

Urban Households Solid Waste Generated and Characteristics: The case of Shah Alam City Hall, Selangor

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INFORMASI ARTIKEL

Abstract: The world's population growth, increasing urbanization and rising standards of living are some of the factors influencing waste generation in Malaysia. A self-administered questionnaire was used to collect primary data of the randomly selected 100 households. These households were provided with five (5) polythene bags to separate their daily wastes during the period of fourteen (14) days. The researcher visits each household in the evening to collect the polythene bags. A sample size, adequate to estimate the value with adequate precision was calculated from three residential neighbourhoods (low, medium and high cost). The rate of waste generated from recyclable items are 45.51% (1,201.61 kg), followed by food wastes with 33.98% (897.18 kg) and non-recyclable items with 20.51% (541.54 kg). Therefore, the aim of this paper is to understand the waste generation and waste composition in relation to the willingness of the households and the objective are (i) to establish the nature of the waste generation and composition per/day; and (ii) to identify the current stakeholders involved in a recycling material. The results clearly show that 96% of respondents are willing to participate in any program for waste minimisation. This also indirectly indicates the lifestyle of the household.

Keywords: Solid Waste Generated; Solid Waste Composition; Socioeconomic; Households;

Abstrak: Pertumbuhan populasi dunia, meningkatnya urbanisasi, dan meningkatnya standar hidup adalah beberapa faktor yang mempengaruhi timbunan sampah di Malaysia. Kuesioner yang dikelola sendiri digunakan untuk mengumpulkan data primer dari 100 rumah tangga yang dipilih secara acak. Rumah tangga ini diberikan lima (5) kantong plastik untuk memisahkan limbah harian mereka selama empat belas (14) hari. Peneliti mengunjungi setiap rumah di malam hari untuk mengambil tas plastik. Ukuran sampel, cukup untuk memperkirakan nilai dengan presisi yang memadai dihitung dari tiga lingkungan perumahan (biaya rendah, sedang dan tinggi). Tingkat limbah yang dihasilkan dari barang yang dapat didaur ulang adalah 45,51% (1,201.61 kg), diikuti oleh limbah makanan dengan 33,98% (897,18 kg) dan barang yang tidak dapat didaur ulang dengan 20,51% (541,54 kg). Oleh karena itu, tujuan dari makalah ini adalah untuk memahami timbunan sampah dan komposisi limbah sehubungan dengan kemauan rumah tangga dan tujuannya adalah (i) untuk menetapkan sifat timbunan dan komposisi limbah per / hari; dan (ii) untuk mengidentifikasi pemangku kepentingan saat ini yang terlibat dalam bahan daur ulang. Hasilnya jelas menunjukkan bahwa 96% responden bersedia berpartisipasi dalam program apa pun untuk meminimalkan limbah. Ini juga secara tidak langsung mengindikasikan gaya hidup rumah tangga.

Kata Kunci: Sampah yang Dihasilkan; Komposisi Sampah; Sosial Ekonomi; Rumah Tangga;

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INTRODUCTION

Wastes are rejected or undesirable materials arising from human and animal activities. Waste can be categorized as solid and liquid wastes. Solid waste is any solid garbage that can be classified in terms of organic, inorganic wastes, special wastes and hazardous wastes. On the other hand, liquid waste is any unused water (UNICEF, 2006). Wastes generation are the amount/weight/volume of materials or products that enter a waste stream before recycling, composting, incinerating and landfilling. Waste generation is associated with our day-to-day activities because of rapid population growth, increasing urbanisation, fast development of infrastructure, changing lifestyle and economic conditions. Solid waste management of these waste generated is a main problem for the concerned authorities all over the world.

Solid waste minimisation is one way or effort to reduce waste generation. Each country tries to minimise the amount of waste going to the landfill due to environmental, health, financial, and lack of available land issues. Most developed countries have succeeded in applying this method, while many developing countries are moving towards it. Waste minimisation is the process of reducing the amount of waste produced by humans (person or a society) and animals. The waste minimisation hierarchy is fundamental to any waste minimisation methodology. Solid Waste Management (SWM) is a serious problem or challenge to local government authorities in many countries. The total quantity of municipal solid waste generated in Malaysia will increase from 12.8 million tonnes of waste per year in 2015 to 15.6 million tonnes in year 2020, (Harian Metro, 2016). Currently, generation of solid waste per capita in Malaysia is about 1.1 kg/day, (Kamaruddin, M. A., 2017). Therefore, this study attempts to identify the waste generation and wastes composition of household level in Shah Alam City Hall, Selangor. This study provides new insights on the role of various socioeconomic parameters on waste generation and composition to improve the solid waste systems.

Solid Waste Generated & Composition

Solid waste is the term used to refer to materials that have been rejected and need to be removed; this is an unavoidable daily routine. However, solid waste management is a major issue in the world, and the need to increase solid waste minimisation has become a challenge to both governments and local authorities. Municipal solid waste (MSW) is usually considered to include all solid wastes generated by the households with the exclusion of agricultural and industrial wastes (Tchobanoglous et al., 1993). MSW, also known as urban solid waste, refers to waste that comprises primarily waste from residential or domestic sources (EPA, 2002) with the addition of commercial wastes, construction and demolition debris, and waste from streets collected by a municipality (see Table 1). The most basic features to be noted in SWM studies are the solid waste generated, the sources of wastes, and the SWM systems. If the SWM fails to be implemented, especially in SWM systems and solid waste minimisation, therefore, it will be more difficult to achieve a good quality of environment and health. The sources of MSW are as follows:-

Table 1. Sources of Solid Waste Generation

No	Sources of Waste	Typical Waste Generators	Types of Solid Waste
1.	Domestic sources a. Residential/ Household	Single and multi-family homes, apartments, bungalow, terrace, semi-detached, cluster house, etc.	Organic wastes, organic wastes, special wastes and hazardous wastes.

	b. Commercial	Shop house, shop office, hotels, restaurants, shopping complex, office buildings, stores, markets, private schools.	
2.	Institutional	Universities, schools, prisons, government centres, hospitals, etc.	Organic waste, special waste and hazardous waste.
3.	Municipal	Landscaping, open spaces, playgrounds, alleys, street cleaning, beaches, parks, water and wastewater treatment plant sites, roadside litter, vacant lots, treatment plant sites, other recreational areas, etc.	Street cleaning, garden waste (landscape and tree trimmings), general waste from parks, beaches and other recreational areas.
4.	Agricultural	Farms, orchards, field and row crops, feedlots, vineyards, dairies, etc.	Organic waste (spoil food wastes), garden waste (agricultural waste), hazardous waste (pesticides)
5.	Construction & Demolition	Renovation sites, broken pavements, new construction sites, demolition of buildings, road repair, etc.	Organic waste (wood), special waste (metal and inert material).
6.	Industrial	Construction sites, refineries, manufacturing, fabrication, mineral extraction and processing, power and chemical plants.	Industrial process wastes, scrap materials, off-specification products, slay tailings.

Source: Compiled from Kreith and Tchobanoglous (2002), Soncuya and Viloría (1992), Pichtel (2005), EASUR (1999).

Focus of this study is primarily on household wastes that are generated in residential areas within multi-family and single-family houses. Household waste is generally defined as the waste generated from household activities (Dahlen and Lagerkvist, 2010), and it includes four types: kitchen waste, garden waste, bulky waste, and hazardous waste (Christensen, 2011). However, F. Kreith & G.Tchobanoglous, (2002); Soncuya & Viloría, (1992); K. Sasikumar & S. G. Krishna, (2009); J. Pichtel, (2005) stated that household wastes also can be categorized into organic wastes, inorganic wastes, special wastes and hazardous wastes.

In the municipal solid waste stream, paper and paperboard are the largest component after organic and food wastes. The rest of the components are plastic, glass, rubber, aluminium, metals and others. The details of the waste characteristics at residential area are given in Table 2.

Table 2. Characteristics of Wastes at Housing Area in Municipal Solid Waste Stream

No	Types of Waste	Wastes Component
a)	Organic wastes	
i.	<u>Composting/Biodegradable waste</u>	
1	Food	Vegetables and fruit discards and peeling, egg shells, spoiled food and bread, meat and fish bones, etc.
ii.	<u>Recyclable/non-biodegradable waste</u>	
1	Paper	Newspapers, books, comics, magazines, office papers directories, wrapping paper, paper bags, paper towels, writing paper, cigarette packages, paper plates and cups and other non-packaging paper.
2	Plastic	Trash bags, plastic plates and cups, toys, wraps, sacks, other plastic packaging, bottle etc.
3	Rubber and leather	Rubber tyres, leather shoes, handbags, carpets etc.

No	Types of Waste	Wastes Component
a) Organic wastes		
4	Textiles	Clothes, rags, carpets, hats, other fabrics
5	Wood	Lumber, plywood boxes, furniture and cabinets, toys, tree branches, coal, coke, etc.
6	Yard wastes	Grass clippings, flowers, plants, leaves, tree and brush trimmings, etc.
iii. Non-Recyclable/residual waste		
1	Plastic	Sanitary napkins, disposable diapers.
b) Inorganic wastes		
i. Recyclable/non-biodegradable waste		
1	Glass	Bottles, jars, broken glass, beer and soft drinks, food products etc.
2	Aluminium cans	Soft drink cans, food and other aluminium cans.
3	Bulky wastes	Furniture, refrigerators, stoves (can use any part of it), etc.
c) Special wastes		
1	Petroleum products	Oil, grease, etc
2	Metals	Wire, auto parts, iron, steel, etc
3	Inert material	Rocks, stones, ceramics, bricks, sand, dirt, ashes, cinder.
d) Hazardous wastes		
1	Hazardous wastes	Batteries, chemicals, pesticides, paints, thinners, spray canisters, tires, worn-out/broken radios, stereos, and TV, etc.

Source: F. Kreith & G. Tchobanoglous, (2002); Soncuya & Vilorio, (1992); K. Sasikumar & S. G. Krishna, (2009); J. Pichtel, (2005).

The quantity of waste generated in Selangor has been increasing every year because of the increase in the population and urban urbanisation. Table 2.3 shows that Selangor generated the highest amount of solid waste. According to MHLG (2010), Selangor state showed the greatest increase as the quantity of municipal solid waste increased from 2,827 tons per day in 2000 up to 3,904 tons per day in 2009.

Table 3. Solid Waste Generation in Peninsular Malaysia

States	Solid waste generated (tons/ day)					
	2000	2002	2004	2006	2008	2009
Johor	1,915	2,093	2,255	2,430	2,578	2,655
Kedah	1,324	1,447	1,559	1,680	1,782	1,835
Kelantan	1,034	1,131	1,213	1,302	1,382	1,423
Melaka	515	563	605	650	690	711
N. Sembilan	757	828	890	957	1,015	1,046
Pahang	957	1,046	1,125	1,210	1,284	1,322
Perak	1,527	1,669	1,795	1,930	2,048	2,109
Perlis	196	214	230	247	262	270

States	Solid waste generated (tons/ day)					
	2000	2002	2004	2006	2008	2009
Pulau Pinang	1,088	1,189	1,278	1,375	1,458	1,502
Selangor	2,827	3,090	3,322	3,573	3,790	3,904
Terengganu	883	965	1,038	1,116	1184	1,219
Kuala Lumpur	2,520	2,755	3,025	3322	3,525	3,631
Malaysia	15,587	21,452	23,073	24,969	26,489	27,284

Source: Compiled from Ministry of Housing and Local Government (2010); Agamuthu and Hamid (2011); Johari et al. (2014).

Thus, Selangor generated the highest amount of solid waste among of all states in Malaysia, and Shah Alam City is an urban area and is actively developing. Sections 1 – 14 are the Central Zone in Shah Alam and represent a residential area within the city. These areas have various facilities and a variety of housing types (low, medium, high cost) and so were considered a suitable area for study to achieve the objectives of the research. Therefore, study of the solid waste generation and solid waste composition is necessary to give policy makers and every sector involved in environmental management a better view of the state in Shah Alam, Malaysian.

RESEARCH METHOD

Shah Alam City is the capital state of Selangor Darul Ehsan, Malaysia. Shah Alam City becomes the fastest growing district in Selangor. The city is the seventh city of Malaysia that has been inaugurated in 2000. Shah Alam is also the nearest city to Kuala Lumpur city. 100 households were chosen to participate in the household waste generation and composition analysis. These households were provided with five (5) polythene bags to separate their daily wastes during the period of fourteen (14) days. The researcher visits each household in the evening to collect the polythene bags. A token gift was given to all respondents to encourage household participation. A sample size, adequate to estimate the value with adequate precision was calculated from three residential neighbourhoods (low, medium and high cost). In each of the neighbourhoods, around 33 to 34 households were surveyed.



Figure 1. Malaysia MAP

The respondent for the survey were selected by probability sampling method (Wayne, 1978) assuming 50 percent probability of community awareness and participation with 95 percent confidence interval and a margin error of 5 percent. Daily measurement of waste generated per household was recorded in a form. Mode of solid waste disposal at the household

level is primarily discussed among the variables. Although the study covered solid waste generation and composition, focusing on households. The limitation of this study is covering the small sample size and one-time sampling of households may provide an inaccurate average value on waste generation and composition for Shah Alam City Hall, Selangor. The data on waste quantities were analysed using Microsoft Spreadsheet EXCEL to determine trends, averages, median values, and overall quantities for the households. Due to the small nature of the sample set, no extensive statistical analyses were undertaken.

RESULTS & DISCUSSION

All the respondents were adults with mean age of 49.8 years and male to female ratio of was 0.86 :1.14. In all, 7 which indicates more availability of man in and around their houses. Most (96 percent) of the respondents were either married, single father and mother with an average family size of about 4.00 percent. Among the respondents, 60 and 20 percent were Malay followers, respectively, while 20 percent were Chinese and Indian. Respondents were categorized as professional, semi-professional, labourer, self-employment, housewife and not working with the proportion of 35, 36, 1, 12, 4 and 12 percent, respectively. Majority of the respondents (41 percent) reported their monthly income up to RM 5,000.

Table 4. Socio-Demographic Information of Respondents

Socio-demographic Characteristics	Number	Percentage
Gender (n = 100)		
Male	57	57.00
Female	43	43.00
Age (n = 100)		
35 - 44 years old	21	21.00
45 - 54 years old	60	60.00
> 55 years old	19	19.00
Race (n = 100)		
Malay	60	60.00
Chinese	20	20.00
Indian	20	20.00
Marriage Status (n = 100)		
Married	96	96.00
Single Mother or Father	4	4.00
Occupation (n = 100)		
Professional	35	35.00
Semi-Professional	36	36.00
Labourer	1	1.00
Self-Employed	12	12.00
Housewife		4 4.00
Not Working	12	12.00
Household Total Income (n = 100)		
RM 999 or less	12	12.00
RM 1,000 - RM 2,499	20	20.00

RM 2,500 - RM 4,999	27	27.00
RM 5,000 and above	41	41.00

The wastes generation rate was found in the present study which may be due to the lifestyle, economic status and habits of respondents and the development of the area. Waste generation further depends upon population density, economic development, proportion of urban population and consumption pattern (Vesilind et al., 2002). According to the Town Planning Department (MBSA) 2013 report, the estimated population of Shah Alam is 866,832 people. The waste generation rate in this city shows about 1.89 kg per household or 0.43 kg per capita per day respectively. In other words, about 372,737.76 kg of solid wastes are generated daily within the entire Shah Alam City region. The wastes are classified into three groups; recyclable materials 45.51% (1,201.61 kg), food wastes 33.98% (897.18 kg) and non-recyclable materials 20.51% (541.54 kg). Figure 4.1 shows the separation activity will increase solid waste minimisation because 80 percent of the waste materials can be recycled and composted. The government must take the initiative to increase solid waste minimisation in order to decrease the disposal site. The product designs that enable reusing, repairing or re-manufacturing will result in fewer products entering the waste stream.

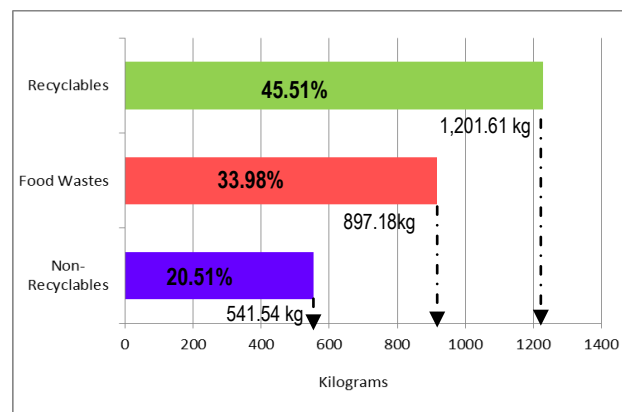


Figure 2. Solid Waste Generation

For the waste composition, the results in Figure 2. show that plastic (18.28%) is the main constituent among recyclable items, followed by paper (11.95%), glass (4.67%), textiles (3.91%), leather (2.23%), aluminum (2.15%), cooking oil (1.56%), and metal (0.76%). Non-recyclable or hazardous items constitute less than 0.51% while miscellaneous wastes accounted for about 20%. In this study, food wastes constitute about 33.98% of the total waste generated per household. According to Tchobanoglous *et al.*, (1993) large portion of solid wastes in developing countries is food waste. Likewise, wastes from urban areas in developing countries have a much higher percentage of food waste in their overall refuse mix (Neuman, K., 1982). In contrast, study area showed only 33.98% of generated food wastes and highly significant percentage of generated recyclables materials (45.51%) compared to the previous studies. The results of the waste composition are shown in Figure 3.

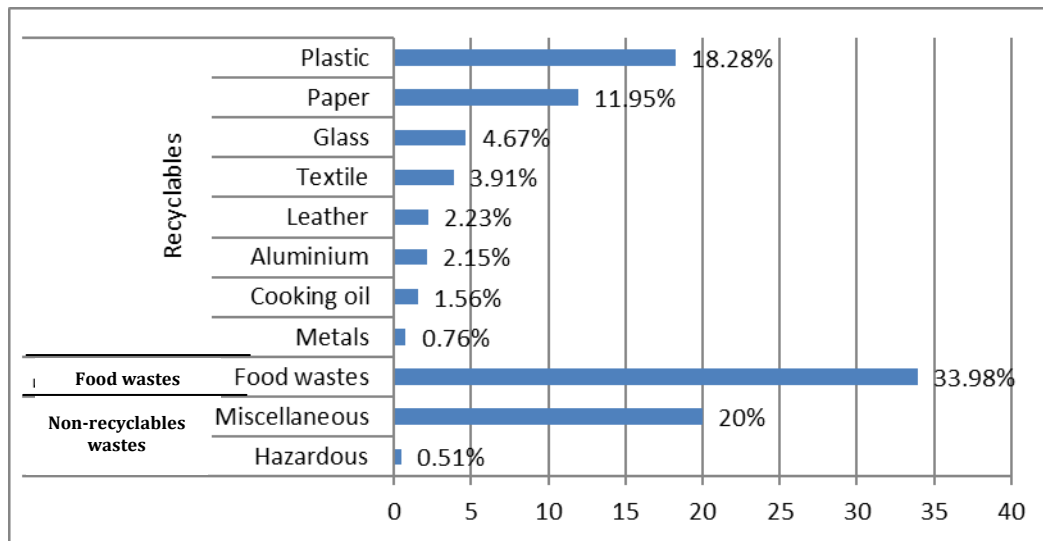


Figure 3. Percentage of Solid Waste Compositions

Whether the households deliver wastes to “drop-off” centers (recycling bins) or receive deposit money when bottles and cans are returned to junkshops or itinerant waste buyers, chances are that the households have already begun recycling. Instead, they separate plastics, aluminum and other metals, papers, glasses, and even appliances. They take these materials to recovery facilities to begin the recycling process. There is a direct link between increased recycling and the creation of jobs in the local economy. Table 5 shows the categories of recyclable materials of eleven materials namely plastic, paper, glass, metals, leather, rubber, textile, aluminum, cooking oil, computer parts and car battery. However, not all of the recyclable materials will be collected by stakeholders as leather and rubber. Paper (100%), aluminum (86%), metals (71%), and plastic (57%) are in high demand from recycling stakeholders than the others. When being asked for the reasons, several junk shops and itinerant waste buyers stated that;

"These materials (textiles, leather and rubber) do not have any economic value because the recycling plants do not demand for such materials."

All stakeholders must take part in the creation of the complementary system. The household is the major roles in decision-making and waste management system, since the attainment of solid waste minimization is dependent on them.

Table 5. Recycling Materials Participation by Stakeholders

Waste Buyers/ Stakeholders	Recyclable materials										
	Plastic	Paper	Glass	Metals	Leather	Rubber	Textile	Aluminum	Cooking Oil	Computer Parts	Car Battery
Waste pickers		✓								✓	✓
Welfare Organizations		✓					✓				
Dump pickers	✓	✓		✓				✓			
Recycling	✓	✓	✓					✓			

Waste Buyers/ Stakeholders	Recyclable materials										
	Plastic	Paper	Glass	Metals	Leather	Rubber	Textile	Aluminum	Cooking Oil	Computer Parts	Car Battery
bins											
Junkshops		✓		✓				✓	✓		
Itinerant waste buyers	✓	✓	✓	✓				✓		✓	✓
Waste collectors	✓	✓		✓				✓			
NGO's	✓	✓	✓	✓			✓	✓	✓		
<i>Total take part by waste buyers</i>	57%	100%	43%	71%	-	-	29%	86%	29%	29%	29%



None of the stakeholders are taking part



Only a small number of stakeholders commit on collection

Generally, most respondents showed concern about solid waste generation issues, and all respondents (100%) were concerned about the environmental related issues such as improper waste storage and disposal of waste. Results clearly show that 96% of respondents are willing to participate in any programs which aimed at reducing, recycling, or composting of domestic garbage's. The respondents' view on the actions taken by local authority with respect to waste minimisation was sought during the field survey. Results show that about 36% of the respondents agreed that the local authority has been creating awareness on waste minimisation in the neighbourhood, while 26% stated otherwise, and 38% do not know.

Another aspect of the respondents' view on local authority's involvement in waste minimisation is the provision of facilities. Half of the respondents (57%) stated that the facilities provided by the local authority for waste minimisation in their neighbourhood are adequate, while 43% said the facilities are inadequate. When being further asked about the lacking of facilities in their neighbourhood, they mentioned that the recycle bins in their neighbourhood have damaged and have not yet been replaced. They also want a collection schedule and the strategically located collection points in the neighbourhood so that people will have good access to the waste bins.

There are few suggestions from respondents regarding ways to manage the waste. These include more enlightenment campaigns by the local authority on waste minimization (30%), more recycling bins provision (18%), proper waste collection schedule (13%), and advocating the need for organic and inorganic wastes separation before their final disposal (12%). Other suggestions made by the respondents include: cooperation of various stakeholders involved in waste management, enforcement by government and taking cue from other countries that have been successfully implemented waste minimisation activity.

CONCLUSION AND RECOMMENDATION

Based on the solid waste's generation and characterisation in site area, the following conclusions were drawn: Compared to household, the waste generation rate among households is quite high, 1.89 kg per household or 0.43 kg per capita per day respectively. Major component of the waste stream from the households are organics, 33.98% (897.18 kg) which can be used as source of compost to fertilize the landscape in study area; and Shah Alam City Hall waste stream consists of many recyclables 45.51% (1,201.61 kg), which can either be sold

to any stakeholders for additional income.

This study has been able to provide an idea about urban solid waste minimisation in Shah Alam City Hall, Selangor. People in Shah Alam area would like to cooperate and participate in a proper waste management system. Therefore, their involvement in the development and implementation of waste management system should be encouraged by local authority. Also, it was found that further commitment of the government is required in implementing more proper facilities and sensitisation of the public in the area. Furthermore, it will be very effective if the private sector collaborates with the government to identify ways of achieving a sustainable waste minimisation strategy. This could be done by injecting new ideas into the whole process of waste management, starting from the phase of collection, separation, recycling up to final disposal.

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