RESIDENTIAL SOLID WASTE AT POINT OF GENERATION
(A CASE STUDY AL-AMMARAH CITY)

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الخلاصة

تعد النفايات الصلبة ذات طبيعة متغيرة ومحتوى غير متوافق ، وان طريقة سحب النماذج (العينة) تلعب دور كبير في تحديد قيمة النتيجة التي سيتم اعتمادها. تم اعتماد الطريقة العشوائية ذات العلاقة الترتيب الطبقي في سحب النماذج الخاصة بهذا البحث، اي انه قد جرى تقسيم العدد الكلي لسكان المدينة المعنية الى مجاميع (حسب المستوى الاقتصادي –الاجتماعي) واخذ نماذج عشوائية من كل مجموعة او طبقة وبعدد يتناسب مع نسبة تلك الطبقة في مجموع السكان ككل.

واعتمادا على نتائج البحث الاولي لمستويات ثقة 99% ونسبة الخطأ القياسية 10% والذي اجري في مدينة العمارة مركز محافظة ميسان ، تبين ان افضل حجم لعينة ممثلة هو ١٠٤ عينة . تم حساب معدل التولد والمكونات الفيزياوية لكمية النفايات الصلبة المنزلية في نفس منطقة التولد لمجموعة سكانية ممثلة في مدينة العمارة باعتماد الطريفة الاحصائية.

تم تحديد ١٠٤ وحدة سكنية من مستويات اقتصادية-اجتماعية مختلفة لسحب العينات يوميا ولمدة اسبوع وبمجموع ٧٥٠ كيلو يوميا كمعدل.

بينت الدراسة ان معدل تولد النفايات لمركز محافظة ميسان وباعتماد الطرق الاحصائية هو ٠.٦٦ كغم/ شخص/ يوم وبمحتوى عضوي (نفايات طعام) 44% وورق 4.9% ومعادن 4% وزجاج 4.2% ومطاط 1.13% ونسيج 4% ، وومواد متنزعة قابلة للاحتراق 0.6% واخيرا مواد متنوعة غير قابلة للاحتراق وبنسبة 32.3%.

Abstract

Municipal solid waste is of variable, non-uniform inconsistent nature and the method by which the sample is obtained is critical if the results are to be reliable. In this survey the proportional stratified random sampling was adopted, i.e., the total population was divided into groups (socio-income levels) and random samples were taken in each level in its proportion to the total population.
Based on the results of the preliminary survey for 99% confidence interval and 10% standard error, held in Al-Ammarah City, the optimum sample size was shown to be 104. An estimate of the total waste generated and physical composition analysis of residential solid waste were carried out at the source of generation, in Al-Ammarah City in Missan Governorate by carrying out a statistically designed sampling survey,

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Up to 104 units with different socio income level were sampled, yielding an average of 750 kg of waste to be handled in each day for one week.

The study showed that Al-Ammarah City have an average generation rate of 0.66 Kg per capita per day, having 44% food waste, 4.9% paper, 4% metal, 4.2 % glass, 1.13% rubber, and textile 4%, 0.6% combustible miscellaneous materials, and 32.3% noncombustible miscellaneous materials.

Introduction

Municipal solid waste (MSW) is a heterogeneous material. The production rates and composition vary from place to place and from season to season. Due to the heterogeneity and variability of MSW it is necessary to carry out a statistically designed sampling survey by which the average quantities and composition of waste can be accurately estimated. From a statistical point of view the accuracy of determination of these parameters will be increased by increasing the number of samples which will be analyzed. On the other hand, economy and limited resources dictate that the number of samples be minimal. To meet both statistical and economical requirements, the number of samples is usually determined by first selecting the required accuracy. For example, Kirov in 1972 (1) found that 700 samples were required to give a 95% confidence interval with 5% standard error.

The purpose of this study was to evaluate the quantities and composition of residential solid waste generated in Al-Ammarah City[1] in Missan governorate at the source of generation (houses). Most previous studies evaluated the characteristics of MSW at transfer stations or disposal sites (e.g. landfills) but in this study, it was decided to conduct the survey at the source of generation for the following reasons:

(1) The climate in Iraq is very hot, especially during the summer-season, so is in Al-Ammarah City in Missan as it is one of the southern governorates of Iraq, where temperatures reach 50°C. This severe climatic condition affects the solid waste properties during the storage, collection, and transportation processes. So, when conducting sampling at transfer stations or landfill sites, reliable results, which are supposed to reflect the actual characteristics of the wastes, will not be obtained. Therefore, sampling at the point of generation will produce more accurate data.

(2) In order to assess the effect of the socio-economic level of householders on MSW quantities and composition, it is important to know the source of the sampled waste and this will be a difficult task when sampling takes place at the

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[1]Al-Ammarah City is the central of Missan governorate having an area of 52 km^2 with total population of 345300 capita (4)

transfer station or landfill site as there could be mixed waste from different homes of different socio-economic levels.

Methodology

In order to obtain reliable results from the survey, it was necessary to determine the minimum number of samples, which should be analyzed and evaluated to get data with reasonable accuracy.

According to the sampling theory and the central limit theorem, the mean value a sample of (n) items drawn from population with a known mean (M) and standard deviation (SD) will also be (M) with an error, which is called the standard error (2). Furthermore, the sample means are normally distributed as long as the sample is large enough (n>30).

In the case of Al-Al-Ammarah City, the optimum sample size has been estimated by selecting a 99% confidence interval with an error of 10% of the mean value (3). As the standard deviation of the population is unknown, it is required to determine this parameter, and to do so it was necessary to run a preliminary survey.

The preliminary sampling took place for 2 weeks in May 2007 during which 280 samples were collected from 20 houses. The results of the preliminary survey are shown in table 1 with the statistical analysis. From table 1 it was concluded that the average generation rate is 0.53 kg per capita per day with a standard deviation of 0.40.

Number of samples

Based on the results of the preliminary survey for 99% confidence interval and 10% standard error, the optimum sample size, n, by which the average generation rate and composition can be determined by equation (1) (2):

$$n = [Z \times (SD)/R]^2 = [\ 2.575 \times (0.4 / 10)\ ]^2 = 103.6 \cong 104 \text{ samples} \qquad .... \quad (1)$$

where:

n = minimum number of samples that will give the required precision;

z = score determined from statistical tables of the percentage for standard normal distribution;

SD = standard deviation of population which is equal to the standard deviation of the preliminary sample; and

R = sampling error.

Table 1: Results of the primary sampling survey

Residence no.	Total waste generated from residence(kg)	No. of capita per residence	Average generation rate (kg/capita/day)
1	5	7	**0.78**
2	127.6	8	**1.14**
3	50.8	7	**0.07**
4	137.6	6	**1.64**
5	119,2	9	**0.37**
6	43.2	6	**0.51**
7	76.9	7	**0.78**
8	43.3	7	**0.44**
9	26.7	5	**0.38**
10	43.2	8	**0.39**
11	58.3	9	**0.46**
12	86.6	5	**1.24**
13	37.15	6	**0.44**
14	21.3	4	**0.38**
15	18.7	7	**0.19**
16	20	5	**0.29**
17	33.9	9	**0.27**
18	30.7	9	**0.24**
19	26.1	7	**0.27**
20	26	5	**0.37**
Total	592.05	136	**10.66**
Average	51.83	6.8	**0.53**
St Dev.	34.80	1.54	**0.40**

Sample weight

When sampling for quantity or composition of solid waste, the weight of individual samples should be sufficient to overcome the variability in the amounts and components produced. Wood yard and Klee in 1978 (5) have developed curves for selecting the proper size for a desired level of precision for number of components. For example, using samples of 90 kg, to obtain a precision of ±10% and confidence interval 90%, the following number of samples is required for each component:

1. Organics (10 samples)
2. News print, ferrous, glass, aluminum (80 samples); and
3. Corrugated paper (500 samples)

However, the 90-kg sample weight refers to samples taken from collection vehicles at transfer stations or landfill sites. In this study, it was impossible to get sample with 90 kg weight, as the samples were taken directly from dwellings and the average sample weight was about 3.05 -7.69 kg (table A-1, day 6 and A-2 day 1) respectively . It is assumed that the large number of samples analyzed (104) will overcome the limitation of sample weight.

Main sampling survey

After the required number of daily samples (104) had been decided, the main sampling survey started. There were 104 houses (sampling sites) involved in this survey. The survey took 1week (from 23 July to 29 July 2007) during which a total of 728 samples were analyzed through the working week.

As the socio-economic level of population affects the quantities and the nature waste generated, a stratified random sampling procedure was applied, in which sampling sites were allocated to high, middle and low-income socio-economic categories.

The socio-economic level of families who participated in the survey was determined based on the housing type of each family (1). To get proper results from the survey, the number of houses from each socio-economic category participating in the survey was proportional to their percentages in the community. Information on the percentage of each socio-economic category in the community was not available. Therefore, it was assumed according to the quarters of the city: Quarters of high income level are those of families living in villas (table 2), quarters of middle income levels are those of families living in flats (table 3), and quarters of low income levels are those families living in low-cost houses **(table 4).** According to Figuring Division / Department of arranging/Al-Ammarah municipality Directorate, there were:

9000 villas, 13,900 flats and 14,600 low-income houses, which mean that the percentages of each socio-economic category are as follows (figure 1):

(1) High income (24%);
(2) Middle income (37%); and
(3) Low income (39%).

Based on these percentages, out of 104 residences from which samples were collected daily, there were 25 residences with high income, 38 residences with middle income, and 41 residences with low income.
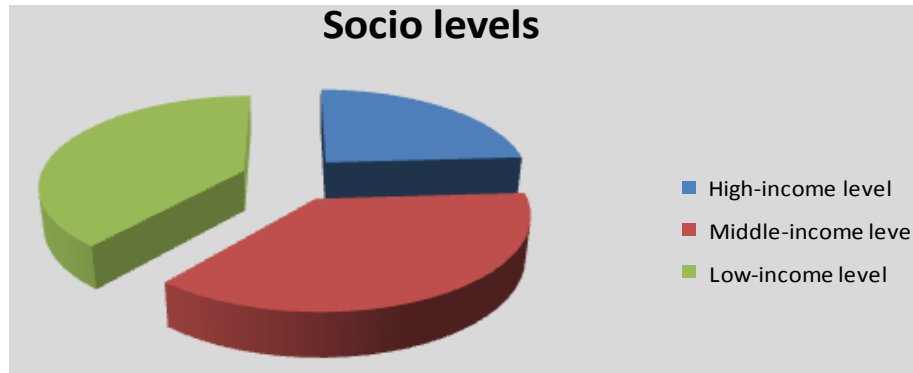
Figure 1 Socio-levels percentage in Al-Ammarah City

Table 2 Name of area, number of household, number of population and ratio of high-income level in Al-Ammarah city

No.	Name of area	No. of household	Population
1	Awasha	٥٥٠	4600
2	Al-Mualmeen Al-Kadeem	٤٠٠	٣٥٠٠
3	Al-Escan	٧٥٠	6٥00
4	Al-Kahera	٨٥٠	7٢50
5	15 Sheaban	٨٥٠	7٥00
6	Al-Sadeq	٨٠٠	68٥0
7	Merkez Al-Medeiyna (City center)	١٢٠٠	١٠١٠٠
8	Al-Keffaat	١٢٥٠	11٢٥0
9	Al-Khdra	٤٠٠	3٥00
10	Al-Wehda Al-Eslameya	١٣٠٠	11١٠٠
11	Al-Emarat Al-Jedeyda	٦٥٠	5٥٠0
	Sum	٩٠٠٠	**77650**
	Ratio of high-income level **9000/37500 =**	**24%**	

Table 3 Name of area, number of household, number of population and ratio of mid-income level in Al-Ammarah City

No.	Name of area	No. of household	Population
1	Al-Zhraa/1	١١٥٠	10500
2	Al-Zhraa/2	1000	10200
3	Al-Shuhda	1100	11250
4	Al-Gaddere	2000	20400
5	Al-Krama	٨٥٠	8400
6	Al-Husseien Al-Jedeyed*2	١٣٠٠	12800
7	Al-Ameen	٤٠٠	4050
8	Al-Hadi	700	7300
9	Al-Shabanah	٦٥٠	6300
10	Old building	٥٠٠	4700
11	Al-zyot& al-saylow houses	٤٥٠	4250
12	Al-resalah al-islamya	١٧٥٠	16250
13	New teachers	١٦٠٠	15500
14	College &teachers	٤٥٠	5000
15	**Sum**	١٣٩٠٠	**136900**
	Ratio of mid-income level **13900/37500 =**	**37%**	

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Table 4 Name of area, number of household, number of population and ratio of low-income level in Al-Ammarah City

No.	Name of area	No. of household	Population
1	Al-Ressul	١١٥٠	10٢00
2	Al-Baker	١٧٠٠	14500
3	Al-Munteder	١١٠٠	10300
4	Al-Ameer	١٥٠٠	12800
5	Al-Hassen Al-Askri	1900	17500
6	Al-Uruba	٥٥٠	٥٣٠٠
7	AL-Jehad	٩٠٠	٨٢٠٠
8	Al-Neda	١٤٠٠	١٢٥٠٠
9	Al-Murteda	١٦٠٠	14٢50
10	Al-Sejad	٩٥٠	٨٢٠٠
11	Seyed Ashur	٩٢٥	8٥00
12	Al-Hassen Al-Kadeem	٩٢٥	8٥٠٠
	Sum	١٤٦٠٠	130750
	Ratio of mid-income level= 14600/37500	**=39%**	

Plastic bags were distributed to the selected residence to collect waste in and number of occupants was recorded. Bags are to be collected each the other 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.
It has been found that the average generation rates of residential solid waste for different economic categories are as follows (figure 2):
High- income: 0.51 kg/capita/ day, middle- income: 0.68 kg/capita/ day, and low-income level: 0.55 kg/capita/ day

Figure 2 Generation rates of solid waste for families with different income levels
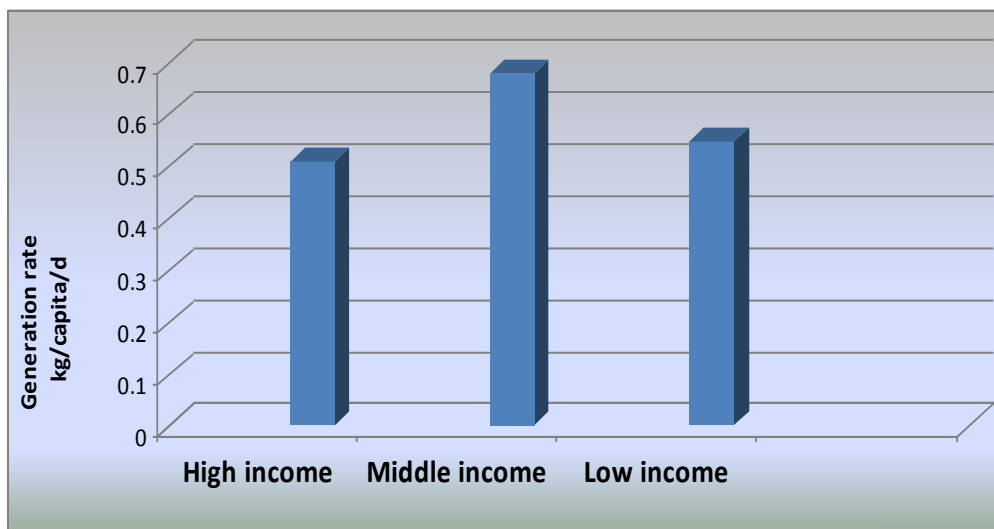
The weighted average generation rate for Al-Ammarah City is (12):
(0.51x 24%)/100 %+(0.68 x 37%) + (0.55 x 39%) = 0.5936= 0.60 kg per capita /day **… (2)**

As it can be seen, there is considerable confusion on generation rates of solid waste in this study as the high income level got the lowest generation rate and the middle income level got the highest generation rate. Spot or inadequate samples maybe entirely misleading, besides there were considerably problems involved in obtaining a representative sample of different levels due to intrusions of different socio-levels. Yet the reason for measuring generation rates is to obtain data that can be used to determine the total amount of wastes to be measured. Therefore, the average generation rate for the three different societies levels was obtained and to be relied upon as in equation (2). Different generation rates were obtained through studies carried out in some Iraqi governorates at different times of the year. Generation rates varied from 0.35 kg/capita/day for Fallujah city (6) to 0.420 kg/capita/d. for Al-Najaf (7) to 0.7 kg/c/day for Baghdad (8) .Table 5 shows a clear comparison in solid waste generation rates throughout some Iraqi governorates.

Table 5 Generation rates in some Iraqi governorates

City or governorates	Generation rates kg/capita/d	References
Al-Mussel	0.54	(9)
Baghdad	0.70	(8)
Kirkuk	0.44	(10)
Al-Najaf	0.42	(7)
Al-Fallujah	0.32	(6)
Al-Ammarah	0.60	Current study

Solid waste composition

There were eight components of MSW evaluated in the sampling survey namely, food, paper, metals, glass, plastics, rubber, textile and miscellaneous (e.g. wood, leather, garden trimming, ashes, etc.). Those components are the major constituents of the residential solid waste (11). The break-down of the components of solid waste for different socio-economic categories and the overall range composition for Al-Ammarah are given in table 6, figure 3. A comparison of the composition of solid waste of Al-Ammarah with those reported for some other Iraqi governorates is presented in Table 7, figure 4.
Table 6 shows that the largest component by far is the food wastes, food waste constitutes 44% of the total solid waste quantities. Yet it can be noted that the percentage of food in the Al-Ammarah waste is the lowest as compared with other governorates in Iraq (Table 7). This does not necessarily mean that the other

governorates are throwing away more food; it means that the overall production of solid wastes is much lower than its in Al-Ammarah city (at the time of survey) and that the food wastes make up a greater percentage of this smaller waste amount in other governorates, besides, most local residents in Al-Ammarah city insist on giving their food waste to their animals as soon as generated and thus were not encountered in calculations.

Also it can be noted that the percentage of plastics in Al-Ammarah City is almost as high as Baghdad, which can be explained by the fact that most of the people as in most southern Iraqi governorates use drinking water packed in disposable plastic containers, besides the absence of recycling programs may result in large quantities of plastics entering the waste stream.

Table 6 Average solid waste composition for Al-Ammarah City

| Waste component | Percent by weight | | | Average |
	Low	Middle	High	%
Food waste	40.9	45.1	46.1	44
Paper	4.7	5.0	5.0	4.9
Metals	2.9	4.3	4.6	4.0
Glass	4.1	4.3	4.3	4.2
Plastics	3.8	4.5	5.7	4.6
Rubber	1.0	1.4	1.0	1.13
Textile	4.1	3.2	4.9	4.0
Combustible	0.8	0.7	0.5	0.6
Noncombustible	37.7	31.4	27.9	32.3
Total	100	100	100	100
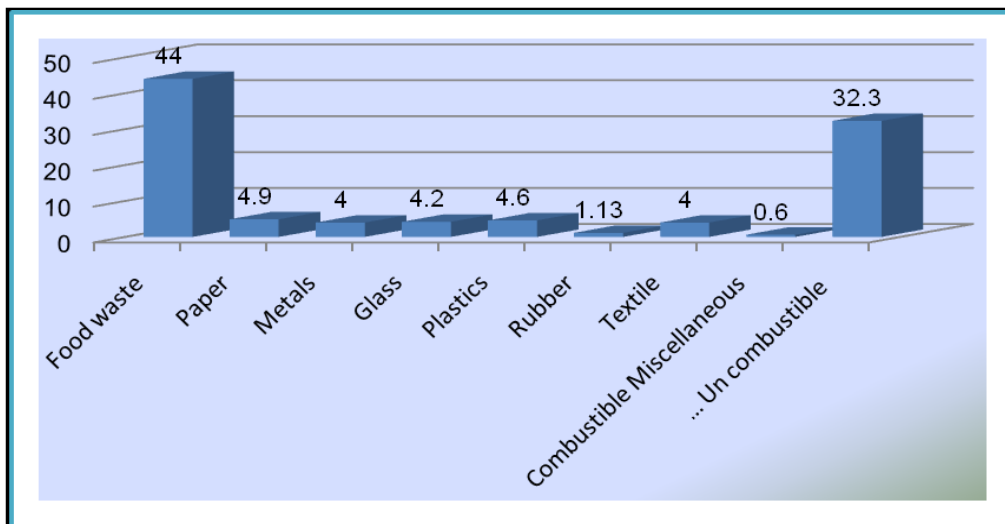
Figure 3 Average physical composition of Al-Ammarah residential solid waste

Table 7 Comparison of major solid waste components for Al-Ammarah with some other Iraqi governorates

Waste component	Al-Ammarah	Baghdad	Naynva	Kirkuk	Al-Fallujah	Al-Najaf
Food waste	44.00	69.6	81.00	67.5	70.60	60.03
Paper	4.90	5.00	3.00	6.33	2.60	3.06
Metals	4.00	2.20	5.40	8.40	1.30	7.09
Glass	4.20	2.20	1.00	2.50	2.20	2.71
Plastics	4.60	5.30	3.00	6.33	8.10	5.89
Rubber	1.13	-----	-----	-----	------	------
Textile	4.00	3.00	1.50	2.50	4.30	3.59
Combustible	0.60	------	----	-----	------	-----
Non combustible	32.30	------	-----	------	-----	-----
Garden waste	-----	5.00	2.90	3.00	1.00	3.06
Inert	-----	7.70	-----	4.77	10.00	4.04
Leather	------	------	0.20	2.50	------	1.50
Total		100				
References	Current study	8	9	10	6	7

Figure 4 Comparison of major solid waste components for Al-Ammarah with some other governorates

Results and discussion

The main period of sampling took 1week, and total quantities of more than 7 tons of waste were analyzed. This quantity was ge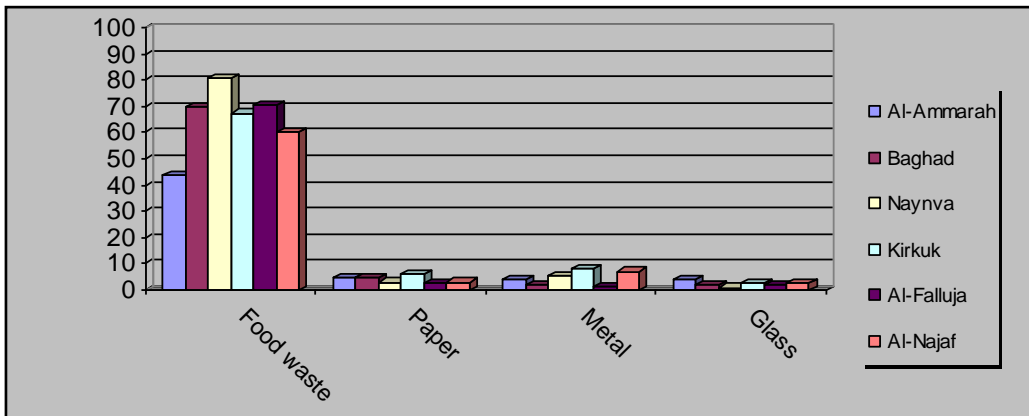nerated by 104 dwellings, which belong to various socio-economic categories and involved different numbers of residents; It is noted that the highest generation rate (0.68 kg per capita days) was found for families of middle.-income level, while the lowest rate (0.51 kg/capita. day) was for families of high-income level, Although the result is confusing but it was related to problems involved in obtaining a representative sample of different levels due to intrusions of different socio-levels .

Based on the obtained results, the overall weighted average generation rate for Al-Ammarah City is 0.60 kg per capita /day. By comparing this rate with the rates reported for other countries in Iraq, it can be seen that the Missan rate is among the lowest rate of Iraqi governorates. In contrast, it is 0.7 kg per capita day for Baghdad, 0.54 kg per capita per day for Al-Mussel, 0.44 kg per capita per day for the Kirkuk, 0.42 kg per capita per day for Al-Najaf, and 0.33 kg per capita per day for Al-Fallujah.

Conclusions

The present study has illustrated the accuracy that can be expected from a household solid waste survey.

1st. This study showed that an average residential solid waste generation rate is 0.6 kg per capita day for Al-Ammarah City.

2nd. It is unusual to have generation rate of the high- income level to be lower than the middle and low-income level generation rates, as observed in Al-Ammarah City but this may be attributed to the fact discussed above and that the low-income level raise different kind of animals and practice handcrafts within their houses, thus increasing the stream of waste.

3rd. The waste component percentages of the solid waste for different levels are almost alike within the Al-Ammarah City but differ largely with other Iraqi governorates.

Table A-1 Solid waste generation rate in high –income level in Al-Ammarah City

Sample	Number of persons	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
		23/72	24/7	25/7	26/7	27/7	28/7	29/7
H1	9	4.5	3.1	4.2	4.1	4	4.5	4.9
H2	7	6.5	6.2	5.6	5	6.1	6.4	7.3
H3	3	2	2.1	4.7	4.8		3.3	2.9
H4	5	4	3.5	7.1	2	4.2	3.2	2.5
H5	6	6	4	5.9	10.2	-----	6.3	4.4
H6	17	4.6	9.1	3.2	6.1	2.1	5.9	5.3
H7	4	3	7.1	4.5	8.3	6.2	5	10.2
H8	9	4.2	5	5.7	5.3	13.1	6.1	4.2
H9	7	10	4.3	6.1	5.5	6.6	9.2	6
H10	7	4	7	6.2	8	8	5	7.6
H11	8	5.5	6.2	7.4	6.2	8.2	4.3	5.8
H12	6	3	4	3.1	7.4	7.2	6.3	4.1
H13	10	6.5	5.3	8.2	7.1	6.4	8.2	10.3
H14	6	10.1	10.2	8.4	8.1	6.3	5.2	2.6
H15	9	6.1	3	2.1	2.3	3.2	4	4.9
H16	10	4.6	5.3	6.2	6.1	1.2	8.5	4.5
H17	5	5.4	-----	5.3	6.3	3.5	7.6	8.1
H18	7	7.2	5.1	6.3	3.5	4.1	5.5	3.3
H19	7	3.1	6	9	8.5	9.2	8.3	3.6
H20	15	1	6.3	5.2	7.1	9.2	5.2	7.6
H21	7	3.1	9.1	6.1	4	14.2	10.3	8.1
H22	11	6.3	6.5	5	5.9	7.4	8.2	5.3
H23	7	10.2	5.1	9.6	6.7	8.6	10.3	4.2
H24	8	7	12	6.1	5.5	5.7	7.7	6.8
H25	14	8.5	6.4	4.3	5.2	1.3	4.9	8.7
Sum	204	136.4	141.9	145.5	149.2	146	159.4	143.2
Average	8.16	5.46	3.50	4.08	3.68	3.05	3.29	5.73
Median	7	5.4	5.65	5.9	6.1	6.3	6.1	5.3
Std. dev	3.31		2.47	2.57	2.45	2.15	2.27	2.26
Avg. of capita/.house3	8							
Avg. of SWGH4	0.51 kg/(person/.day)							

[2] Kg/d
[3] Total number of persons in the 25 houses/25 number of houses
[4] (Total average weights/7)/8(average capita number per house)

Table 2-A Total amount of solid waste generated in middle -income household in Al-Ammarah City

Sample	Number of persons	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
		23/7	24/7	25/7	26/7	27/7	28/7	29/7
M1	٦	٧٫٦	٦	٤	٦٫١	٣٫٤	٥٫٦	10.1
M2	١٨	١٦٫١	٧	٧٫٣	٦٫٢	٥٫٨	٦٫٢	5.4
M3	١٦	٤٫٢	٧	٦٫٥	١١٫٢	٦٫١	٧٫٢	6.3
M4	٨	٤	٣٫٨	٥	١٢٫٣	٨٫٢	٤٫٥	3.7
M5	٨	٥٫٣	١٠	١٠٫٢	٧٫١	٣٫٧	٤٫١	5.2
M6	١٠	٦	٥٫١	٥٫٢	٢٫١	٣٫٢	٤٫٣	8.2
M7	٢٠	١٤	١٠	١١٫٣	10.3	٩٫٨	١١٫٧	10.4
M8	٩	٨٫٢	٥	٥٫٢	٣٫٣	٥٫٣	٥	6.3
M9	١٢	٩٫١	٥	٤٫١	٦٫٤	٩٫٥	٧٫٣	6.1
M10	١٥	١٤٫٦	١٥٫١	١٢٫٩	١٢٫١	١٠٫٥	١١٫١	13.7
M11	١١	٧٫٥	٨	١٠	٩٫٢	٧٫٤	٦٫٢	4.6
M12	٨	٦٫١	٥	٧٫٢	١٠٫٢	٦٫٢	٥٫٦	5.1
M13	٦	٧٫٣	١٠	٨٫٣	٥٫٥	٦٫١	٨٫٥	4.3
M14	٥	٥	٣٫٩	٣	٢٫١	١٫٦	٢٫٢	2.5
M15	٩	١٤	٤٫٥	٤٫١	٤٫٢	٥٫٣	٧٫٥	6.2
M16	١٤	٦	٦٫٥	٥	٧	٩	٨٫٣	8.4
M17	٥	٤	٤٫١	٤	٦٫٢	٤٫٢	٣٫٦	2.6
M18	٩	١٠	١٠٫٢	١١٫٢	٥٫٢	٨٫١	١١٫٢	7.5
M19	٣	٦		٧٫٨	٨٫١	١٢٫١	١٠٫٥	5.3
M20	١٢	١٢	٩٫١	٥٫٦	٨٫٣	٩٫٣	٤٫٢	4.6
M21	١٥	٤	٩	٩٫٢	٦٫٩	٤٫٢	٥٫٣	6.9
M22	٤	٧	٦	٦٫٢	٤٫٦	٣٫٢	٤٫١	5.3
M23	٩	٥٫٥	٥	٨	٦٫١	٦٫٣	٤٫٦	7.8
M24	١٧	٩	٥	٣٫١	٥٫٧	٨٫٧	٢٫٣	5.6
M25	٦	٣	٣٫٤	٧٫١	٥	٦٫٢	٤٫١	3.5
M26	٦	٣٫١	١٫٥	٢٫٣	٣	٣٫٧	٣٫٢	4.6
M27	٨	٥	٧	٢٫٤	٥٫٦	١١٫٢	٣٫٢	4.3
M28	٤	٤	٩	٢٫٣	١٫٢	١٫٢	٢	1.5
M29	٨	١٢	٢٫٥	١٫٢	٤٫٣	١٫٣	٣٫٣	4.2
M30	٩	٤	١٠	٧٫١	٣٫١	٦٫٢	٧	4.1
M31	٧	٥	٦٫٩	٥٫١	٤	٢٫٥	٣٫٨	4.3
M32	٤	٤٫٥	٦	٣٫١	٢٫٥	٣	٢٫٦	3.3
M33	١٥	٥	٦٫٩	٨٫١	٧٫٣	٣٫٢	٣٫٥	7.3
M34	١٦	٧٫٥	٣	٨٫٤	٦٫١	٥٫١	٣٫٢	8.3
M35	١١	٣٫١	٧	٦٫٢	٥٫٣	٦٫٣	٧٫٨	6.9
M36	٧	٤	٤٫٧	٥٫١	٥٫٢	١٫٥	٣٫٥	3.8

M37	٩	٥	٤	٤.٥	٣	٣.٢	٥.٤	11.4
M38	٢٤	١٧.٤	٩	٤	٨.٥	٩.٦	٦.٤	14.5
Sum	506	376.8	323.2	305.3	297.6	282.2	288.7	311
Average	10.12	7.69	6.60	6.11	5.95	5.76	5.77	6.22
Median	9	7	6.1	5.3	5.55	6.1	5.15	5.3
Std. dev.	4.84	3.87	2.70	2.89	2.69	2.88	2.73	3.37
Avg. of capita/ house	10							
Avg. of SWGM	0.63 kg/(person./day)							

Table 3-A. Total amount of solid waste generated in low -income household in Al-Ammarah City

Household	Number of Persons	Day 1 23/7	Day 2 24/7	Day 3 25/7	Day 4 26/7	Day 5 27/7	Day 6 28/7	Day 7 29/7
L1	١٣	١٢.١	٧.٣	٨.٧	٤	٤.٢	٤.٥	6.2
L2	٣	١.٤	٢.١	٤.٩	٣.١	١.٢	١.٥	0.5
L3	١١	٦.١	٨.٥	٦.١	٦.٧	٨.١	٢.٣	7.1
L4	٥	٣.٥	٣	٣.٩	٣.٧	٤.٣	٥.١	2.4
L5	١٠	٥.١	٧	٥	٧.٢	٥.٤	٣.١	4.2
L6	١٧	٤.٣	٥.٦	٣.٩	٤.٣	٥.٢	٥	6.3
L7	٨	٥.٣	٤.٣	٤.٤	٥.٦	٨.٥	٣.٣	1.6
L8	٥	٦.٤	٣.٢	٤.٢	٣.٤	٢.٧	٢.١	2.6
L9	٨	٣.١	٨.١	٥.٧	٤.٦	٧.٢	٥.١	5.6
L10	٩	١٤.٥	٦.٣	٧.٢	٥.٢	٤.٢	٣.٥	3.2
L11	١٠	٧.٣	٦.١	٦.٢	٣.٩	١.٥	٦.٣	3.6
L12	١١	١٤.٥	٨.٣	٥.٢	٣.٨	٣.٥	٣.٤	11.2
L13	٥	٣	٢	١.٩	٣.٤	٢.١	٢.١	4.9
L14	١٣	١٠	٧.٢	٩.١	٦.٢	٧.٣	٧.٥	9.2
L15	١١	٦.٥	٥.١	٧.٤	٥.٣	٦.٤	٥.٧	7.5
L16	٥	٢.٢	٣.١	٢.٣	١.٨	٢.١	٣.٣	4.1
L17	٧	٣.٩	٤	٤.٢	٦.١	٤.٩	٣.١	3.6
L18	٧	٤.٢	٢.٢	١	٢.٦	١.٢	٤.٢	7.3
L19	٧	٥.١	٤.١	٥.٢	٩.٧	٣.٥	٢.١	2.7
L20	١٢	٧.٣	٤	٦.١	٥	٨.١	٦.٢	7.2
L21	٦	٦.١	٤	٧.٣	٢.١	٤.٥	٣.٣	4.2
L22	١٢	٢.١	٦	٦.١	٧.١	٤.٣	٦.٢	8.4
L23	٩	٦.٢	٨.١	٦.٥	٥.٨	٥.١	٤.٣	6.1
L24	١٥	٨	٩.٤	٦.٧	٥.١	٣.٣	٤.٦	6
L25	٨	٥.٦	١.١	٥	٣.١	٤.٤	٤.٣	4.1
L26	٦	١.١	٦	١.٩	٥.٥	٢.١	٩.٢	3.1

L27	٥	٠.٤	١	٢	٢.٥	٣.١	٢	3.8
L28	٥	٥	٩.٢	٣.٤	٤.٨	٦.٢	٤.١	3.3
L29	٥	٥.٢	٥.١	٣.٢	٤	١.٢	٣.٢	4.2
L30	٩	٨.١	٢.٢	٤.١	١٠.٢	٦.٣	٣.٥	4
L31	١٦	٦.٧	٧.٣	٦.١	٦.١	٤.٢	٣.٣	6.9
L32	١٨	٦.١	٥.٣	٤.٢	٥.٤	٣.٢	٢.١	5.3
L33	١١	٦.٣	٥.٥	٧	٨.٥	٦.٤	٧.٣	5.8
L34	١٠	٧.١	٦.٨	٦.٧	٥.٢	٤.١	٥.١	6.3
L35	٧	١٢	٧.٤	٤.١	٦.٣	٨.٣	٤.١	3.1
L36	١٣	٥.٣	٧	٦.٣	٤.٩	٥.٤	٥.٢	4.9
L37	١٢	٨.١	٣	٦	٧.٦	٨.٦	٧.١	6.1
L38	٨	٥	٥.٤	٣.٥	٢.٤	٢.٥	٤	2.1
L39	٢	٣.١	٣.٩	١.٢	١.٢	١.٩	٢.٤	4.6
L40	١١	٧.5	٤.٣	٣.٨	٤.٥	٦.٣	٣.٦	5.1
L41	٥	٥.٢	٥.١	٣.٢	٤	١.٢	٣.٢	4.2
Sum	354.0	233.3	205.2	193.9	193.4	176.7	164.7	193.3
Average	9.08	5.98	5.26	4.97	4.96	4.53	4.22	4.96
Median	9	5.85	5.4	5	5	4.3	4.1	4.6
Std. dev	3.83	3.27	2.29	1.96	2.02	2.19	1.74	2.16
Avg. of capita/.house								9
Avg. of SWGL						0.55 kg/(person/.day)		

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