

Household Behavior on Solid Waste Management a Case of Al-Kut City

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Abstract

This paper investigates the household behavior of Al-Kut City residents towards solid waste management. The paper is the outcome of a house to house survey of 560 households per week; the sampling program was based on Random Uniform Sampling for seven months period (January to July 2009), covering different parts of the city. Samples were collected and analyzed periodically.

Solid waste generation and composition in Al-Kut City (like other countries) is typically affected by population growth, urbanization, and improved economic conditions.

The daily per capita waste generation in Al-Kut is 0.53 kg which is lower in the low- economic level zone in the city than in other zones. Among the total waste generated in Al-Kut City, 70.38% is food waste, 4.19% plastic waste, 2.44% metal waste, 2.32% glass waste, 3.36% paper waste, 6.75% textile waste, while the remaining percentages represents miscellaneous combustible and non combustible materials. Quantity and composition were measured in order to be used in a new MSW management plan.

Keywords: Al-Kut City, Solid waste, Socio-income level, Solid waste generation rate, Solid waste physical composition, Point of generation.

السلوك البيئي على إدارة النفايات الصلبة لحالة مدينة الكوت

الخلاصة

يسلط هذا البحث الضوء على طريقة تعامل المواطنين مع النفايات الصلبة المنزلية . فجراء البحث نتيجة لمسح اجري موقعا على مستوى الدور ،اذ تضمنت عملية المسح جمع النفايات الصلبة ل 560 دار اسبوعيا وبطريقة النماذج العشوائية المتجانسة عبر فترة استمرت 7 شه¹ور (من شهر كانون الثاني الى شهر تموز 2009) ولمستويات اجتماعية مختلفة في مدينة الكوت وقد تم جمع النماذج وتحليلها دوريا .

تتأثر عملية تولد النفايات الصلبة وماتحتويه من مكونات في مدينة الكوت (حالتها حال اي مدينة اخرى) نظريا بمعدل النمو السكاني ، والمدنية، والمستوى الاجتماعي. تبين من نتائج البحث ان معدل تولد النفايات الصلبة اليومي للشخص الواحد في مدينة الكوت 0.53 كغم ، وانه اقل من ذلك في مناطق واطئة الدخل ، وان 70.83% منه تمثل نفايات غذائية، و 4.19% نفايات بلاستيكية، و 2.44% نفايات معدنية ، و 2.32 نفايات زجاجية، و 3.36 نفايات ورقية ، و 6.75% نفايات نسيجية وما تبقى من النسبة المئوية يمثل مواد قابلة وغير قابلة للاحتراق . ان ما يجري من قياس معدل تولد النفايات الصلبة ونسب المحتويات الفيزيائية ما هو الا خطوة استهلاكية استعدادا لوضع خطة ادارة نفايات صلبة جديدة .

Introduction

Prior to 1980, there was hardly any problem of solid waste management. The solid waste was locally managed in all urban areas through Iraq. Almost all the wastes then were organic in nature. The wastes collected were dumped on nearby riverbanks or in open fields. In those days, the flow of water in nearby rivers was capable in degrading the dumped organic wastes, which were small in quantity. However, these traditional practices could not continue due to the increasing population densities in urban areas. Increase in population density has lead to the increase in the volume of waste. This has created a massive threat to public health due to the lack of proper solid waste management.

After the mid-1980s initiation started in the diagnosis of the problem and some short-term as well as long term suggestions were given by different local studies [1], [2], [3], [4] [5]. These studies were basically meant for smooth functioning of the solid waste management projects. Some other studies were on quick

collection and disposal of the waste and on the possibility of pricing for garbage services [6], [7], [8].

Even with all these research and studies, the problem of solid waste management through Iraq has been increasing over the years. Presently, the task of solid waste management comes under the auspices of concerned municipalities. The service is provided almost free of charge using funds available at the disposal of the municipalities.

One of the studies conducted in Al-Kut City showed that unmanaged waste disposal was considered the main cause of environmental problems in Al-Kut [9].

The rate of growth of population of the Al-Kut is more than 3%, which is the same among the cities of Iraq [10], and because of this rapid increase in population, the amount as well as the quantum of degradable and non-biodegradable waste is increasing over time.

In the early days, economists discussed the socio-economic factors influencing waste generation by the

households. [11] analyzed the theoretical concept about household behavior on waste generation due to the changes in income, price of refuse service, frequency of service, site of refuse collection and packaging; he also compared the composition and quantity of waste in terms of income level. The study shows that grass, yard wastes and newspaper were positively correlated to the level of income.

The present paper attempts to conduct the survey at the source of generation, while most of the previous studies evaluated the characteristics of MSW at transfer stations or disposal sites (landfills).

Justification of Sample Size

To depict the reliability of the overall situation of the population, the selected sample should contain a sufficient number of households. Therefore, to reduce costs, simplify management and control of the quality of sampling, the sample size was kept within reasonable limits.

For a pure random sample drawn from an infinite population, the following formula has been taken as the basis for computing the sample size [12];

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

Where,

n is the number of samples

p is the value of the proportion in the population,

e is the acceptable error

$k\alpha$ is a coefficient dependent on the confidence level for $\alpha = 0.95$ (i.e. " 95 % confidence level"), $k\alpha = 1.96$, the term $p (1-p)$ is maximum for $p = 0.5$

Then the formula becomes:

$$n = 0.9604/e^2$$

Thus, to achieve a maximum error of 0.05 (5%) in the estimation of proportion,

$n = 0.9604/(0.05)^2 = 384$. Therefore, a minimum sample size of 384 households is required

Description of study area and sampling methodology

Wassit government is bordered by the governorates of Missan and Thi-Qar to the south, Qadissiya and Babylon to the west, and Baghdad and Diyala in the north. The eastern side of the governorate coincides with Iraq-Iran border. It is composed of five major geographical zones, of which Al-Kut is the most heavily populated. The governorate has an overall population density of 59.3 capita/km² [13].

The city of Al-Kut is located in the northern part of the governorate (figure 1). The population is approximately 315,377 according to the 2007 estimates [10].

The entire area is served by one sanitary landfill, which has been operated by Wassit Municipality Directorate.

Methodology

Quantity and composition were measured in order to be used as new MSW management plan; the sampling program was based on Random Uniform Sampling.

560 samples were collected and analyzed per week for 7 months, i.e. a week in each month for the period from January to July 2009, following a rolling schedule based on days of the week, i.e., starting with Monday in the

first week, in the first month, Tuesday in the second week, in the second month and so on. Samples were taken from high-economic² level representing 20% of the incoming amount a day, from middle-economic level representing 35% of the incoming amount a day, and from low-economic level representing 45% of the incoming amount a day (figure 2).

Based on these percentages, out of 560 samples per week, 80 samples were collected daily, there were 16 residences with high income, 28 residences with middle income, and 36 residences with low income levels. On each sampling day, from 08.30 am to 12.00 pm in evenly distributed intervals, 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. Bulky objects, hazardous wastes and special waste, such as hospital waste, chemicals, sewage sludge, debris, etc.

² 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, quarters of middle income levels are those of families living in flats, and quarters of low income levels are those families living in low-cost houses.

were excluded. It has been found that the average generation rates of residential solid waste for different-economic categories are as follows (figure 3):

High-income: 0.64 Kg/capita/ day,
middle-income: 0.61 kg/capita/ day,
and low-income: 0.45 kg/capita/ day,
mean average generation rate
= $0.64 \times 0.20 + 0.61 \times 0.35 + 0.43 \times 0.45 =$
0.535 kg/capita/d

Solid waste composition

A total sample of 1 m³ was compiled, and thoroughly mixed before the final representative waste sample was taken. The representative waste sample was then placed into a 1 m³ bucket and any material sticking out side of the bucket was removed. The remaining materials in the bucket were hand sorted into the main categories, weighing them to find their percentages. Table (1) and figure 4 give the break-down of the basic nine components of solid waste for different socio-economic levels and the overall range composition for Al-Kut municipal solid waste namely, food, paper, metals, glass, plastics, rubber, textile, miscellaneous combustible materials and miscellaneous non combustible materials. Those components are the major constituents of the residential solid waste [14].

Organic waste percentages ranges (67.74 - 72.31%) such as food and yard wastes represent the highest percentages. The lower percentages of the composition recorded are rubber, glass, and paper wastes (0.66-0.87) %, (1.39-2.90) %, and (2.53-3.87) % respectively.

Conclusions

Still very little data is available regarding the waste management situation in Al-Kut City. Even if such data was available and accurate, the expected changes in the coming years are so drastic when compared with the past years that any estimate should be adopted with caution and regularly updated.

The per capita waste generation is 0.535 kg./person/day as a mean value for the different socio levels in the city. It seems to be slightly lower than that of the earlier studies conducted in other Iraqi cities. The low per capita waste generation may be due to the increase in household sorting of paper and bottles at the point of generation since they are easily sellable. The per capita waste generation is found to be the lowest in the low-economic level and highest in the high-economic level, which may be attributed to the household sorting of waste more intensively in the low-income society than in other zones. This may also be true because in this poor zones people have been facing the waste problem since a long time and thus managing their wastes mostly by throwing it on the streets, burying or burning on their land whereas the high and middle zone people have open space and have no problem of waste disposal. Thus, as there are more open space people usually generate more and vice versa. For reasons of public health, people living in illegal settlements and slums are not entirely ignored but service levels are considerably lower in terms

of availability of waste bins and frequency of collection.

Al-Kut City household waste stream has a higher percentage of organic wastes (67.74-72.3) found as food and yard waste percentages. The lower composition percentage recorded is rubber, glass and paper wastes (0.66-0.86%), (1.39-2.90) % and (2.53-3.87) % respectively.

Yet people are not much aware of the environmental problems and safe disposal of the waste. It still shows that the households of Al-Kut have the feeling of NIMBAY (i.e. not in my backyard), where most of the city people do not know where the collected waste is disposed. People are conscious regarding the waste problem within their compound but they do not care where and how the waste is disposed, and even if they know about the disposal place of the collected waste, they do not know whether the disposal practice is environmentally safe or not.

Suggestions

Most households feel that the lack of stiff penalty and non-execution of law is the basic problem for the effective management of waste. Thus, provision of strong penalties and effective execution of the law will be the major tool to reduce the problem of solid waste management in Al-Kut or in any other city in Iraq.

It is found that environmental awareness is very low among the residents, stringent regulations with environmental awareness programs for household sorting and composting can reduce the volume and quantity of

waste for land filling. It could be suggested that a fee be charged as per the electricity or water bill to the households to cover the costs. At the initial stage, only regular direct cost should be covered by the charge and fixed cost as well as environmental costs should be subsidized. After the successful implementation of this scheme then only full cost pricing of the solid waste generation should be initiated and this will be the only sustainable way for the better management of waste of Al-Kut City as well as other Iraqi cities.

Recycling and reutilization of waste materials is one good answer not only to the growing waste disposal and pollution problems but also to improved conservation and resource utilization efficiency. Our current technology in solid waste management remains primitive. There is a need to develop new or improved ways for the handling and reuse of waste materials.

Abbreviations and acronym

COSIT: Central Organization of Statistics and Information Technology.

MMPW: Ministry of Municipality and Public Works.

MPDC: Ministry of Planning and Development Cooperation.

UNDP: United Nations Development Programs.

MSW: Municipal Solid Waste.

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Table 1 Physical composition of solid waste in Al-Kut City in Percentages

Waste component	Percent by weight			Average %
	Low	Middle	High	
Food waste	67.74	72.31	71.09	70.38
Plastics	4.24	4.58	3.74	4.19
Metals	1.60	2.94	2.78	2.44
Glass	1.39	2.90	2.67	2.32
Paper	2.53	3.69	3.87	3.36
Rubber	0.87	0.66	0.67	0.73
Textiles	6.36	5.76	8.14	6.75
Combustible materials	1.46	1.45	2.33	1.75
Noncombustible materials	13.81	5.71	4.71	8.08
Total	100	100	100	100



Figure 1 Study area in Wassit governorate

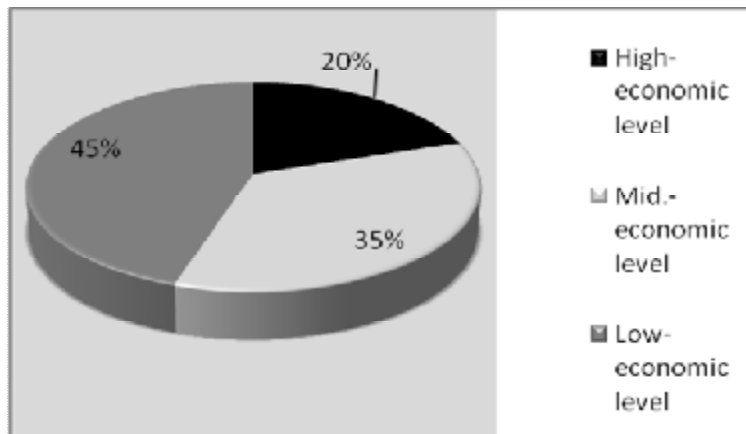


Figure 2 Income levels percentages in Al-Kut City

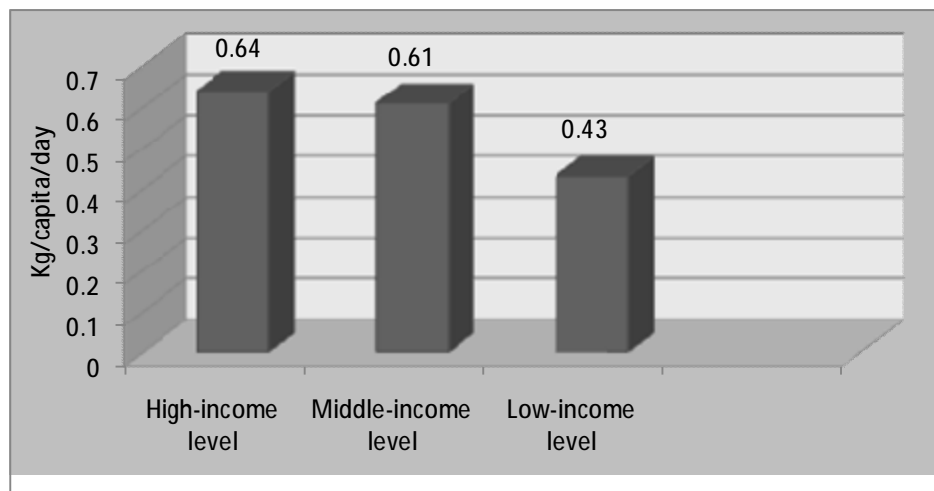


Figure 3 Generation rates of solid waste for different -income levels

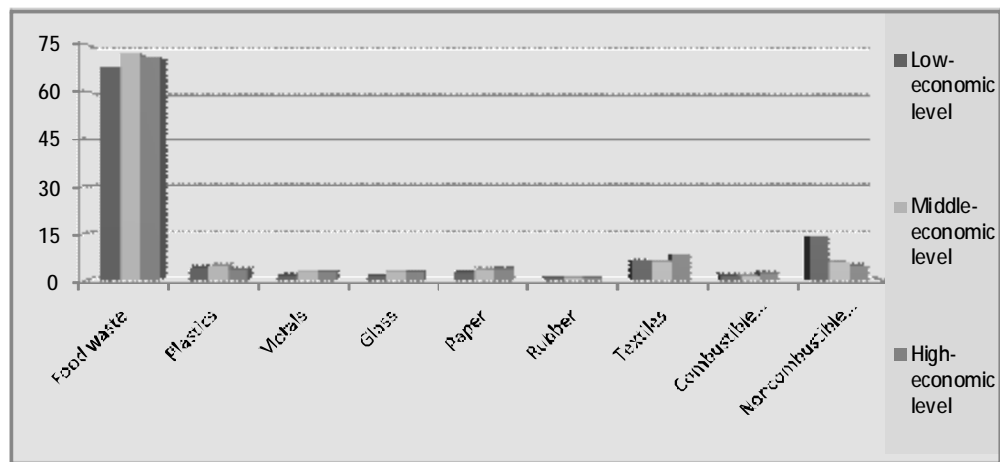


Figure 4 the break-down of the basic nine components of solid waste for different socio-economic levels in Al-Kut City.