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Estimation of the Components of Residential Solid Waste in Baqubah City and their Generation Rate

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K E Y W O R D S

Baqubah City, Generation rate, Municipal Solid Waste (MSW), Socio-income level

A B S T R A C T

Municipal solid waste is of variable, non-uniform inconsistent nature and the method by which the sample to acquire is decisive if the results are to be reliable. For data collection, an integrated methodological approach was introduced, including field investigation, questionnaire survey, and personal interviews, which were employed to estimate the rate of waste production and physical composition at the source of generation. Samples were collected from different socio-economic clusters (socio-income level). According to the results of the preliminary survey for 99% confidence interval and 10% standard error, the optimum sample size was 105 households, in Baqubah City in Diyala Governorate by implementation a completely random block design for sampling. Up to 105 units were sampled which were allocated to high, middle, and low-income socio-economic categories, yielding an average of 650 kg of waste collected daily for one week. It is concluded that Baqubah city has an average generation rate of 0.56 kg/ person/ day which is lower in the high-economic level zone in the city than in the other zones. Among the total waste generated in the city, 68% is food waste, 5.2% paper waste,7.4% plastic waste, 5.8% metal, 2.3% glass waste,3.1% textile waste, while the remaining percentages represent miscellaneous combustible and noncombustible materials.

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1. INTRODUCTION

One of the key practices for resource conservation and environmental protection is proper waste management [1]. Municipal solid waste management (MSWM) is one of the important environmental challenges in many countries [2]. The rapid growth of population, urbanization, industrialization, and economic growth coupled with the changing lifestyles have increased solid waste generation [3]. Nationally, the quantity of solid waste in developing countries has been consistently rising over the years [4].

Managing such massive amounts of urban solid waste has become a major concern for governme nt departments, environmental authorities, regulators and the general public. The increased volume of solid waste presents difficulties inefficient waste management (transport, storage, and disposal) [5].

The volume and composition of solid waste worldwide varied according to region /state, environment, and socioeconomic conditions [6]. Therefore, accurate information about the origins and types of solid waste, the rate of generation, and the characteristics composition of solid waste are very important for the operation and design of successful waste management system strategies [7]. Solid waste generation is greatly impacted by several factors, such as the level of family income, education standard, and infrastructure [8]. Estimation and forecasting of a solid waste generation plays a significant role in the successful implementation of management solutions and helps to make better financial, regulatory, and institutional decisions. The composition of municipal solid waste varies from place to place and also has a relatively strong connection with the average living standards [9]. Municipal solid waste (MSW) is highly heterogeneous [10] and has variable physical characteristics depending on its sources. Most preceding studies assessed the quantity of municipal solid waste in transfer stations, landfill sites, or material recovery facilities [11]. However, only a few studies were conducted at the source of generation, namely individual households. Samples collected at transfer stations or disposal sites are composite samples from various sources; specific results that are meant to represent the actual characteristics of the waste are not obtained. On the contrary, sampling at the point of generation is a single source that generates more detailed results. As a result to the high heterogeneity and variability of sampling methodologies, a statistically designed sampling survey should be performed to reliably obtain the average quantity and composition of waste. The accuracy of the determination of these parameters would be improved from a statistical point of view by increasing the number of samples to be evaluated [12]. On the other hand, the economy and limited resources are moving towards reducing the number of samples. To satisfy both statistical and economic criteria, the number of samples is typically calculated first by choosing the required precision [13]. For example, Chyad in 2016 [14] found that 100 samples were needed to offer a confidence interval of 99 percent with a standard error of 5 percent. Al-Ameen, and Graimed in 2010 [15] with a confidence interval of 99% and standard error of 10% held in Al-Ammarah City, found that the optimum sample size was 104. The present study aims to evaluate the quantity and composition of residential solid waste generated in the city of Baqubah, the center of Diyala governorate, by surveying the generation source (houses), which were two weeks for a preliminary survey and one week for the main survey.

2. MATERIALS AND METHODS

I. Description of the study area

Baqubah is the main center of Diyala governorate and it is one of the most heavily populated cities. It is located at a latitude of (33º 44' 41") and longitude (44° 38′ 37″) and is 46 m above the sea-level. The total population estimated of the city is 664830 population equivalent according to the estimation of the Diyala Directorate Census based on the census of Iraq's Ministry of planning in 2017 [16]. The governorate of Diyala covers approximately 17685 km^2, 1630 km^2 of which forms the City of Baqubah. Diyala is one of the provinces that have international borders, specifically with Iran from the east. While it is bordered on the north by the Sulaymaniyah governorate and part of Salah al-Din governorate, on the west by the Baghdad and Salah al-Din governorates, and in the south by the Wassit governorate. The climate of Diyala province is well known as hot and dry in summer, cold winter, and rainfall is limited to the winter season.

II. Sampling design

Sampling covered residential waste that was collected from households of Baqubah city. A sampling survey was conducted to quantify the amount of waste generated and to know about physical composition data, which will later help to suggest a waste management strategy. The accuracy of the data concerning waste composition is strongly impacted by the sampling procedure [17]. The adopted test method was based on the classification categories of the American Society for Testing and Materials. This standard describes a test method for determining the mean composition of municipal solid waste that depends on sampling the waste itself and manual sorting over a specified period into the desired number of material fractions (e.g. paper, organics, plastic, combustibles, etc.).

Waste samples survey was selected by applying the stratified random sampling technique. Households were first stratified according to strata so that all areas of the municipality were represented in the study. The number of samples was collected from each district, in proportion to the number of households in each district.

Household sources were categorized into different socio-economic levels; high, medium, and low-income level areas to ensure representative samples. The survey selected a total of 105 sampling points from all types of waste generation sources to get the waste amount discharge ratio by generation source for 14 consecutive days. Hence, a total of 735 samples were obtained and analyzed. Thus, the three levels have the following percentages out of the total population: low income (42%), middle income (35%), and high income (23%).

III. Preliminary survey

To obtain reliable and accurate results from the field survey, both for the planning and environmental assessment of waste management and for improving resource recovery in society.it was necessary to determine the number of samples to be, analyzed. The sample size and method of characterizing the waste are the most important variables for this process, which should be carefully selected before the study of any waste stream composition is initiated. Generally, it is indispensable to determine the right sample size to be analyzed based on the theory of sampling and the center-limiting theory, in which the value of the arithmetic mean of a given sample (n) is obtained from population society with a known mean (M) and known standard deviation (SD) will be the same (M), with an error, which is called the standard error [18]. Also, the mean sample is the normal distribution whenever the length of the sample is (n>30).

To determine the optimum size of the sample, the level of confidence, error, and standard deviation (SD) of the samples were needed. Since the population's standard deviation (SD) is uncertain, thus a preliminary survey was conducted to determine this parameter. The preliminary sampling survey was carried out in July 2019 for two weeks for one season, where 280 samples were collected randomly from twenty houses. As a result of this survey, it was found that the average generation rate is (0.69) kg/capita/day and the standard deviation is (0.4), as represented in Table I.

TABLE I: Results of the primary sampling survey

No. of units	No. of persons per unit	Total waste generated (kg)	Average generation rate (kg/capita/day) *
1	6	67.8	0.807
2	9	93.78	0.744
3	7	95.23	0.971
4	3	54.65	1.301
5	3	42.23	1.005
6	5	40.12	0.573
7	4	87.00	1.553
8	10	52.05	0.371
9	5	24.35	0.347
10	8	45.95	0.410
11	9	69.20	0.549
12	5	65.80	0.940
13	4	28.80	0.514

14	6	32.30	0.384
15	10	60.65	0.433
16	4	17.8	0.317
17	5	35.50	0.507
18	7	40.20	0.410
19	5	58.30	0.832
20	6	72.70	0.865
Total	121	1084.41	13.833
Average	6.05	54.22	0.69
Std. Dev.			0.398

*Generation rate= [total waste generated/(no.of persons*14 day)]

IV. Number of samples

In agreement with the fundamentals of the statistic as well as the outcome of the preliminary survey using a 95% confidence interval and a 10% standard error, the optimum sample size can be calculated using the following Eq. (1) [19]:

$$n = \left(\frac{Z \times SD}{R}\right)^2 = [2.575 \text{ x } (0.398)/\ 10]^{\ 2} = 105 \text{ samples} \quad (1)$$

where:

n = Number of Samples;
z = the percentage score for regular normal distribution calculated from statistical tables;
SD = Standard population deviation which is equal to the preliminary sample standard deviation; and
R = Error sampling.

V. Main survey and collection of household data

The survey was continued for 8 days, in which the first day the visited households randomly to receive their willingness to participate in the study. In the target households to collect information about the size (number of individuals per household) and socioeconomic conditions. Samples were taken immediately after household selection (required number of daily samples). Before the execution of sampling, the required number of plastic bags was distributed to all selected sampling points. Each plastic bag of collected waste was bounded with code numbers according to the (H, M, and L) referring to high, middle, and low economic socio level so that no intermingling of samples will occur. Then, the volume of waste at the collection points is determined by weighing individually and recording it on the datasheet. New bags were provided again to each household selected for the survey. This procedure was repeated consecutively for 7 days to calculate solid waste generation rates in Baqubah city in kg/capita/day. Generation rates of solid wastes were determined using Eq. (2) [20]:

$$\text{CSWG} = \text{rH} \times \text{SWGH} + \text{rM} \times \text{SWGM} + \text{rL} \times \text{SWGL} \quad (2)$$

where:
CSWG: Composite solid waste generation rate;
rH: Ratio of high-income community;
SWGH: Level of generation of solid waste for high income society;
rM:Ratio of middle-income community;
SWGM: Level of generation of solid waste for middle income society;
rL: Ratio of low-income community; and
SWGL: Level of generation of solid waste for low income society

3. RESULTS AND DISCUSSION

I. The rate of Waste Generation

The survey has selected a total of 105 sampling points which were allocated to high, middle, and low-income socio-economic categories, yielding an average of 650 kg of waste collected daily for one week (from 2 July to 8 July 2019). To ensure sufficient and proper results, the number of samples selected from each socio-economic category was proportional to the number of households in the community. Information was not available on the percentage of every socio-economic group in the community [21]. Therefore it was presumed according to districts as seen in Tables II, III, and IV.

In order to find the percentages for each socio-economic category, the number of houses from each socio-economic category participating in that survey was proportional to their percentages for that community, where high-income represents 23 %, middle-income 35%, and low-income 42 % of the total population as illustrated in Figure 1. Referring to each socio-level percentage, there should be 25 households in high level-income (23%), 36 households in middle-level income (35%), and 44 households in low-level income (42%); they were collected daily to obtain a total of 105 samples, thus collecting 735 samples per week as illustrated in Appendix.

TABLE II: Name of area, number of households, and the ratio of High-income level in Baqubah [21]

No.	Name of area	No. of household
1	Al-Takya/1	2046
2	Al- Saray	1200
3	New Baqubah	1926
4	Al-Takya/2	3541
	Sum	8713
Ratio of high-income level	8713/38133 = 23%	

TABLE III: Name of area, number of households, and the ratio of Mid-income level in Baqubah [21]

No.	Name of area	No. of household
1	Shefta	**1230**
2	khan Al-Alwalwa	**1473**
3	Teachers district	**4436**
4	Al-Mustafa	**2210**
5	Al-Mufraq	**3871**
	Sum	13220
Ratio of mid income level	13220/38133 = 35%	

TABLE IV:Name of area, number of households, and the ratio of Low-income level in Baqubah [21]

No.	Name of area	No. of household
1	Al-Tahreer/1	4073
2	Al-Tahreer/2	2423
3	Al-Khatoon/1	1574
4	Industrial district(complex)	1250
5	Al- Khatoon /2	3136
6	Industrial district and Om Al-Eatham	300
7	Al-Sawamra	914
8	Dor Al-khalis	244
9	Al-Hakim	562
10	Al-Tahwilyaih	1724
	Sum	16200

Ratio of low-income level	16200/38133 = 42%

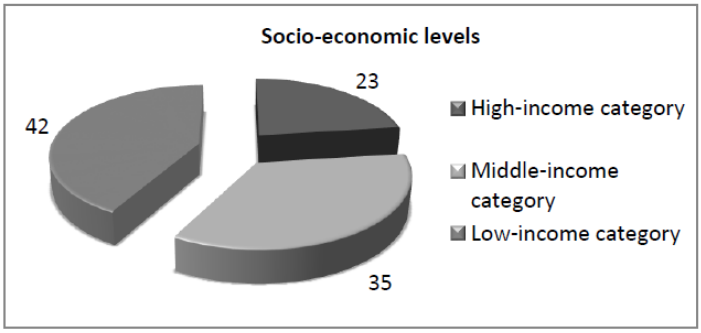

Figure 1: Percentages of socio-levels in Baqubah city

Unit generation rates can be obtained by using field data that were collected from a representative sample. As shown in Figure 2, the average levels of residential solid waste generation for different economic categories are: High income: 0.49 kg per day, middle income: 0.61 kg per day, and low income: 0.54 kg per day

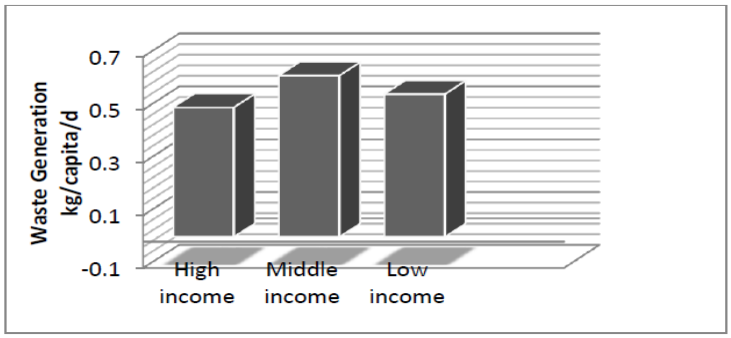

Figure 2: Amount of waste generated from household sources in kg/capita/day

Depending on the results from Figures 1 and 2, the weighted average generation rate for solid wastes in Baqubah City can be determined by utilizing Eq. (2) is:

$$(0.49 \text{ x } 23\%)/100 + (0.61 \text{ x } 35\%)/100 + (0.54 \text{ x } 42\%)/100 = 0.56 \text{ kg per capita /day}$$

As it can be seen, there are substantial intrusions 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. Insufficient samples can be entirely misleading; besides, there have been considerable problems in obtaining a representative sample at different levels due to intrusions of different social groups. Nevertheless, the purpose for calculating levels of generation is to collect data that can be used to assess the total quantity of wastes to be calculated. Consequently, the average generation rate was obtained for the three different levels of societies and to be relied upon as in Eq. (2).

Different generation levels were obtained through studies carried out at different times of the year in some Iraqi Governorates. It was found that the generation rates varied from 0.32 (kg/capita/day) for Fallujah city [22] to 0.420 (kg/capita/day) for Al-Najaf [23] and 0.7 (kg/capita/day) for Baghdad [24]. Table V offers a direct comparison of the levels of solid waste generation throughout several Iraqi Governorates.

TABLE V: Rates of generation in some Iraqi Governorates

City or governorates	Rates for generation kg/capita/d	Reference
Kirkuk	0.44	(25)

Baghdad	0.70	(24)
Al-Fallujah	0.32	(22)
Al-Amara	0.60	(26)
Al-Diwaniya	0.68	(27)
Al-Najaf	0.42	(23)
Al-Mussel	0.54	(28)

II. Composition of Solid Waste

In this survey, the physical composition of waste from three residential area categories for six fractions was evaluated namely, food, metals, paper, glass, and plastics. These constituents are the main elements of solid residential waste [20]. The breakdown of solid waste components for various socio-economic groups and the overall composition for Baqubah city was described in Table VI and illustrated in Figure 3. Furthermore, a comparison of Baqubah city's solid waste composition with that recorded for some other Iraqi cities is given in Table VII.

As can be seen from Table VI, overall the residential waste comprises the highest percentage of food waste which is 68% of the total waste quantity, followed by plastic (7.4%) and paper waste (5.2%). The enormous quantity of organic waste in the MSW system has the potential to cause environmental problems and at the same time has tremendous potential for the recovery of resources. Metals are found in large amounts of residential waste. Also, plastic and paper are easily found in the waste stream, that the most important reason is the absence of recycled or segregated waste at the household level. Besides that, Citizens still do not know environmental issues and proper waste disposal.

For some studies, Table VII offers an overview of the waste compositions corresponding to the Baqubah region. Many of these studies showed that food waste was the predominant fraction of household waste, although the percentage of food waste differed significantly between studies. The differences in the composition of waste among governorates may be directly linked to the differences in source-segregation, type of waste characterized, waste collection systems, local regulation, terminology as well as waste sampling and characterization methodologies. Comparison between data on the structure shows the complexities in interpreting and applying aggregated data in certain contexts.

TABLE VI:Average solid waste composition of residential areas

	Percent by weight			**Average**
Waste Composition	***Low income***	***Middle income***	***High income***	***%***
Food waste	65.4	68.8	69.8	68
Plastics	6.9	7.9	7.4	7.4
Metals	4.8	6.1	6.5	5.8
Glass	2.2	2.4	2.3	2.3
Paper	4.9	5.3	5.4	5.2
Textile	3.2	2.3	3.8	3.1
Others	12.6	7.2	4.8	8.2
Total	100	100	100	100

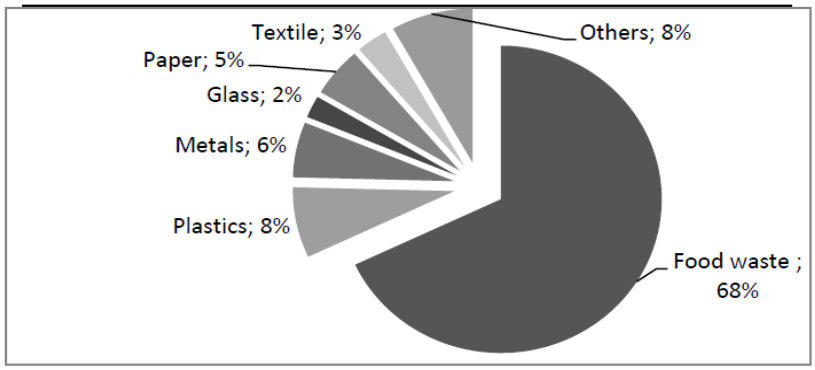

Figure 3: Average physical composition of Baqubah residential solid waste

TABLE VII: Comparison of major components of solid waste for Baqubah with some other cities in Iraq

Waste component	Baqubah	Al Amarah	Baghdad	Al-Fallujah	Al-Najaf	Naynva
Food	68	44	69.6	70.6	60	81
Paper	5.2	4.9	5	2.6	3.1	3
Metals	5.8	4	2.2	1.3	7.1	5.4
Glass	2.3	4.2	2.2	2.2	2.7	1.0
Plastics	7.4	4.6	5.3	8.1	5.9	3.0
Textile	3.1	4	3	4.3	3.6	1.5
Other		34.3	12.7	10.9	17.6	5.1
Total	100	100	100	100	100	100
Reference	Current study	26	24	22	23	28

4. CONCLUSIONS

Household survey was carried out in Baqubah city and resulted in a total of 105 sampling points from three income groups, thereby a total of 735 samples were collected and analyzed. The following conclusions could be drawn:

1) The results indicate that the overall weighted average generation rate in this region is 0.56 kg per capita per day. As well as, it seems that the middle- economic level have the highest generation rate (0.61 kg per capita days), while the lowest rate (0.49 kg/capita. day) was for families of high- economic level, Although the result is confusing but it was related to difficulties in obtaining a representative sample at various levels due to intrusions at different socio-groups.
2) If this rate is compared to the generation rate recorded in other governorates in Iraq, can be seen the waste generated in Baqubah is among the lowest rate of Iraqi cities. In contrast, it is about 0.7 kg/day per capita for Baghdad. This may be attributed to economic development, accelerating population growth, and changing trends of lifestyle.
3) The waste component percentages of the solid waste for different levels are almost alike within the Baqubah City and other Iraqi governorates. As can be seen, the overall residential waste comprises the highest percentage of food waste which is 68% of the total waste quantity, followed by plastic (7.4%) and paper waste (5.2%).

Appendix

Table A.1 Solid waste generation rate in high –income level in Baqubah City

Sample	Number of persons	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7

		2/7	3/7	4/7	7/5	7/6	7/7	7/8
H1	7	3.2	3.0	4.2	3.8	3.0	3.8	4.0
H2	8	5.4	3.1	5.0	3.2	2.8	3.1	2.7
H3	3	2.0	1.2	2.2	2.0	---	2.4	3.3
H4	5	3.5	2.0	3.0	2.5	2.1	3.2	2.8
H5	6	3.2	2.4	3.5	----	3.5	4.0	-----
H6	5	4.3	3.0	3.0	2.1	3.2	3.2	3.0
H7	4	3.2	2.2	2.7	1.5	2.6	2.1	2.0
H8	7	3.3	3.0	4.5	3.5	4.1	3.7	3.3
H9	6	4.2	2.6	4.5	2.0	3.6	3.0	2.6
H10	8	4.0	2.8	4.2	3.3	3.0	3.1	4.1
H11	9	5.2	4.2	-----	5.0	3.7	4.7	3.4
H12	4	3.1	2.6	2.8	2.5	2.5	1.8	2.2
H13	10	4.3	4.3	4.5	4.6	5.6	3.1	4.1
H14	7	5.1	3.2	4.2	3.6	3.0	4.0	2.7
H15	4	4.0	1.3	1.5	2.0	1.5	1.7	2.0
H16	6	3.2	3.1	3.0	2.2	2.0	2.0	2.2
H17	5	3.0	2.0	2.5	2.7	3.8	3.9	2.7
H18	7	3.5	3.5	4.3	4.0	3.2	3.8	3.0
H19	3	3.2	----	2.2	2.1	2.0	1.5	-----
H20	6	3.5	4.2	2.1	2.0	3.0	2.6	3.0
H21	7	3.2	4.6	2.1	4.2	3.5	4.6	3.0
H22	9	4.1	-----	4.5	3.7	3.8	4.2	3.7
H23	5	3.8	2.5	4.0	1.6	3.5	2.3	2.8
H24	4	3.5	1.3	1.5	2.7	1.6	1.3	1.9
H25	8	2.8	6.1	------	4.6	3.2	3.9	5.2
Sum	147	89	62.1	76.0	66.8	70.6	73.1	64.5
Average	6.04	3.66	2.58	3.16	2.78	2.91	3.04	2.69
Median	6	3.50	3.0	3.25	2.70	3.1	3.1	3.0
Avg. of capita/.house[3]				6				
Avg. of SWGH[4]				0.49 kg/(person/day)				

2 Kg/d

3 Total numbers of persons in the 25 houses/25 number of houses

4 (Total average weights/7)/8(average capita number per house)

Table A.2 Solid waste generation rate in middle –income level in Baqubah City

Sample	Number of persons	Day 1 2/7	Day 2 3/7	Day 3 4/7	Day 4 5/7	Day 5 6/7	Day 6 7/7	Day 7 8/7
M1	6	6.0	4.2	4.0	6.2	3.3	4.6	7.7
M2	7	5.7	4.0	4.1	6.1	5.5	3.4	4.0
M3	7	4.1	5.5	4.4	7.5	4.2	4.5	4.6
M4	6	4.2	3.1	3.4	4.2	3.3	4.1	3.2
M5	8	5.2	7.5	2.4	8.0	3.7	4.0	5.0
M6	9	5.7	5.1	4.9	3.2	3.9	4.6	6.8
M7	10	8.5	6.2	5.5	2.1	5.8	7.3	6.2
M8	9	6.5	5.0	5.1	3.8	5.3	4.8	3.3

M9	8	8.2	6.7	4.1	6.1	7.5	5.2	6.1
M10	12	7.5	8.1	6.9	8.2	6.0	6.0	6.3
M11	11	7.2	8.0	7.0	8.8	6.4	4.5	4.5
M12	8	6.2	5.3	5.1	8.2	4.0	4.2	5.1
M13	7	7.0	7.5	2.3	8.3	4.5	2.1	6.0
M14	5	3.0	2.9	2.1	1.7	2.3	2.5	2.5
M15	8	5.2	6.5	3.1	4.2	5.3	6.0	6.2
M16	11	5.7	4.5	5.2	8.1	5.0	4.5	4.7
M17	8	4.5	4.9	7.1	3.6	4.2	5.0	5.2
M18	7	5.5	6.0	7.1	8.1	5.2	5.0	-----
M19	4	2.2	2.5	5.2	-----	5.6	3.2	4.3
M20	9	3.8	5.2	7.2	6.5	5.2	4.1	4.8
M21	8	5.1	7.0	1.5	6.5	4.6	4.0	3.0
M22	4	2.5	4.0	3.0	3.0	3.2	3.0	5.5
M23	9	4.1	7.2	2.1	5.5	6.0	2.3	4.1
M24	10	4.7	5.6	5.0	6.1	6.2	6.3	4.3
M25	9	7.3	5.6	3.1	4.6	6.0	4.2	4.0
M26	6	4.6	4.5	1.6	2.2	3.1	3.5	3.2
M27	8	5.7	5.8	3.1	5.1	6.5	3.5	4.2
M28	4	5.2	6.0	2.3	1.5	1.7	2.0	1.9
M29	8	4.0	5.8	6.3	2.6	3.4	4.6	4.9
M30	9	5.6	4.0	6.1	3.3	5.1	6.2	4.1
M31	9	6.0	7.9	5.1	3.9	2.4	3.6	4.4
M32	6	5.1	5.2	2.0	2.7	3.1	3.3	3.8
M33	11	8.5	7.5	3.2	7.8	6.6	5.8	6.9
M34	9	9.7	8.3	5.0	3.5	6.5	5.1	4.5
M35	4	2.6	1.2	5.1	3.1	6.4	---	3.2
M36	12	9.5	7.8	6.0	5.1	4.2	7.7	5.2
Sum	282	199.5	200.9	151.6	176.3	164.8	154.7	160.5
Average	8.05	5.70	5.74	4.33	5.03	4.70	4.42	4.58
Median	8	5.6	3.38	4.40	3.12	3.02	3.26	4.6
Avg. of capita/.house3				8				
Avg. of SWGH4				0.61 kg/(person/day)				

Table A.3 Solid waste generation rate in low–income level in Baqubah City

Sample	Number of Persons	Day 1 2/7	Day 2 3/7	Day 3 4/7	Day 4 5/7	Day 5 6/7	Day 6 7/7	Day 7 8/7
L1	12	10.2	7.2	8.5	4.1	4.2	4.4	-----
L2	4	1.5	2.0	4.2	3.0	1.1	1.3	1.0
L3	7	3.7	4.1	4.2	3.2	5.6	2.0	3.6
L4	5	3.5	3.1	3.7	3.5	3.1	4.0	2.2
L5	8	4.2	4.0	2.7	2.5	2.5	2.1	3.3
L6	8	5.7	5.1	4.2	5.6	4.0	3.2	4.2

L7	7	3.1	5.5	4.6	5.1	5.6	2.5	5.0
L8	3	1.7	2.5	2.0	2.1	4.6	3.3	1.9
L9	5	4.2	4.0	3.5	3.2	2.0	3.2	2.5
L10	9	6.0	7.2	5.2	4.1	3.2	4.9	6.5
L11	7	5.5	4.6	3.1	5.6	2.7	3.0	7.3
L12	10	7.2	5.0	5.3	4.2	5.2	5.9	3.6
L13	11	12.3	5.2	4.7	3.6	3.4	4.7	9.2
L14	5	2.7	2.1	3.1	2.2	1.7	2.0	3.2
L15	7	4.1	4.2	6.0	4.5	3.1	3.6	3.0
L16	9	6.1	8.2	6.0	2.6	5.1	4.3	5.2
L17	5	2.0	3.1	1.8	4.2	2.1	3.2	1.0
L18	7	3.8	4.1	2.2	1.1	2.7	1.2	3.0
L19	4	4.1	2.0	1.5	2.0	2.6	1.5	1.6
L20	4	3.5	2.2	1.2	1.2	2.2	1.5	3.0
L21	13	9.7	6.8	8.1	6.0	7.3	5.2	5.7
L22	6	5.0	3.1	3.0	6.3	1.5	5.2	2.0
L23	4	3.2	2.4	1.8	2.1	3.3	4.2	3.1
L24	9	6.1	7.6	5.3	3.0	5.0	2.0	6.3
L25	13	8.8	9.0	4.0	7.5	2.5	6.3	4.6
L26	6	2.3	3.5	3.1	3.7	1.7	2.5	2.2
L27	5	2.9	2.0	1.7	2.2	3.5	4.0	1.2
L28	5	2.2	7.5	2.6	4.5	1.2	4.1	3.7
L29	9	5.8	6.1	4.1	4.5	3.0	2.7	4.2
L30	10	2.7	4.2	6.5	5.2	6.3	4.6	5.0
L31	9	6.5	2.7	4.0	3.7	6.6	3.3	3.9
L32	7	7.8	3.5	6.2	2.5	5.2	4.1	3.0
L33	7	5.1	5.0	3.3	3.0	5.0	2.5	2.1
L34	12	7.6	6.9	3.0	7.8	6.2	3.6	7.6
L35	6	1.2	2.0	2.5	3.1	4.0	2.1	3.7
L36	2	1.5	3.1	3.7	1.3	1.2	1.9	2.4
L37	5	5.0	4.8	3.0	4.1	3.2	1.5	4.1
L38	9	7.3	2.0	4.3	3.2	5.5	3.5	-----
L39	3	3.1	3.7	1.2	1.1	2.7	2.5	3.0
L40	4	3.7	3.6	1.7	1.5	2.0	3.2	2.7
L41	2	1.2	----	3.7	2.2	1.3	4.7	3.1
L42	4	2.4	5.1	3.7	2.2	---	3.1	3.0
L43	12	6.3	3.0	6.2	7.5	5.1	3.6	6.2
L44	8	5.0	5.3	3.2	2.3	2.6	4.0	2.5
Sum	307	203.9	183.2	160.2	153.7	151.3	138.4	149.5
Average	7.16	4.85	4.36	3.81	3.65	3.60	3.29	3.55
Median	6	4.2	4.05	3.6	3.35	3.2	3.25	3.45
Avg. of capita/.house			7					
Avg. of SWGL			0.54 kg/(person/day)					

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