleaning around these areas. The collection equipment employed for such areas is very primitive and principally relies on donkey-driven carts. Solid wastes are collected and disposed into refuse piles in open lands, where the waste stays giving rise to odor and other problems. Besides when solid wastes are transferred in open carts and trucks, light items, such as paper and plastics, are blown away by the wind and scattered along the route to the disposal site.

Aside from waste collection, paved roads are manually cleaned with street sweepers five to six times a week. The central commercial areas are cleaned daily.

Local authorities also provide collection services for domestic wastes generated from hospitals and clinics. However, medical and pathogenic wastes are usually incinerated by the hospital authorities within the hospital grounds. Industrial wastes are the responsibility of industry itself and are collected by transported by the industry.

Domestic solid wastes and industrial solid wastes, which are collected by the private

sectors, are salvaged for valuables by the collection staff. Salvaging is performed manually in streets, on vacant land and/or at open lands used for dumping. Salvable items such as paper, high-density plastics, wood, glass, metal, cloth, leather and bones are collected and sold. This recycling process is beneficial as it provides pertinent industries with some raw materials at low prices.

As for collection, vehicles there are five basic types of vehicles used for municipal waste collection:

- " Tractor
- " Waste collection truck
- " Trolley
- " Ordinary truck
- " Waste truck for bulk transportation

In general, solid waste collection system is characterized by the following:

- " Inadequate staff, organizational and management structures
- " Inadequate number and type of equipment required for consecutive collection- transport operation.
- " Old equipment that result in frequent breakdown
- " Lack of awareness and negative attitude of the population.
- " Funding limitations

Municipal Waste Disposal

The problems related to final disposal of solid waste have been growing at an alarming rate. Their manifestation in large city like Al-Basrah and Al-Nassiriya has reached such serious proportions that they called for considerable governorate intervention and a series of judicious actions. Still proper solid waste management

techniques are not practiced on any notable scale, particularly from the standpoint of waste treatment and disposal.

The great majority of wastes collected by municipalities or by private contractors in the southern

governorates was disposed of in open dumps and often burned them. One could witness large heaps to small mountains of refuse on the outskirts of the major cities. In some of them, the refuse is periodically leveled and compacted, in other the refuse is piled as high as equipment will permit, and some are ignited and allowed to burn to reduce volume.

Recently, municipalities made an effort to control their wastes by hauling these residues to an "open dumps" located on the edge of the city. Location of open dumps in each city town surveyed is as shown in Figures 4 through 12. At present, solid waste from industrial sources are also disposed at these open dumps.

Although the three governments and their districts and sub-districts were served by sanitary landfills and solid waste used to be hauled for disposal in these authorized sites⁵, but after the 2003 war, wastes are to be dumped in open lands located adjacent to residential areas. These authorized sites were abandoned and were considered too far to reach for instance Suq Al-Shuyuk sanitary dumping site is located 15 km from the city boundaries and solid waste are currently dumped in an open land 1.5 km from the city boundaries instead.

Garden wastes were usually burned either by municipality workers or by citizens in empty lots in various districts.

Table 4 Collection, Transport and Disposal of Municipal Wastes in the Surveyed Areas

Item	Thi-Qar Governorate			Basrah Governorate			Missan Governorate		
	Al-Nassiriya	Suq Al-Shuyukh	Al-Nasr	Basrah Central	Al-Zubayr	Al-Deyr	Amara Central	Qallat Al-Salih	Al-Maymuna
1. Availability of solid waste collection system	Available								
2. Organization responsible for collection/transport	Municipality			Private Contractor			Municipality		
3. Use of common bins	Yes	No	No	Yes	No	No	Yes	No	No
4. Practice of waste thrown in open spaces	Yes								
5. Practice of people collecting of valuables	Yes								
6. Institutional and commercial waste collection	Collected together with household wastes								
7. Industrial solid waste collection	By industry ^{#1}	No large industries ^{#2}	By industry ^{#1}	No large industries ^{#2}	By industry ^{#1}	No large industries ^{#2}	By industry ^{#1}	No large industries ^{#2}	By industry ^{#1}
8. Solid waste collection frequency									
- From Common Bins (day/week)	7 (daily)	Nil	3	3	Nil	Nil	5	Nil	Nil
- From open spaces (day/week)	7 (daily)	5	7 (daily)	3	5	5	5	7 (daily)	5
9. Waste Collection equipment									
- Tractors	14	4	8	50	13	4	72	3	2
- Waste Collection Trucks	3	Nil	4	45	7	3	25	2	1
- Trolley	12	Nil	Nil	Nil	2	Nil	Nil	Nil	Nil
- Ordinary Truck	50	Nil	Nil	Nil	Nil	Nil	50	Nil	1
- Waste Truck (for bulk transportation)	2	5	1	20	8	1	2	1	2
10. Manpower employed									
- Supervisors	25	12	0	80	5	4	48	3	3
- Machinery/equipment operators	115	10	13	160	15	8	88	14	10
- Workers	750	200	105	2,305	285	55	942	182	120
11. Quantity of waste transported to disposal site (ton/day)	303	56	28	540	180	22	314	34	24
12. Waste disposal method	Open dumping and burning								
13. Number of major open dumps	One	One	One	One	Two	One	One	One	One
14. Street cleaning	Yes								
15. Method utilized for street cleaning	Manpower (manual cleaning)								
16. Frequency of street cleaning (day/week)	5	0	0	0	5	5	5	5	Nil ^{#3}

Note: #1- Recycled/reused by industry itself, sold as scrap to others and transported to municipal dump site by the industry.
 #2- No large industries exist in this area. Small & medium-scale industries for vehicle repair
 #3- Streets are unpaved.

Other Waste Sectors

In addition to the waste generated by households including the electrical appliances, commercial and institutional entities managed by municipality, the municipality also manages the following waste sectors as follows.

a) Construction and demolition waste

Generally collected and transferred to fill low-lying areas nearby and the equipment available

is inadequate equipment for the purpose resulting in heaps of construction and demolition

waste in open lands.

b) Sludge from sanitation facilities

Sludge generated at wastewater treatment plant and the septage collected from septic tanks are generally left to accumulate at the treatment plant premises or disposed to the river/canal. At Ammara Central, treatment unit available for sludge treatment is inadequate. In all cities and towns, equipment to collect and treatment facilities are inadequate.

c) Household electrical appliances and household hazardous waste Household electrical appliances are collected and disposed together with other wastes by the municipality. There is no separation of hazardous wastes from households and they are collected and disposed together by the municipality with other wastes.

For the following waste sectors, waste generators are responsible for managing their waste.

a) Clinical waste

Individual medical institution is responsible for managing the pathogenic and medical waste.

Incineration is the mainly used for treatment of these wastes and most of incinerators are suffering from inadequate capacity and frequent breakdown of incinerators. In Al-Deyr, there is no incinerator and the clinical wastes are disposed together with municipal waste.

Further, discussion and information on clinical waste generation is provided in the subsequent section on results of waste characterization survey.

b) Industrial waste

Individual industry is responsible to manage their wastes and collection and

transport is carried-out by private contractors. During this process, valuable items are salvaged and sold and the rest disposed at the municipal dumpsite together with other wastes.

In large cities i.e. Al-Nassiriya, Basrah Central and Ammara Central, large industries are located in industrial estates. In other cities and towns, small and medium-scale industries mainly for automobile repair exist. Industrial wastes in these towns are collected together with municipal waste. Further, discussion and information on industrial waste generation is provided in the subsequent section on results of waste characterization survey.

c) War-related debris

Police and Civil Defense are responsible for the war-related debris and there is no specific

method employed to clear and dispose the debris.

Results of solid waste characterization surveys

Household Waste Generation Rate and Household Waste Generation Estimates

Table 5 shows the summary of solid waste generation rate expressed as per household and per capita and are also shown in Figure 13 and 14. These values were obtained by averaging waste generated by each household over seven days of measurements and by calculating the median value for the set of households in each-income level surveyed. Per capita generation rates were obtained similarly by first dividing the average waste generation rate over seven days by the number of persons in the

respective household.

Per capita household waste generation was 0.55, 0.51 and 0.46 kg/(capita.day) for high-income, middle-income and low-income levels respectively with maximum of 0.83 kg/(capita.day) in high-income area in Ammara Central and minimum of 0.33 kg/(capita.day) for high-income area in Al-Deyr (Table 5).

Per capita household waste generation rates were higher with higher income level in Al-Nassiriya, Al-Nasr, Ammara Central, Qal_at Al-Salih, Al-Maymuna and for the average for all three governorates. This relationship was not observed for all towns in Basrah governorate and in Suq Al-Shuyuk in Missan governorate. Similar relationship was also not observed for the household waste generation rate except in Al-Nasr, Ammara Central, Al-Maymuna and for the overall average. Income levels of sub-areas were based on the state of residential pattern etc. and the household sizes may have been affected by internal displacement due to prevailing security situation. For estimates of total waste generation, per capita generation rates will be used.

Based on the per capita generation rates determined in this survey for each income level and respective population in each income level, total quantity of household solid waste generation is estimated for each survey area and is shown in Table 6.

Density of Household Waste

Table 7 shows the density of household waste and was obtained averaging results of density measurements for seven consecutive days of

the household waste collected in each income-level.

Simple average for the three income-levels is also shown for each of the area surveyed. Density of waste from high-income and low-income households was generally higher than that of middle-income households except in Ammara Central and Al-Maymuna. Median values of household waste density were 297, 243 and 271 kg/m³ for high-, middle and

low-income households in for the surveyed areas with the maximum of 331 kg/m³ at high-income area in Suq Al-Shuyuk and 223 kg/m³ at low-income area in Ammara Central.

Composition of Household Waste

Tables 8, 9 and 10 show the summary of solid waste composition for each of the income-level in the survey areas into nine constituents. Table 11 shows the summary of average waste composition for each income level and in each governorate. Figure 15 shows the composition graphically.

Organics were the main constituent of household waste in the order of 60-70%. Plastics were at

6-7% and metal, glass, paper and textile were in the range of 3-5% each. It should be noted that

miscellaneous incombustibles were exceptionally high above 10% especially in Al-Zubayr, Al-Deyr, Ammara Central, Qal_at Al-Salih and at Al-Maymuna for all income levels. Source and origin of this constituent needs to be investigated in the future.

Table 5 Household Waste Generation Rates

Survey Areas	Household waste generation rate kg/(household.day)			Per Capita Household Waste Generation Rate kg/(person.day)		
	High-income	Middle-income	Low-income	High-income	Middle-income	Low-income
Thi-Qar Governorate						
Al-Nassiriya	3.9	4.3	3.1	0.58	0.47	0.38
Suq Al-Shuyuk	3.4	4.0	3.8	0.44	0.49	0.43
Al-Nasr	5.0	4.2	3.6	0.60	0.58	0.42
Basrah governorate						
Basrah Central	3.4	3.0	3.3	0.55	0.42	0.53
Al-Zubayr	5.4	3.3	4.0	0.46	0.55	0.52
Al-Deyr	3.5	3.3	3.5	0.33	0.43	0.40
Missan Governorate						
Ammara Central	6.2	5.9	5.1	0.83	0.64	0.59
Qal'at Al-Salih	3.7	4.1	3.4	0.58	0.53	0.41
Al-Maymuna	4.2	4.1	3.6	0.58	0.46	0.42
Average (Three governorates)	4.3	4.0	3.7	0.55	0.51	0.48

Note: For each income-level surveyed, generation rates were averaged arithmetically over seven days measurement for each household and median values were calculated for the set of households.

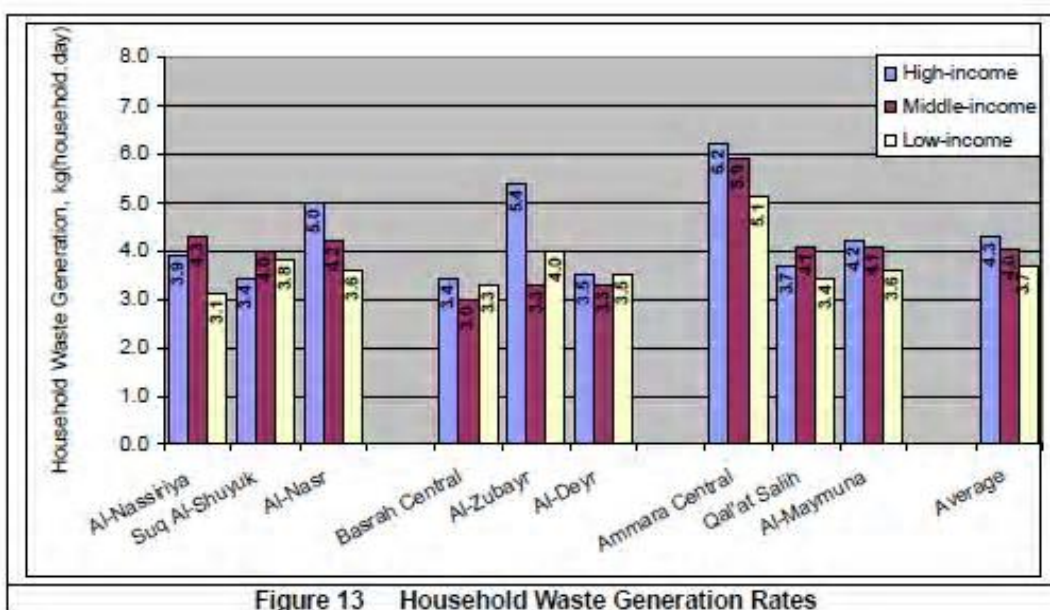


Figure 13 Household Waste Generation Rates

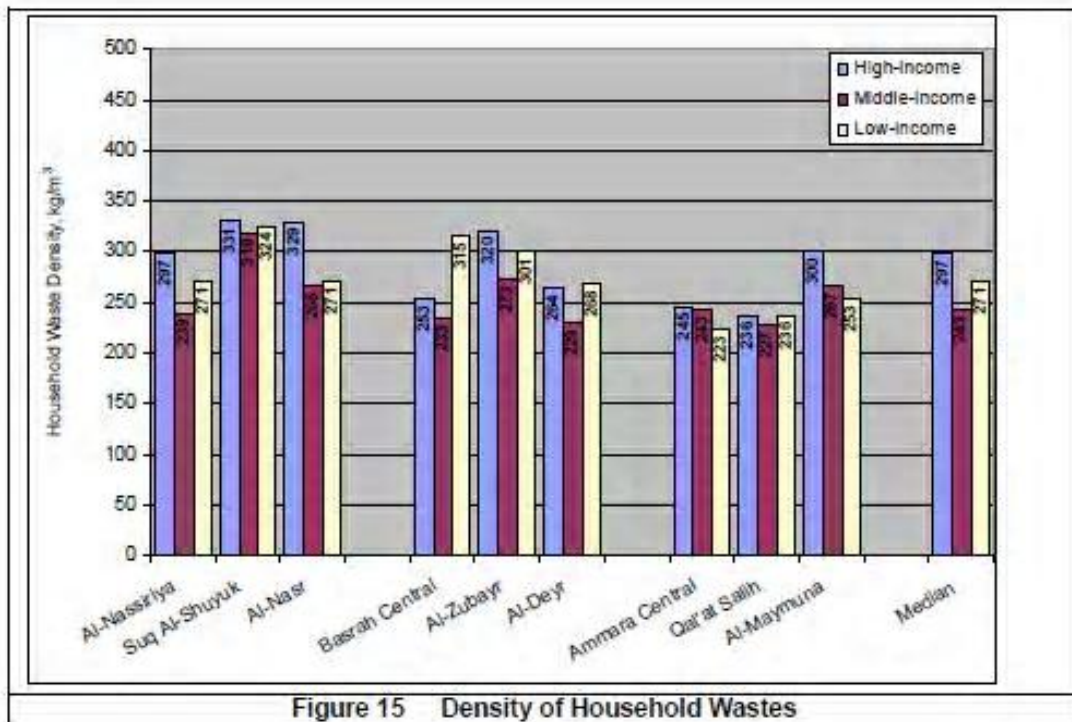
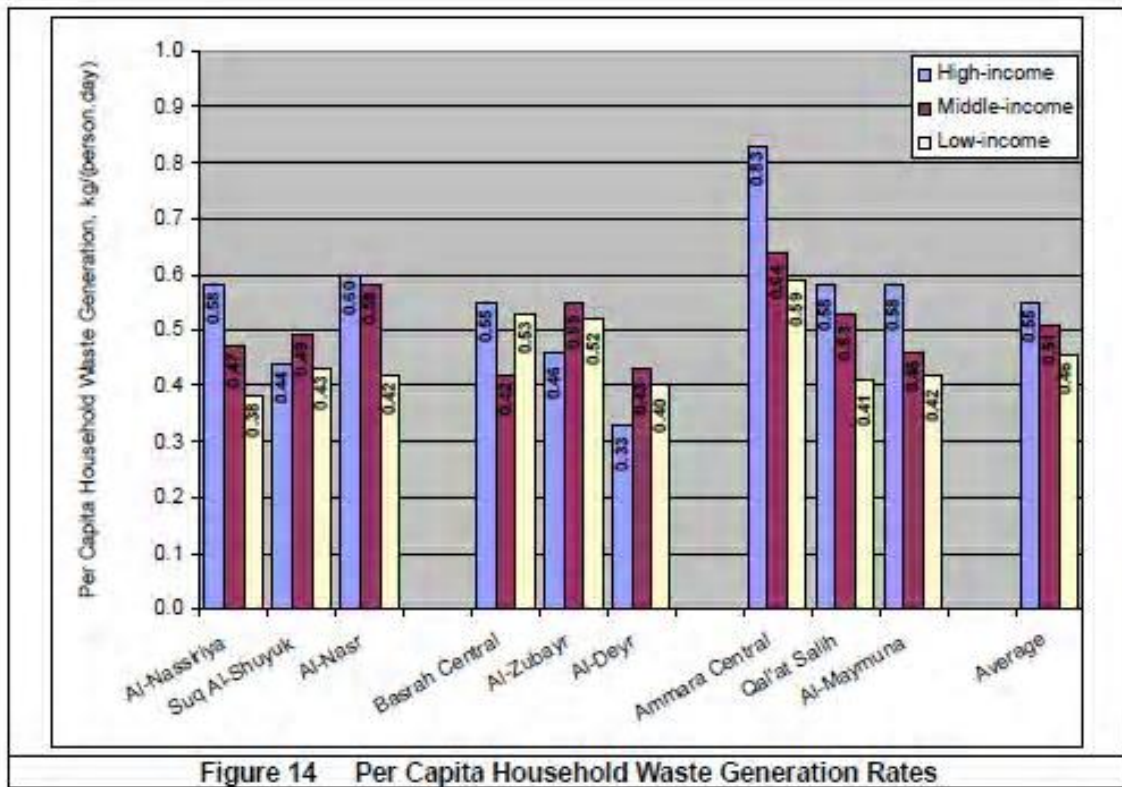


Table 6 Estimated Quantity of Household Waste Generation

Survey Areas	Per Capita Household Waste Generation Rate, kg/(person.d)			Population			Household Waste Generation, Ton/d			
	High	Mid	Low	High	Mid	Low	High	Mid	Low	Total
Thi-Qar Governorate										
Al-Nassiriya	0.58	0.47	0.38	53,675	144,635	126,600	31.1	68.0	48.1	147
Suq Al-Shuyuk	0.44	0.49	0.43	15,130	34,580	47,790	6.7	16.9	20.5	44
Al-Nasr	0.60	0.58	0.42	4,900	13,450	15,150	2.9	7.8	6.4	17
Basrah governorate										
Basrah Central	0.55	0.42	0.53	206,900	285,000	311,500	113.8	119.7	165.1	399
Al-Zubayr	0.46	0.55	0.52	31,350	54,250	82,950	14.4	29.8	43.1	87
Al-Deyr	0.33	0.43	0.40	4,400	9,750	11,350	1.5	4.2	4.5	10
Missan Governorate										
Ammara Central	0.83	0.64	0.59	77,650	136,900	130,750	64.4	87.6	77.1	229
Qafat Al-Salih	0.58	0.53	0.41	5,300	9,750	12,750	3.1	5.2	5.2	14
Al-Maymuna	0.58	0.46	0.42	2,600	4,300	6,600	1.5	2.0	2.8	6

Note: Total waste generation is rounded to the nearest ton/d.

Table 7 Density of Household Waste

Survey Areas	Average Household Waste Density, kg/m ²			
	High-income	Middle-income	Low-income	Average* ¹
Thi-Qar Governorate				
Al-Nassiriya	297	239	271	269
Suq Al-Shuyuk	331	319	324	325
Al-Nasr	329	268	271	289
Basrah governorate				
Basrah Central	253	233	315	267
Al-Zubayr	320	273	301	298
Al-Deyr	264	229	268	254
Missan Governorate				
Ammara Central	245	243	223	237
Qafat Al-Salih	236	227	238	233
Al-Maymuna	300	267	253	273
Median	297	243	271	-
Standard Deviation	37	30	34	-

Note: Average density values were obtained by averaging results of density measurements for seven consecutive days of the household waste collected in each income-level. #1 – Simple average across income levels.

Table 8 Average Composition of High-income Household Waste

Survey Areas	Percentage (by weight)								
	Organic	Plastic	Metal	Glass	Paper	Rubber	Textile	Misc. Comb.	Misc. Incomb.
Thi-Qar Governorate									
Al-Nassiriya	88.2%	9.1%	5.1%	4.5%	8.0%	0.0%	3.2%	0.8%	5.3%
Suq Al-Shuyuk	74.3%	4.4%	4.6%	3.5%	3.7%	0.0%	2.9%	1.4%	5.2%
Al-Nasr	88.2%	7.6%	4.4%	4.4%	4.1%	0.0%	4.1%	1.5%	5.8%
Basrah governorate									
Basrah Central	59.5%	9.0%	3.2%	7.8%	5.3%	1.2%	3.1%	2.1%	8.8%
Al-Zubayr	85.2%	3.4%	5.2%	6.0%	3.3%	0.4%	4.9%	1.0%	10.6%
Al-Deyr	63.7%	4.9%	4.3%	3.6%	5.9%	1.8%	3.3%	2.5%	10.2%
Missan Governorate									
Ammara Central	46.1%	5.7%	4.6%	4.3%	4.5%	1.0%	5.1%	0.5%	28.0%
Qafat Al-Salih	70.7%	6.0%	2.9%	4.8%	3.0%	0.4%	1.7%	1.7%	8.6%
Al-Maymuna	49.6%	6.8%	5.1%	5.6%	6.9%	0.5%	2.6%	1.6%	21.2%
Overall									
Average	62.6%	6.3%	4.4%	5.0%	4.7%	0.6%	3.4%	1.4%	11.5%
Maximum	74.3%	9.1%	5.2%	7.8%	6.9%	1.8%	5.1%	2.5%	28.0%
Minimum	46.1%	3.4%	2.9%	3.5%	3.0%	0.0%	1.7%	0.5%	5.2%
Standard Deviation	9.4%	2.0%	0.8%	1.4%	1.3%	0.6%	1.1%	0.7%	7.9%

Table 9 Average Composition of Middle-income Household Waste

Survey Areas	Percentage (by weight)								
	Organic	Plastic	Metal	Glass	Paper	Rubber	Textile	Misc. Comb.	Misc. Incomb.
Thi-Qar Governorate									
Al-Nassiriya	85.4%	11.0%	4.6%	4.6%	5.1%	0.0%	2.6%	0.6%	6.1%
Suq Al-Shuyuk	77.3%	3.3%	3.3%	2.6%	2.2%	0.0%	2.9%	0.8%	7.4%
Al-Nasr	70.2%	9.6%	3.1%	2.8%	3.5%	0.2%	3.0%	1.0%	6.6%
Basrah governorate									
Basrah Central	70.0%	5.3%	4.3%	3.4%	3.5%	0.4%	2.6%	1.4%	9.0%
Al-Zubayr	64.0%	5.4%	2.0%	3.3%	3.2%	0.8%	4.2%	1.0%	16.0%
Al-Deyr	60.9%	6.4%	3.5%	4.6%	5.3%	0.9%	4.3%	1.7%	12.4%
Missan Governorate									
Ammara Central	46.6%	4.6%	4.5%	4.4%	5.2%	1.5%	3.3%	0.8%	32.8%
Qafat Al-Salih	62.0%	6.6%	2.5%	3.4%	3.8%	0.0%	2.8%	0.9%	18.1%
Al-Maymuna	48.8%	6.5%	4.2%	5.2%	5.3%	1.1%	4.0%	1.9%	23.0%
Overall									
Average	62.8%	6.5%	3.6%	3.8%	4.1%	0.5%	3.3%	1.1%	14.6%
Maximum	77.3%	11.0%	4.6%	5.2%	5.3%	1.5%	4.3%	1.9%	32.8%
Minimum	46.6%	3.3%	2.0%	2.6%	2.2%	0.0%	2.6%	0.6%	6.1%
Standard Deviation	9.9%	2.4%	0.9%	0.9%	1.1%	0.5%	0.7%	0.4%	8.9%

Table 10 Average Composition of Low-income Household Waste

Survey Areas	Percentage (by weight)								
	Organic	Plastic	Metal	Glass	Paper	Rubber	Textile	Misc. Comb.	Misc. Incomb.
Thi-Qar Governorate									
Al-Nassiniya	74.0%	4.3%	5.2%	5.6%	5.5%	0.0%	2.5%	0.0%	2.7%
Suq Al-Shuyuk	73.8%	4.7%	2.6%	3.4%	3.0%	0.0%	1.8%	0.6%	9.9%
Al-Nasr	69.1%	11.7%	3.0%	2.9%	2.7%	0.0%	2.9%	1.0%	6.6%
Basrah governorate									
Basrah Central	71.0%	5.2%	3.2%	4.8%	2.5%	0.4%	2.4%	1.9%	10.2%
Al-Zubayr	36.6%	6.5%	4.1%	1.9%	3.1%	0.6%	8.5%	1.3%	37.4%
Al-Deyr	56.6%	8.6%	3.1%	3.5%	5.7%	1.2%	5.3%	1.7%	14.5%
Missan Governorate									
Ammara Central	40.9%	3.8%	2.9%	4.1%	4.6%	1.0%	4.1%	0.8%	37.7%
Qafat Al-Salih	55.5%	4.7%	2.0%	2.5%	2.9%	0.2%	1.6%	1.0%	29.6%
Al-Maymuna	42.8%	8.2%	4.1%	2.8%	5.3%	0.8%	3.8%	1.7%	30.5%
Overall									
Average	57.8%	6.4%	3.3%	3.5%	3.9%	0.5%	3.7%	1.1%	19.9%
Maximum	74.0%	11.7%	5.2%	5.6%	5.7%	1.2%	8.5%	1.9%	37.7%
Minimum	36.6%	3.8%	2.0%	1.9%	2.5%	0.0%	1.6%	0.0%	2.7%
Standard Deviation	15.0%	2.6%	0.9%	1.2%	1.3%	0.5%	2.2%	0.6%	13.8%

Table 11 Summary of Average Composition of Household Waste by Income-level

Survey Areas	Percentage (by weight)								
	Organic	Plastic	Metal	Glass	Paper	Rubber	Textile	Misc. Comb.	Misc. Incomb.
High-income									
Thi-Qar	69.6%	7.0%	4.7%	4.1%	4.6%	0.0%	3.4%	1.1%	5.4%
Basrah	62.8%	5.8%	4.2%	5.8%	4.8%	1.1%	3.7%	1.9%	9.8%
Missan	55.5%	6.2%	4.2%	4.9%	4.8%	0.6%	3.2%	1.3%	19.3%
Average	62.6%	6.3%	4.4%	5.0%	4.7%	0.6%	3.4%	1.4%	11.5%
Middle-income									
Thi-Qar	71.0%	8.0%	3.7%	3.4%	3.6%	0.1%	2.8%	0.8%	6.7%
Basrah	65.0%	5.7%	3.3%	3.7%	4.0%	0.7%	3.7%	1.4%	12.5%
Missan	52.5%	5.9%	3.7%	4.3%	4.8%	0.9%	3.4%	1.2%	24.6%
Average	62.8%	6.5%	3.6%	3.8%	4.1%	0.5%	3.3%	1.1%	14.6%
Low-income									
Thi-Qar	72.4%	6.9%	3.6%	4.0%	3.7%	0.0%	2.4%	0.5%	6.4%
Basrah	54.7%	6.7%	3.4%	3.4%	3.6%	0.7%	5.4%	1.6%	20.7%
Missan	46.4%	5.6%	3.0%	3.1%	4.3%	0.7%	3.2%	1.2%	32.6%
Average	57.8%	6.4%	3.3%	3.5%	3.9%	0.5%	3.7%	1.1%	19.9%

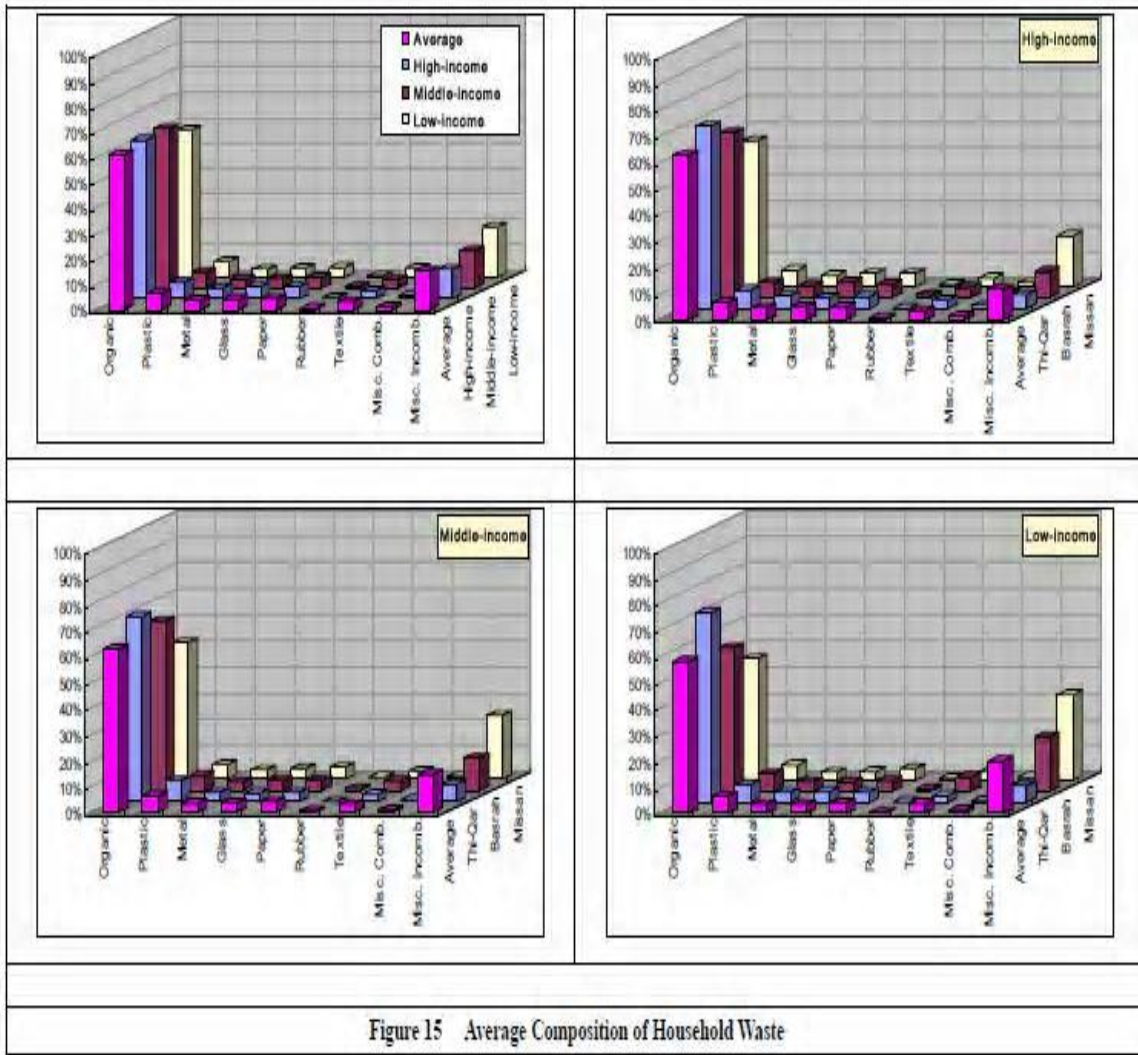


Figure 15 Average Composition of Household Waste

Comparison with Reported Results for Iraq and in the Region

Per capita generation rates for each of the survey area was estimated by dividing the total waste generation by total population (refer Table 6) and is shown in Table 12 with the reported values for cities in Iraq and in the region. Caution must be exercised, as it is not clear whether the reported per capita generation

rates are only for the household waste as in this survey or either based on the gross estimate of all municipal waste including commercial, institutional and small/medium-scale industrial waste generated or based on the amount of waste disposed. Results of this survey are closer to the recent results of Al-Najaf and Al-Falluja but much lower than that reported for Baghdad in at 0.70 kg/(capita.day) in 1978. In the region,

the survey results are close to the generation rate reported for Amman, Jordan at 0.63 kg/(capita.day) in 1993. Average waste density values for each area surveyed are also shown anare in the range of 233 - 325 kg/m³ which are lower than that reported for Al-Najaf (473 kg/m³) and Al-Falluja recently. However, they in the similar range of values reported for Amman and Syria in 1993.

Industrial Solid Wastes

a) Large-scale Industries

Thi Qar Governorate:

Table 13 shows the list of large industries in Al-Nassiriya which are located outside the city center. There are eight main industries and most of them are not running at their full capacity. Their waste is managed by the industry itself. Al-Nassiriya Textile Factory which used to discharge sludge and washing water to AL-Furat River has completed a facility to separate sludge and transfer to a nearby pond to stop polluting Al-Furat River. Total waste generation of these industries is estimated at 39 ton/day and they are mainly from the refinery and the brick factory.

Basrah Governotare

Industries in Al-Basrah are concentrated in oil and petrochemical complexes which produces a range of hazardous wastes including bottom sludge from oil storage tanks, oiled mud from the drilling of wells, contaminated soils from oil spills, waste lubricating oil from pumps and other machinery. There are also fertilizer plants, refineries, chemical plants and pulp and paper industries. Table 14 shows medium and large-scale industries in Al-Hamdan industrial estate of area 4 km², which include workshops, garages, food industries, construction material production etc. There are over 200 such industries and 22 of them were visited during this survey to collect information. Estimate of waste generated from this site is 34 ton/day.

Missan Governotare

Table 15 shows list of large-scale industries in Al-Ammara and three out of eight industries are currently not functioning. Waste generation was estimated at 8 ton/day. In the Ammara industrial site there are two juice production industries and four tile production industries.

Table 12 Per Capita Household Waste Generation Rate Reported for Iraq and in the Region

City	Per Capita Generation Rate, kg/(person.day)	Waste Density, kg/m ³	Population	Waste generation, ton/day	Year	Ref. No.
IRAQ						
1. Baghdad	0.70	445		N/A	1978	9
2. Al-Mussel	0.54	280		N/A	1988	22
3. Kirkuk	0.44	489		N/A	1988	4
4. Al-Najaf	0.42	473		N/A	2004	5
5. Al-Falluja	0.32	463		N/A	2005	20
6. Al-Nassiriya	0.45 ^{#1}	289 ^{#2}	325,000	147	2007	This survey
7. Suq Al-Shuyuk	0.46 ^{#1}	325 ^{#2}	97,500	44	2007	
8. Al-Nasr	0.51 ^{#1}	289 ^{#2}	33,500	17	2007	
9. Basrah Central	0.50 ^{#1}	267 ^{#2}	802,600	399	2007	
10. Al-Zubayr	0.52 ^{#1}	298 ^{#2}	168,500	87	2007	
11. Al-Deyr	0.33 ^{#1}	254 ^{#2}	25,500	10	2007	
12. Ammara Central	0.66 ^{#1}	237 ^{#2}	345,450	229	2007	
13. Qal'at Al-Salih	0.50 ^{#1}	233 ^{#2}	26,850	14	2007	
14. Al-Maymuna	0.44 ^{#1}	273 ^{#2}	13,400	6	2007	
REGION						
15. Cairo, Egypt	0.81	N/A	6,253,000	5,074	1988	15
16. Tehran, Iran	0.85	N/A	6,700,000	5,680	1991	16
17. Amman, Jordan	0.60	143 - 434	1,400,000	833	1993	17
18. Syria	0.29	120 - 300	14,000,000	4,000	1993	18
19. Damascus, Syria	0.20 - 0.24	N/A	4,000,000	800 - 1,300	1993	18
20. Yemen	0.30 - 0.60	160 - 330	15,000,000	N/A	1993	19

Note: N/A indicates information not available. #1 – Gross average household waste generation rate. #2 – Simple average of waste density measurement of high, middle and low-income household wastes. It is not clear whether the per capita generation rates in the literature is limited to household waste or is an overall average including commercial, institutional and small-scale activities.

Table 13 Waste Generation of Large Industries in Al-Nassiriya

Name of Industry	Type of Waste	No. of Employees	Waste Generation Rate, (Ton/month)	Remarks
1. Ur Industrial General Company				
a) Wooden pulley factory	Excelsior and discarded wooden material	150	0.01	Currently running at 20% capacity and at full capacity, waste generation estimate is 1,000 kg/d
b) Cable factory	Waste cables and metal cuttings	2,000	0.02	Waste is either being sold or reused.
b) Aluminum factory	Aluminum scrap and sludge	2,000		Currently at 20% actual capacity
2. Thi-Qar Refinery	Sludge from oil tanks, grease etc.	850	15	Benefits from selling and reuse
3. Al-Asedi Asphalt Factory	Tar	15	0.04	
4. Al-Zahra Salt Factory	Sediment	5	0.03	For production rate of 2 ton/day
5. Al-Nassiriya Textile Factory	Sludge and cuttings etc.	2,200	0.01	Running at 10% capacity (0.0033) kg/emp./d
6. Thermal Electric Power Station		1400	0.02	(0.0119) kg/emp./d
7. Thi-Qar Brick Factory	Broken bricks, sludge, ash		24	

Table 14 Waste Generation in Medium and Large-scale Industries in Al-Hamdan Industrial Estate, Basrah

Name of Industry	Total no. of units	No. of units visited	Average Waste Generation Rate, kg/(unit.d)	Estimated Waste Generation, ton/d
1) Medium-sized carpentry workshop	75	1	60	4.5
2) Large-sized carpentry workshop	50	1	300	15
3) Furnaces manufacturing industries	1	1	75	0.1
4) Nylons and hoses production	6	1	100	0.6
5) Hoses production	6	1	35	0.2
6) Juice production industries	13	3	97	1.3
7) Car exhaust production industry	3	1	300	0.9
8) Flour production industries	14	2	660	9.2
9) Rubber production industries	1	1	100	0.1
10) Al-Nejbieya electric power station	1	1	60	0.1
11) Salt production industry	6	1	12	0.1
12) Cement blocks production industry	8	3	94	0.8
13) Cement boards production industry	2	1	7	-
14) Tile production industry	15	2	40	0.6
15) Aluminum production	2	1	15	-
16) Black smith	4	1	80	0.3
TOTAL	207	22		34^{#1}

Note: #1 – Estimate rounded to the nearest ton/day. Waste generation is estimated based on the average rate of generation of industries visited during the survey.

Table 15 Waste Generation in Large-scale Industries and in Al-Ammara

Name of Industry	Type of Waste	No. of Employees	Waste Generation Rate, (Ton/day)	Remarks
1. Al-Muatesem industry for vegetable oil production	Residual oil	1,200	0.07	N/A
2. Al-Ammara tar industry	Tar	25	0.75	N/A
3. Al-Ammara brick industry	Broken bricks, sludge, ash	50	6	N/A
4. Missan factory for food production	Organic (food waste)	150	0.02	N/A
5. Flour production industry	Husks, millings etc.	15	0.9	N/A
6. Missan factory for plastic production	Plastic chips etc.	N/A	N/A	Not functioning
7. Missan dairy products	Organic sludge	N/A	N/A	Not functioning
8. Missan pulp and paper industry	Sludge	N/A	N/A	Not functioning
TOTAL			8^{#1}	

Note: #1 – Estimate rounded to the nearest ton/day.

Table 16 shows the summary of the number of large-scale industries and their estimate of waste generation.

Table 16 Waste Generation in Large-scale Industries

Area	No. of Industries	Estimated Waste Generation, Ton/d
1. Thi-Qar	7	39
2. Basrah (Al-Hamdan Industrial Estate)	16	34
3. Missan	8	8

b) Small and Medium-scale Industries

Table 17 provides a summary of small and medium-scale industries located in specific industrial sites, except in Qal'at Al-Salih and at Al-Maymuna. In those two towns, industries are scattered in the main market area of the town. Locations of industrial sites in each city/town are also shown in Figures 4 through 12. Most of these industries are related to automobile repair. Waste generation was estimated based on the data from the industries visited

during this survey by multiplying average waste generation per entity and the total number of similar entities in each industrial site. Table 18 shows the average waste generation rate per entity for each of the area surveyed based on the results of the units visited during this survey. Data on the number of employees were also collected for the industries visited and could be utilized in the future for refining waste generation estimates.

Table 17 Type of Small and Medium Scale Industries and Their Waste Generation

Type of industrial Activity	Number of Units								
	Al-Nassirya	Suq Al-Shuyuk	Al-Nasr	Basrah Central	Al-Zubayr	Al-Deyr	Ammara Central	Qal'at Al-Salih [#]	Al-Maymuna [#]
1. Car tin smith	300	14	9	150	50	20	100	10	3
2. Exhaust repair	50	-	-	50	-	-	50	5	4
3. Spare parts shop	40	18	10	50	10	5	30	8	4
4. Car painting	45	6	8	100	50	-	20	-	-
5. Car seat refurbishing	15	-	-	50	-	-	10	-	-
6. Wheel balance	7	-	-	70	-	-	15	-	-
7. Radiator repair	50	5	3	100	40	-	40	-	-
8. Car mechanic	300	-	-	400	20	4	50	5	3
9. Puncture repair	70	12	10	125	40	10	60	8	6
10. Cafeteria	25	8	7	50	20	-	20	-	-
11. Constructive material shop	20	6	4	50	20	5	25	5	5
12. Carcass repair (Car body)	30	7	5	100	50	-	15	-	-
13. Turner	30	5	5	80	5	-	40	3	1
14. Car class repair	15	-	-	30	-	-	6	-	-
15. Car Lathe	-	-	-	100	-	-	30	-	-
16. Door & windows tin smith	-	-	-	40	-	3	-	-	-
17. Press shop	-	-	-	5	-	-	-	-	-
18. Door tin smith	-	-	-	-	20	-	-	-	-
19. Tin smith	-	-	-	-	5	-	-	-	-
20. Garage	-	-	-	-	25	-	-	-	-
21. Carpentry factory	-	-	-	-	3	-	-	-	-
22. Car Electrician	-	-	-	-	-	7	30	-	-
23. Chopping cars	-	-	-	-	-	-	15	-	-
24. Blacksmith	-	-	-	-	-	-	25	-	-
Total number of Industrial Units	997	79	61	1,550	358	54	581	44	26
Total number of units surveyed	30	13	9	37	30	9	41	10	9
Estimated Waste Generation Rate, ton/d	9.2	0.7	0.3	23.5	2.5	0.3	4.8	0.2	0.1

Note: "-" indicates absence of such industry. #1 - There is no specific industrial site and these industries are scattered in the main market area of the town.

#2 - Waste generation is estimated based on the average waste generation of industries visited multiplied by the number of such industry and rounded to the nearest hundred.

Most of these wastes are scrap material and sometimes may contain copper, which is usually sold. Ten of tons of waste generated throughout the past are left to accumulate on the vacant areas in the industrial site. Some quarter owners may time to time hire a carriage to transfer demolition and scraps to municipal open dumps.

It can be concluded that presently there is no system specifically for the collection, transportation, treatment or dumping of

industrial waste. Moreover, there is a total lack of legal structure to define and control the management of industrial wastes including hazardous wastes. As a consequence, there are multitudes of waste disposal systems, often ill adapted as described above and are usually not controllable. The lack of sensitization or sometimes the carelessness of some industrialist has also contributed to the current anarchy of the situation.

Table 18 Unit Waste Generation Rate of Small and Medium Industries

Type of industrial Activity	Unit Waste generation rate, kg/(unit.day)									
	Al-Nassriya	Suq Al-Shuyuk	Al-Nasr	Basrah Central	Al-Zubayr	Al-Deyr	Ammara Central	Qafat Al-Salih	Al-Maymuna	Average
1. Car tin smith	7.1	3.5	1.5	13	3.9	7.5	6.2	10	2	6.1
2. Exhaust repair	14.3			58		-	17.3	13	7.5	22.0
3. Spare parts shop	2.7	2.3	1	2.8	0.8	1.3	1	1	1	1.5
4. Car painting	5.5	6	0.8	2.8	3.3		4			3.2
5. Car seat refumishing	0.8	-	-	6.5	-	-	1.3	-	-	2.2
6. Wheel balance	1	-	-	2.5	-	-	1	-	-	1.1
7. Radiator repair	17.5	23	15	27.5	8	-	14.5	-	-	15.1
8. Car mechanic	6	-	-	7.3	1.4	3.6	7.3	2.5	2.5	4.4
9. Puncture repair	24	18.5	14	30.3	22.5	11	6.7	4	4.3	15
10. Cafeteria	3.5	2.5	1.8	9	3	-	3.5	-	-	2.9
11. Constructive material shop	11.3	13.3	12.5	9.3	1.6	1.5	1.5	1	1	5.9
12. Carcass repair (Car body)	16.7	15	4	33.2	9.7	-	10.7	-	-	12.8
13. Turner	16.7	1.8	4	24	1.8	-	15	1.5	1	8.2
14. Car class repair	20	-	-	17.7	-	-	7.2	-	-	15.0
15. Car Lathe	-	-	-	5.3	-	-	25	-	-	15.2
16. Door & windows tin smith	-	-	-	25	-	10	-	-	-	17.5
17. Press shop	-	-	-	3.5	-	-	-	-	-	3.5
18. Door tin smith	-	-	-	-	5.2	-	-	-	-	5.2
19. Tin smith	-	-	-	-	3.5	-	-	-	-	3.5
20. Garage	-	-	-	-	3.8	-	-	-	-	3.8
21. Carpentry factory	-	-	-	-	17.5	-	-	-	-	17.5
22. Car Electrician	-	-	-	-	-	1	-	-	-	1.0
23. Chopping cars	-	-	-	-	-	-	3	-	-	3.0
24. Blacksmith	-	-	-	-	-	-	4	-	-	4.0

Commercial Solid Wastes

Table 19 shows summary of commercial entities in the survey areas indicating

number of entities by type, number of entities visited and estimated quantity of waste generated from these units. In those

two towns, industries are scattered in the main market area of the town. Locations of commercial areas in each city/town are also shown in Figures 4 through 12. Most of

these commercial activities are related to retailing of food such as groceries, markets, butchers, restaurants etc.

Table 19 Commercial Activities and Their Waste Generation

Type of Commercial Activity	Number of Units								
	Al-Nassriya	Suq Al-Shuyuk	Al-Nasr	Basrah Central	Al-Zubayr	Al-Deyr	Ammara Central	Qal'at Al-Salih ^{#1}	Al-Maymunah ^{#1}
1. Copying office	250	13	9	240	25	5	80	7	7
2. Food Grocery shop	100	70	11	130	15	25	50	14	10
3. Barber	140	25	9	160	73	9	100	11	12
4. Sewing shop	60	11	11	60	30	12	32	-	-
5. Coffee house	80	25	9	125	54	10	64	4	11
6. Boutique	125	35	11	500	60	20	55	12	9
7. Market	100	25	10	400	15	25	40	16	10
8. Butcher	110	25	9	125	16	4	45	8	5
9. Barbecue Restaurant	30	11	5	60	10	3	20	3	4
10. Restaurants	15	3	6	80	8	4	15	5	5
11. Fast food Restaurant	40	20	6	120	25	9	35	10	7
12. Carpenter	40	22	12	130	50	20	15	11	8
13. Blacksmith	70	25	18	100	24	10	20	-	4
14. Slaughter house	1	1	1	3	1	1	1	1	-
15. Mill	4	3	1	7	1	-	3	-	-
16. Pastry shop	60	20	4	30	15	2	30	3	3
17. Juice and soft drink shop	15	10	5	50	10	3	18	5	5
18. Mattresses and pillows refilling Shop	20	9	9	30	-	-	-	-	-
19. Constructive material shops	150	-	9	80	25	15	25	10	4
20. Shoe repair shop	35	15	9	25	35	2	17	-	-
21. Pharmacy	60	27	6	115	12	10	60	5	7
22. Clinic	150	13	8	-	60	6	-	-	-
23. Medical analysis lab	20	3	3	50	9	-	15	-	4
24. Glass shop	40	12	4	50	12	4	26	5	3
25. Herbal shop	70	4	4	100	-	-	-	-	-
26. Baker	15	7	75	25	12	3	12	-	-
27. Chicken cleaning	5	2	1	15	3	1	4	1	1
28. Grocery	2,000	450	1	1500	250	120	250	75	100
29. Chicken raising	5	3	2	-	5	-	-	-	-
30. Electronic supplies shop	20	-	-	25	22	-	8	-	-
31. Electronic supplies shop	60	-	-	100	-	-	-	-	-
32. Verbatim	20	-	-	-	-	-	-	-	-
33. Shoes shop	-	-	-	75	-	-	-	-	-
34. Fish Cleaning	-	-	-	5	-	-	-	-	-
Total number of Commercial Entities	3,910	889	268	4,515	877	323	1,040	206	219
Total number of Entities surveyed	83	64	52	123	69	40	56	33	35
Estimated Waste Generation Rate, ton/d	100	8.3	1.3	46	5.1	1.4	5.2	1.8	1.7

Waste generation was estimated based on the data from the commercial entities visited during this survey by multiplying average waste generation per entity and the total number of similar entities in each survey area. Data on the number of employees were also collected for the entities visited and could be utilized in the future for refining waste generation estimates.

Waste generation was estimated based on the data from the commercial entities visited during this survey by multiplying average

waste generation per entity and the total number of similar entities in each survey area. Data on the number of employees were also

collected for the entities visited and could be utilized in the future for refining waste generation estimates.

Table 20 shows the average unit waste generation rate of each commercial activity based on the average of the entities visited

during this survey. Mills, grocery, slaughterhouse, restaurants and barbecue restaurants have high unit waste generation rates. Number of such units in the areas is also high except for mills.

Table 20 Unit Waste Generation Rate of Commercial Activities

Type of Commercial Activity	Unit Waste generation rate, kg/(unit.day)									
	Al-Nasiriya	Suq Al-Shuyuk	Al-Nasr	Basrah Central	Al-Zubayr	Al-Deyr	Ammara Central	Qat'at Al-Salih	Al-Maymuna	Average
1. Copying office	1.3	0.3	0.3	0.5	0.2	0.5	0.7	0.6	1	0.6
2. Food Grocery shop	21.7	4.9	1.7	1.5	6.3	1.8	2.5	1.1	1.1	4.7
3. Barber	0.9	0.8	0.4	1	0.6	0.5	0.8	0.8	1	0.7
4. Sewing shop	0.4	0.2	1.7	1.4	0.7	0.3	0.4	-	-	0.7
5. Coffee house	0.8	0.8	0.4	0.8	0.6	0.4	0.6	0.5	0.5	0.6
6. Boutique	0.8	0.8	0.7	1.8	0.4	0.2	1.9	1.5	0.8	1
7. Market	16.3	2.3	7	3.4	2.8	3.8	5	3.5	2.5	5.2
8. Butcher	8.8	7.3	3.2	11	4.3	6	5.5	8	4	6.5
9. Barbecue Restaurant	32.5	11.3	19.5	46.7	5.5	15	11	5	5	16.8
10. Restaurants	37.5	25	16	27.4	7.3	11	35	7	13.5	20
11. Fast food Restaurant	14	4.3	8	6.7	3.3	2.5	11	5	4	6.5
12. Carpenter	2.3	4.1	1.1	10.3	8.8	3.5	7.8	7	2.8	5.1
13. Blacksmith	6.5	1.7	3	1.8	7	1.2	2	-	1.5	3.1
14. Slaughter house	525	250	35	250	105	22	135	22	0	149.3
15. Mill	14,000	710	22	50	13	-	124	0	0	1865
16. Pastry shop	5.4	4.5	2	4.1	4	10	7	2.5	2.3	4.6
17. Juice and soft drink shop	13.5	13.8	1.9	2.4	3.3	3.8	5.5	3	2	5.5
18. Mattresses and pillows refilling Shop	1.3	0.5	0.5	1.5	-	-	-	-	-	1
19. Constructive material shops	1.7	-	0.8	0.7	0.4	0.8	1.3	1.5	0.8	1
20. Shoe repair shop	2.2	0.6	0.8	0.6	0.2	0.3	0.5	0	0	0.6
21. Pharmacy	1.8	0.6	0.8	2.4	2.5	0.4	0.5	1	1.3	1.2
22. Clinic	1.5	0.9	0.9	-	1.8	1.5	-	-	-	1.3
23. Medical analysis lab	8	1.8	1.8	1.8	4.5	-	2.5	0	0.5	2.4
24. Glass shop	7.5	6.5	6.3	7	5.7	3	5.5	4.5	2	5.3
25. Herbal shop	7.5	5.5	0.6	1.8	-	-	-	-	-	3.9
26. Baker	7.5	5.5	8.7	1.5	2.8	6	2	-	-	4.9
27. Chicken cleaning	25	20	15	17.5	35	10	15	7	5	16.6
28. Grocery	15.9	9.7	23.5	20.7	12.5	7.6	7.4	18.7	13.8	14.4
29. Chicken raising	104	9.9	20	-	5	-	-	-	-	34.7
30. Electronic supplies shop	15.6	-	-	8.3	11.5	-	7.5	-	-	10.7
31. Electronic supplies shop	4.6	-	-	6.2	-	-	-	-	-	5.4
32. Verbatim	12.7	-	-	-	-	-	-	-	-	12.7
33. Shoes shop	-	-	-	2.1	-	-	-	-	-	2.1
34. Fish Cleaning	-	-	-	5	-	-	-	-	-	5

Clinical Solid Wastes

Table 21 shows summary of hospitals visited and the public health centers (PHC) in the survey areas and their estimated waste

generation. Name and number of these institutions were obtained from the Health Directorate of each governorate.

Hospitals are generally equipped with incinerators for the destruction of contaminated clinical wastes. Some of the incinerators especially in large hospitals in Basrah are often non-functional either because of the non-availability of spare parts, lack of maintenance and absence of skilled technicians. Clinical wastes from hospitals that do not have incinerators or which are not functioning, wastes are mixed with municipal solid wastes and end up in open dumps. As for anatomic wastes, organs are often inhumed for religious reasons, while placenta are either inhumed or conserved or simply eliminated with ordinary wastes for most clinics. Non-clinical waste include kitchen waste, paper waste, other components (metals, plastic, plaster, cotton, and clothes) and are often not sorted at source, are taken in charge by municipal services and forwarded to municipal dump sites without much care. Clinical waste generated at PHC is at an average of 2 – 3 kg/d and are generally incinerated.

Current Solid Waste Management Practices

The collection of solid waste is being managed by both private as well as municipalities. In large urban areas and towns in Thi-Qar and Missan governorates, municipalities are responsible for collection, storage, transport and final disposal of solid waste, while in Al-Basra governorate, solid waste have traditionally been collected by local authorities, however the local governorate has entrusted some of the collection functions recently to private

contractors. Limited facilities are available for solid waste collection and transport. The collection services are available mostly to major centers, while per-urban areas do not have such services and tend to dump their waste at the nearest available land. The frequency of municipal waste collection from common bins varies from three times a week in Basra Central and Al-Zubayr to five times in Al-Ammara and in Suq-Al Shuyuk to daily collection in Al-Nassiriya and in Al-Nasr depending on the local authority. The collection involves hand unloading of containers into the vehicle and carrying back the containers. Most of the industrial wastes generated in cities come from small or medium-scale operations and these are usually disposed off along with the municipal waste.

Larger industries are located outside the city center and the disposal of solid wastes is primarily the responsibility of the industries themselves. Most of solid wastes generated by industry contains significant amount of valuable materials like steel, aluminum, copper and other metal and some of them are recovered and reused by the industry or sold to others as scrap. The rest are disposed to the municipal dump.

Industries in Al-Basrah are concentrated in oil and petrochemical complexes, which, produces a range of hazardous wastes and they are under the responsibility of the industries themselves while some industry wastes are disposed together with residential source. Although it has been reported that many refineries currently deposit hazardous waste into depleted wells or canals specially

dug for this purpose. It could be concluded that there is presently no controlled means specifically for the collection, transportation, treatment or disposal of industrial waste. Moreover, there is a total lack of a legal structure controlling the handling of dangerous/ hazardous wastes of industrial origin. As a consequence, there is a multitude of waste evacuation systems in practice often ill adapted and usually not controllable.

As for commercial wastes which includes wastes generated in groceries, restaurants, markets, offices, hotels, motels, print shops and pharmacies. These institutions yield huge amounts of waste which are under the responsibility of municipality, yet large percent of these wastes are either collected and fed to swine or transported to Zaballeen settlements, where recycling takes place by manual sorting of materials such as paper, plastic, glass, metals, cloth and bones. Recovered materials are baled and transported to factories as raw materials.

Medical institutions produce clinical hazardous wastes of all sorts: contaminated septic wastes, anatomic wastes, chemical wastes. As often the case, hazardous clinics and hospitals wastes are disposed of by incinerators, in hospitals equipped with incinerators for the destruction of contaminated wastes. However, these apparatus are often non-functional either because of the lack of maintenance and absence of skilled technicians that would ensure a good operation and a durable function of the equipment. As for anatomic wastes, organs are often inhumed for religious reasons,

while placenta are either inhumed or conserved or simply eliminated with ordinary wastes for most clinics. Hospitals that do not have incinerators; wastes are mixed with municipal solid wastes and end up in landfills. In fact wastes, often not sorted at source, taken in charge by municipal services and forwarded to public landfill without much care.

Most solid waste is dumped in depressions on vacant land or burnt in open barrels. The great majority of wastes collected by municipalities or by private contractors in the southern governorates was disposed of in open dumps and often burned. One could witness large heaps to small mountains of refuse on the outskirts of the major cities. In some of them, the refuse is periodically leveled and compacted, in other the refuse is piled as high as equipment will permit, and some are ignited and allowed to burn to reduce volume. Although the three governments and their districts and sub-districts were served by sanitary landfills and solid waste used to be hauled for disposal in these authorized sites, but after the 2003 war, wastes are dumped in open lands located adjacent to residential areas. These authorized sites were abandoned and were considered too far to reach for instance Suq Al-Shuyuk sanitary dumping site is located 15 km from the city boundaries and solid waste are currently being dumped in an open land 1.5 km from the boundaries instead. Solid waste practices and technologies are very poor in the surveyed areas and in Iraq. They have problems in collecting, transporting and disposing of solid wastes in

an environmentally sound manner.

Overall storage, collection and disposal activities of waste from municipal, industrial, commercial and clinical sectors are largely unsatisfactory.

Solid Waste Characterization Survey

Waste generation rates for household waste, commercial waste, and industrial waste from small-medium scale industries were determined in the survey. Per capita household waste generation was 0.55, 0.51 and 0.46 kg/(capita.day) for high-income, middle-income and low-income levels respectively with maximum of 0.83 kg/(capita.day) in high-income area in Ammara Central and minimum of 0.33 kg/(capita.day) for high-income area in Al-Deyr.

For commercial wastes and industrial wastes from small- and medium-scale industries, waste generation rates per entity as well as per employee were determined.

Median values of household waste density

were 297, 243 and 271 kg/m³ for high-, middle and low-income households in for the surveyed areas with the maximum of 331 kg/m³ at high-income area in Suq Al-Shuyuk and 223 kg/m³ at low-income area in Ammara Central.

Organics were the main constituent of household waste in the order of 60-70%. Plastics were at 6-7% and metal, glass, paper and textile were in the range of 3-5% each. It should be noted that miscellaneous incombustibles were exceptionally high above 10% especially in Al-Zubayr, Al-Deyr, Ammara Central, Qal'at Al-Salih and at Al-Maymuna for all income levels. Source and origin of this miscellaneous incombustible waste needs to be investigated in the future.

Table 22 summarizes the estimated solid waste generation of household, commercial, industrial and non-clinical hospital sources and the estimated quantity of waste disposed at the open dumpsites.

Table 21 Summary of Hospitals and Public Health Centers in and their Waste Generation

Survey Areas	No. of General Hospital	No. of Private Hospitals	No. of Specialist Hospital	No. of Dental Centre	No. of Public Health Centre	No. of Beds	Clinical Waste, kg/d	Non-clinical waste, kg/d
Thi-Qar Governorate								
Al-Nassiriya	1	1	1	1	9	510	328	984
Suq Al-Shuyuk	1	0	0	0	5	60	17.5	25
Al-Nasr	0	0	0	0	1		3	
Basrah governorate								
Basrah Central	6	7	1	N/A	27	2,680	864	1,945
Al-Zubayr	1	0	0	1	4	760	220	500
Al-Deyr	0	0	0	0	1		1.5	
Missan Governorate								
Ammara Central	3	1	0	0	9	N/A	9	N/A
Qal'at Salih	1	0	0	0	1	80	23	50
Al-Maymuna	1	0	0	0	1	75	13	40

Note: N/A - Data not available

Table 22 Estimates of Solid Waste Generation and Disposal

Survey Areas	Household Waste#1	Commercial Waste	Industrial Waste (Large-scale)	Industrial Waste (Small and Medium -scale)	Non-clinical Waste (from Hospitals)	Total Waste Generation	Total Waste to Dump Site#2	Clinical Waste
	Ton/d	Ton/d	Ton/d	Ton/d	Ton/d	Ton/d	Ton/d	kg/d
Thi-Qar Governorate								
Al-Nassiriya	147	100	39	9.2	1	296	216	328
Suq Al-Shuyuk	44	8.3		0.7	0.1	53	40	18
Al-Nasr	17	1.3		0.3		19	20	3
Basrah governorate								
Basrah Central	399	46.3	34	23.5	2	505	386	864
Al-Zubayr	87	5.1		2.5	0.5	95	136	220
Al-Deyr	10	1.4		0.3		12	16	2
Missan Governorate								
Ammara Central	229	5.2	8	4.8		247	224	9 ^{#3}
Qaf'at Al-Salih	13	1.8		0.2		15	24	23
Al-Maymuna	6	1.7		0.1		8	17	13

Note: #1 – Estimated based on the per capita waste generation rate for each income level and respective population.

#2 – Estimated based on the data provided by local authorities on the number of trucks and their average weight. Waste is transported five days a week to the dumpsites and the values shown are for daily averaged over a week (multiplied by 5/7).

#3 – Does not include waste generated from three general hospitals in Ammara Central.

Estimates of total waste to dump sites are higher than the total estimated from household, commercial and industrial sources. Considering the fact that there is recovery of valuables, open dumping at vacant lands, burning at intermediate locations etc., it is necessary to investigate to account for and to refine the estimates of waste generation and disposal.

The difference between estimated quantity of generation and disposal may have been caused by the followings and the ways to refine the estimates in the future are as follows.

a) Other waste sources

Bulk waste from households including electrical equipment, construction and demolition waste, garden waste etc. are also

disposed to the dumpsites and their quantity need to be investigated and quantified. Waste from large institutions such as public and private offices need to be investigated and quantified. Bulk sources can be specifically targeted for follow-up survey.

b) Estimation Methods - Generation

This is the first survey to estimate the waste generation through the field surveys of each category of waste. Major sources are from households and commercial activities.

Increasing the coverage of sub-areas surveyed can refine estimate of household waste generation. For commercial wastes and industrial wastes from small and medium-scale sources, number of entities and their unit waste generation rates based on the entities surveyed in each category were used

to estimate waste quantity of waste generation.

Accuracy of these unit waste generation rates can be refined by targeting the major categories with higher volume (high number of entities as well as high generation rates) in the follow-up surveys. For example, unit waste generation rates for mills, slaughter house, chicken raising, groceries, barbecue restaurants, etc. can be targeted and if necessary further sub-categorized.

Other methods are also available to estimate quantity of commercial and small and medium-scale industrial waste based on number of employees, production rate, turnover etc.

Combination of estimation methods can also be used to improve accuracy, for example within the commercial waste category, if data on production rates of mills or number of chickens raised or processed become available they can be used for more accurate estimation.

c) Estimation Methods - Disposal

There is no equipment for quantifying the amount of waste disposed at the dumpsites and is based on the number of vehicles transporting the waste and their capacity. Accurate record keeping and data analysis of wastes dumped will be necessary to improve the estimation of waste disposed.

Weighbridge could be installed in the future as part of upgrading the dumpsites and will provide accurate estimate of waste disposed.

d) Frequency of survey

Frequency of survey needs to be increased throughout the year for targeted sources.

Notwithstanding the above, this survey has established a database of waste generation and disposal in the nine cities and towns surveyed that can be utilized to strengthen

solid waste management in the region.

RECOMMENDATIONS

To improve the solid waste management database

Data and information necessary to improve solid waste management in the cities and towns of

southern governorates and the capacity for data collection has been lacking. This survey was the first to address such gaps in these governorates. Following are recommended to improve and update the database developed.

a) Survey on household waste characterization was carried-out during June-September, which is dry season and similar survey is recommended to be carried-out during wet season. Generally, during winter months, an increase in the amounts of tins, plastics, paper and a decrease in organic waste owing to the decrease in fresh food and vegetables in Iraq are expected.

b) Iraq is undergoing stabilization and there are several social and economical changes taking place, which also affect solid waste generation and its management. For example, current household sizes are affected by displaced people due to the security/social situation and they are expected to stabilize in the future. This in-turn affects solid waste generation in addition to the effect of economical/lifestyle changes in the future. Regular surveys need to be scheduled and implemented to follow-up with the changes in solid waste generation rates and their characteristics.

c) Composition of household waste from Missan governorate showed higher percentage of

miscellaneous incombustible materials than that found in the other cities and towns. Future surveys need to determine the cause of

this.

d) Further investigation on commercial wastes, industrial wastes and clinical wastes need to be

carried-out to strengthen the database. Future survey can target those types of activities with

high number as well as high unit waste generation rates to refine the estimate of waste generation.

e) Moisture content and calorific value of municipal waste need to be investigated to facilitate evaluation of technologies for treatment and disposal.

f) Data base on sources, quantity and disposal practices of hazardous waste need to be established.

g) By implementing regular surveys like this survey, institutional capacity to plan, collect, analyze and utilize data need to be established locally.

To improve the solid waste management

a- Integrated solid waste management : There is an on-going project to establish National Solid Waste Master Plan for Iraq and will provide national framework for the management of solid waste including necessary legislations and regulations. Within that framework solid waste management plans for regions/cities needs to be established. Establishing and strengthening of solid waste database will help preparation of these plans for the surveyed areas.

b- Pilot Projects: Actions should be concentrated on ways of establishing systems to collect and manage solid waste, specific to each type of area-urban, semi-urban and rural. These systems should be harmonized with other management of other types of waste, such as agricultural residues and sewage sludge, with a review to reuse, or recycle wastes in the form of compost or energy. As

part of the action, pilot projects can be carried out, both to demonstrate the positive economic result and gain experience in the operation and maintenance of such system locally.

c- Improvement of Facilities : Existing facilities and equipment, which are worn-out or are inadequate, need to be replaced or augmented in the short-term. This also includes improvements to existing final disposal sites.

d- Increasing Public awareness and participation: Campaigns to educate and encourage public on the need to improve solid waste management through their participation to introduce best practices to conserve resources through reduction, reuse and recycling and to dispose waste to protect public health and environment need to be carried regularly. Radio, TV, newspaper and other activities targeting school children and women is necessary.

e- Hazardous waste: : Systems for hazardous waste collection, treatment and disposal including regulatory mechanisms need to be established.

f- Institutional capacity: : Institutional capacity for solid waste management needs to be strengthened to enforce regulations and to manage the facilities.

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Thi-Qar governorate:

-Directory of Municipalities and Public Works, Directory of Health

- _ Offices of municipality in study area
- _ Environment office
- _ City Council
- _ Local authorities in the area of study
- _ Meteorological office
- _ Planning and Development Cooperation
- _ Central Organization for Statistics and Information Technology

Basrah governorate

_ Directory of Municipalities and Public Works, Directory of Health

- _ Offices of municipality in study area
- _ City Council
- _ Local authorities in the area of study
- _ Meteorological office
- _ Planning and Development Cooperation

Missan governorate

_ Directory of Municipalities and Public Works, Directory of Health

- _ Offices of municipality in study area
- _ Environment office
- _ City Council
- _ Local authorities in the area of study
- _ Meteorological office
- _ Planning and Development Cooperation

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الخلاصة

استهدفت هذه الدراسة اجراء مسح ميداني حول ادارة المخلفات الصلبة في المحافظات الجنوبية من العراق لتحديد طبيعة ومواصفات هذه المواد وكيفية ادارتها وقد شمل هذا المسح تسعة مدن (في ذي قار والبصرة وميسان) وهي : الناصرية وسوق الشيوخ والنصر ومركز البصرة والزبير والدير ومركز العمارة وقلعة صالح والميمونة واجريت الدراسة في حزيران الى ايلول عام 2007. جمعت المعلومات من خلال استمارة استبائية وكذلك اجراء مقابلات مع المسؤولين الرسميين وزيادة المواقع وشملت القياسات مخلفات المنازل والانشطة التجارية والمعامل الصغيرة والمتوسطة والمخلفات الصحية والمصانع الكبيرة وحضرت قاعدة بيانات لها وتم تقديم التوصيات الضرورية لتحسين خدمات وادارة المخلفات الصلبة في جنوب العراق .