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The perception of households about solid waste management issues in Malaysia

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Abstract With the aim being to have an integrated and efficient management system, Malaysia is currently facing a remarkable waste issue with a massive increase in waste generated per day. This study collected 400 survey responses to assess the satisfaction and awareness of households about various issues of solid waste management. This study revealed that the majority of the respondents were satisfied with their waste management services. However, there was concern about providing a more diverse waste management facility. This study found a strong positive relationship between age and waste reduction behaviours. The majority of the respondents agreed that their lifestyle affected waste minimisation. Almost half of the respondents indicated that they lacked knowledge to practise waste sorting. Age and education were positively correlated to reuse and recycling behaviours. Overall, a holistic waste management education is vital for Malaysia to build an efficient waste management system.

Keywords Solid waste management · Waste reduction · Waste sorting · Recycling

1 Introduction

Solid waste management is a major challenge in urban areas throughout the world. Without an effective and efficient solid waste management programme, the waste generated from various human activities can result in health hazards and be harmful to the environment (Asian Productivity Organization 2007). In Malaysia, the waste generated per day is almost 30,000 tonnes, and the rate is increasing at 3 % annually. Malaysians produced 33,000 tonnes of solid waste daily in 2012, which exceeded the projected production of 30,000 tonnes in 2020

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(Borneo Post Online 2013). Given the considerable waste issue, the solid waste management in Malaysia is still in the initial stage. The techniques, facilities and treatment of waste management are developing slowly. The improper waste management has led to various types of pollution and health issues. The issue of poor solid waste management has become a challenge for governments of developing countries in Asia and Africa (Zia and Devadas 2008) because it is critical for the protection of public health, safety and the environment. Piles of waste left uncollected in the streets, blocking drainage channels or dumped in watercourses are a major cause of public health risks to those living nearby (Shahjahan 2010).

The state and local government authorities have been traditionally responsible for solid waste management services. Due to the lack of infrastructure, financial, operational and technical resources, it has lead to an inadequate and inefficient level of provision at various levels of the waste hierarchy. Therefore, privatisation of solid waste management was initiated in 1996 with the goal of attaining an integrated, efficient and technologically advanced management system capable of enhancing environmental quality through resource recovery and waste minimisation without affecting the welfare of the public. Under the privatisation plan, the country is divided into four zones to be managed by four consortia with 20-year concessions. The consortia are responsible for infrastructure and related solid waste management services such as collection, storage, transportation, treatment, the 3R's (reduce, reuse and recycle) and public awareness. The Solid Waste and Public Cleansing Management Act 2007 (Act 672) was passed by parliament. The Enforcement of Act 672 and full privatisation were implemented in 2011.

Historically, countries have adopted a non-sustainable approach to manage waste by burying it in the ground (Joseph 2006); such an approach has also been used by Malaysia. In the effort to manage waste in a sustainable manner, the Malaysian government is targeting to achieve a 40 % waste reduction to landfill and a 38 % reduction of greenhouse gas from solid waste disposal by 2020. Currently, 80 % of waste treatment methods in Malaysia are open dumping and landfill (Ngoc 2009). With the current pace of development in urban areas, suitable landfill sites are becoming more limited. The poor management of sanitary landfills has also resulted in negative health effects, as evidenced by the incidence of a contaminated water treatment plant caused by a nearby sanitary landfill (Pek and Jamal 2011). How far has the privatisation plan achieved its goal? Are Malaysians satisfied with the current solid waste management system and the support of the efficient solid waste management facilities?

According to Alexis and James (2009), government policy and finances; waste characterisation, collection and segregation; household education and economics; municipal solid waste management administration, planning and personnel education; local recycled-material market; technological and human resources and land availability are the factors that influence the recycling of municipal solid waste in developing countries. The study also found that waste collection and segregation, the municipal solid waste management plan and local recycled-material market were those requiring the greatest collaboration with other factors. A survey conducted by Rafia and Muhammad (2011) found that households were not aware of the benefits of recycling and waste separation. With the low number of households willing to separate their wastes in Kuala Lumpur, questions arise concerning whether Malaysians are prepared for waste minimisation, waste sorting and recycling.

Traditionally, all waste produced by humans was composed of biodegradable substances and hence a useful material for nature. Although developing civilisations discovered new materials, not known to the biosphere, however the range of negative impact to the nature was very limited (Andrzej and Arkadiusz 2012). Nowadays, human civilisation can obtain a variety of non-biodegradable chemical compounds. These should be returned to the economy to be used again in the production process rather than being thrown away

and deposited in landfills. In Malaysia, at least 61.17 % of municipal solid waste is made up of biomass materials—food, paper and wood. Food/organic makes up 37.43 %, paper (mixed paper, news print, high grade paper and corrugated paper) is 16.78 %, and wood and grass are 6.96 % (Johari et al. 2012). This means that around 40 % of municipal solid waste is made up of non-biodegradable chemical compounds. Moreover, various packaging materials and packaging technologies such as corrugated fibreboard, paper pulp, glass and plastics are available for use. Among these, plastics are the most versatile, which should be returned to the economy to be used again. The production of synthetic polymers has increased more than 100 times since the 1970s (Dongsu et al. 2002). Although polypropylene and polystyrene are widely used by households, there is a lack of knowledge concerning the disposal methods available after use. Are Malaysians aware of bio-degradable plastic bags? Do Malaysians use bio-degradable plastic bags?

The Klang Valley is located in the central regions of Malaysia. It comprises Kuala Lumpur and its suburbs and adjoining cities and towns Klang, Petaling, Gombak and Hulu Langat in the State of Selangor. It is the heartland of Malaysia's industry and commerce. In 2010, its population was about 6.6 million with an average growth rate of 1.7 % per annum. About 20 % of Malaysia's total population lives in the Klang Valley. It is home to large number of migrants from other states within Malaysia and foreign workers who are mainly from Indonesia, Bangladesh, India and Nepal. As Malaysia is moving towards becoming a developed country, the total population in the Klang Valley continues to increase dramatically, and hence, it is expected to have a massive amount of waste in the future. In 2010, the quantity of wastes produced in the Klang Valley and Selangor was about 6000 metric tonnes daily (The Star Online 2010). Therefore, efficient solid waste management is necessary. There is an urgent need to improve the current techniques and facilities for waste management and treatment as well as to increase public awareness concerning waste minimisation, waste sorting and recycling.

The study aims to assess the household level of satisfaction and behaviour on various issues of solid waste management. One study conducted by Shigeru in Japan (2011) revealed that the characteristics of households determine their recycling behaviour and that sociodemographic conditions vary across municipalities, therefore, different municipalities should adopt different recycling programmes. According to Emery et al. (2003), socio-economic status and housing characteristics affect not only the amount of municipal waste but also how they manage it. Therefore, it is crucial to understand the characteristics and needs of various households in designing a suitable waste management programme. Obviously, no uniform solution can be adopted to address all waste management requirements in the diverse service environment today. This study provides an overall picture concerning the current performance of solid waste management and household characteristics and awareness pertaining to various waste issues in the Klang Valley. The findings are crucial for the waste authorities in the process of designing and providing an effective and specific action plan for the Klang Valley.

2 Research methods

2.1 Questionnaire design

A survey approach was used in this study by sending 400 questionnaires directly to the targeted respondents in the Klang Valley. The questionnaire is divided into five parts. The

first part consists of questions related to the demographic variables. The second part consists of the factors that are relevant to waste management services and facilities. The remaining parts solicit the respondents' attitudes, behaviours and actions towards waste reduction, waste sorting and recycling. The questionnaires were randomly distributed to the respondents personally. A pilot test was conducted with 30 respondents drawn from the sample in the study. The feedback from the pilot testing required minor amendments to the questionnaire.

2.2 Statistical analyses

To assess the household level of satisfaction and awareness on solid waste management services and facilities, frequency analysis and factor analysis were employed. The core criterion that determined the household's satisfaction on solid waste management services and facilities was subsequently finalised. Logistic regression was used to determine the strength of the association between factors, in this study, for example, if age group could be used to predict the reuse or recycle behaviour of the respondents (1 = "Yes", 0 = "No"). The Chi-square test of independence was also used to evaluate group differences when the test variable was nominal, dichotomous, ordinal, or grouped interval. For example, in this survey, waste reduction behaviour might be different due to gender. A Chi-square test for independence could be used to determine whether gender is related to waste reduction behaviour.

3 Empirical results

3.1 Respondents' profile

Out of the 400 completed questionnaires, about 46 % were male and 54 % were female. The respondents who participated in this survey were generally 30 years old and below (66 %) and earned <RM3,000 or US$729 per month (65.8 %). The majority of the respondents (44.7 %) had at least obtained a degree. For the accommodation, about 40 % of respondents lived in a flat/apartment/condominium, 37.8 % lived in a terrace house, and the remaining 22.3 % lived in a townhouse/semi-D/bungalow. The details are provided in Table 1.

3.2 Awareness and satisfaction levels on waste management services and facilities

One of the questions in the survey was designed to gauge the level of awareness on waste management. The majority (68 %) were "aware" of waste management. Two of the questions in the survey were designed to gauge the level of satisfaction that respondents had with their waste management services and facilities. About three-fifths (58 %) of the respondents were "satisfied" with their waste management service, while the majority (70 %) were "satisfied" with their waste management facilities.

3.3 Factors affecting the satisfaction levels with the waste management services and facilities

The survey also sought to determine the reasons for the satisfaction or dissatisfaction with the waste management services and facilities. A total of 15 items and 16 items related to

Table 1 Demographic background of respondents

Characteristics	Freq.	%	Characteristics	Freq.	%
Gender			Age group		
Male	185	46.3	<30	264	66.0
Female	215	53.8	31–40	82	20.5
			41 and above	54	13.5
Education level			Monthly income		
Primary/secondary school	121	30.3	≤RM3000	260	65.8
Colleges	100	25.0	RM3001–RM4500	90	22.8
Degree and above	179	44.7	RM4501–RM6000	26	6.6
			RM6001 and above	19	4.8
Dwelling types					
Flat/apartment/condominium	160	40.0			
Terrace house	151	37.8			
Town house/Semi-D, Bungalow	89	22.3			

Freq. frequency

waste management services and waste management facilities, respectively, were designed, and the respondents were asked to rate their satisfaction or dissatisfaction with each of these items. Factor analysis was then conducted to select items with more than 0.50 loadings of rotated component matrix. For the waste management services, 11 items were summarised into three dimensions, namely attitude of garbage collectors, collection time and collection services provided. In addition, 10 items for waste management facilities were summarised into three dimensions: garbage collection vehicles, recycling facilities and public rubbish bins.

Table 2 reveals the Kaiser–Mayer–Olkin (KMO) measurement of sampling adequacy. The KMO values obtained for this survey were 0.836 and 0.845 for factors contributing towards satisfaction with waste management services and facilities, respectively. Given the significant Bartlett's tests at the 1 % significant level, one may conclude adequate sampling. Table 3 illustrates the rotated sum of squared loading results for satisfaction with waste management services and facilities.

The rotated component matrix in Tables 4 provides details concerning the satisfaction with waste management services and facilities, respectively. The attitude of garbage collectors, collection time and collection services provided is the three dimensions contributing to the satisfaction with the waste management services, while garbage collection vehicles, recycling facilities and public rubbish bins are the contributing dimensions affecting satisfaction with the waste management facilities.

Table 2 Kaiser–Mayer–Olkin (KMO) test and Bartlett's test of sphericity

	KMO measure of sampling adequacy (MSA)	Bartlett's test of sphericity
Waste management services	0.836	2151.461**
Waste management facilities	0.820	1552.462**

** Significant at 1 % level

Table 3 Rotation sums of squared loadings

	Eigenvalue	Cumulative variance explained (%)
Waste management services		
Attitude of garbage collectors	2.798	25.432
Collection time	2.564	48.738
Collection services provided	2.426	70.789
Waste management facilities		
Garbage collection vehicles	2.596	25.962
Recycling facilities	2.570	51.659
Public rubbish bins	1.609	67.752

3.4 Waste reduction (minimisation) behaviours

Waste reduction/minimisation is the process of reducing the amount of waste produced by a person or a society. This survey attempted to examine residents' waste reduction/minimisation behaviours—to bring their own plastic bag or recyclable bag when shopping. The survey results show that about half of the sample residents (54.3 %) practise waste reduction. In referring to Table 5, the result of the Chi-square test of independence suggested a significant association between the respondents who said they bring their own recyclable bag when shopping and their age ($\chi^2(2) = 16.243$, $p = 0.000$). The majority of respondents (76 %) aged 40 and above bring their own recyclable bag when shopping, compared to <50 % of the respondents aged below 30. The hypotheses that differences in waste reduction behaviours are related to differences in education ($\chi^2(2) = 5.408$, $p = 0.067$), differences in income level ($\chi^2(3) = 7.553$, $p = 0.056$), differences in gender ($\chi^2(1) = 2.196$, $p = 0.138$), differences in dwelling types ($\chi^2(2) = 4.480$, $p = 0.106$), however, are not supported at the 5 % significant level.

An analysis was performed to determine the reasons for practising waste reduction and the association with various demographic and housing characteristics. The result of a Chi-square test of independence suggested a significant association between respondents' reasons for practicing waste reduction and dwelling type ($\chi^2(2) = 9.205$, $p = 0.010$). More than 80 % of respondents who cited a "for environmental conservation" reason for practicing waste reduction live in a terrace house, while about 30 % of town house/semi-D/bungalow dwellers cited "follow the current trend" for doing so.

Residents who claimed that they do not practise waste minimisation were then asked to identify reasons for not doing so. Regardless of the socio-economic status and housing characteristics, approximately 60 % of residents responded that they "always forget", which deters them from practicing waste minimisation, while about 15 and 25 % of residents cited "do not have time" and "lazy to change" as a deterrent to practise waste minimisation, respectively. In referring to Table 6, the results of a Chi-square test of independence suggested a significant association between respondents' reasons for not practicing waste minimisation and gender ($\chi^2(2) = 10.846$, $p = 0.004$). It is interesting to note that about 30 % of male respondents claimed "lazy to change" for not practising waste minimisation, as against only 10 % of female respondents. The results of a Chi-square test of independence also suggested a marginal significant association between

Table 4 Loadings of the rotated component matrix for reasons contributing to the satisfaction on waste management services and facilities

Items	Waste management services		
	Attitude of garbage collectors	Collection time	Collection services provided
Garbage collectors are rude	0.818		
Garbage collectors are lazy and slow	0.839		
Garbage collectors simply throw my rubbish bin to everywhere	0.749		
Garbage collectors do not collect all the household wastes	0.712		
Collection time is uncertain		0.782	
Lack of information on collection time		0.768	
Frequency of collection is limited		0.647	
No extra collection services on public holiday such as Hari Raya		0.775	
No collection services on big size wastes likes furniture			0.760
No collection services on electronic wastes			0.885
No collection services on recyclable wastes			0.838

Items	Waste management facilities		
	Garbage collection vehicles	Recycling facilities	Public rubbish bins
Garbage collection vehicles are old, dirty and smelly	0.840		
Garbage collection vehicles do not have waste separation facilities	0.830		
No recycling facilities in my housing areas		0.814	
Recycling facilities are too far from my house		0.769	
Recycling facilities in my housing area is only limited to newspapers and related materials		0.679	
No recycling facilities on plastics, glasses and aluminium in my housing areas		0.784	
No public rubbish bin in my housing area			0.766
Public rubbish bin is too far from my housing area			0.738
No public rubbish bin for big size solid wastes			0.833
No public rubbish bin for big size electronic wastes			0.747

Table 5 Respondents' waste reduction behaviours

Bring their own plastic bag or recyclable bag when shopping:			
Category	Percentage (%)		χ^2 (p val.)
	Yes	No	
Gender			
Male	50.3	49.7	2.196 (0.138)
Female	57.7	42.3	
Age			
<30	47.7	52.3	16.243 (0.000)
31–40	61.0	39.0	
Above 40	75.9	24.1	
Education			
Primary/secondary	61.2	38.8	5.408 (0.067)
Pre-U/diploma	57.0	43.0	
Degree above	48.0	52.0	
Income			
<RM3000	51.2	48.8	70553 (0.056)
RM3001–RM4500	61.1	38.9	
RM4501–RM6000	73.1	26.9	
RM6001 above	42.1	57.9	
Dwelling type			
Flat/apartment/condominium	49.4	50.6	4.480 (0.106)
Terrace house	60.9	39.1	
Town house/semi-D/bungalow	51.7	48.3	

P value probability value

respondents' reasons for not practicing waste minimisation and dwelling type ($\chi^2(4) = 8.731$, $p = 0.068$) where approximately 25 % of dwellers from terrace houses said that they "do not have time" as the reason. There is, however, no significant relationship between their reasons for not practising waste minimisation and the remaining demographic characteristics.

3.5 Waste sorting behaviours

Waste sorting is the process by which waste is separated into different elements. This survey also sought to determine residents' waste sorting behaviours and the association between socio-economic status and dwelling type. The residents were asked if they sorted their household wastes according to recyclable waste and non-recyclable waste in their daily life. The survey results show that about 60 % of residents do not sort their household waste in their daily life. In referring to Table 7, the result of a Chi-square test of independence suggested a significant association between respondents who said they sorted their household waste according to recyclable waste and non-recyclable waste in their daily life and their gender at the 10 % significant level ($\chi^2(2) = 5.752$, $p = 0.056$). However, the hypotheses that differences in household waste sorting behaviour are related to differences in education, age, income and dwelling type are not supported even at the 10 % significant level.

Table 6 Reasons for and for not practicing waste reduction

Category	Reasons for practicing waste reduction				Reasons for not practicing waste reduction			
	Percentage (%)			χ^2 (p val.)[a]	Percentage (%)			χ^2 (p val.)
	EC	CT	Fun		NT	DK	Lazy	
Gender								
Male	68.8	24.7	6.5	1.854 (0.173)	15.9	54.5	29.5	10.846 (0.004)
Female	74.4	16.8	8.8		14.9	74.7	10.3	
Age								
<30	69	23.8	7.1	4.603 (0.100)	15.9	62.1	22	2.079 (0.721)
31–40	74.5	21.6	3.9		13.3	70	16.7	
Above 40	78	7.3	14.6		15.4	76.9	7.7	
Education								
Primary/secondary	66.7	24	9.3	1.458 (0.482)	13.6	63.6	22.7	4.295 (0.368)
Pre-U/diploma	70.2	19.3	10.5		23.3	65.1	11.6	
Degree above	77.9	17.4	4.7		12.5	64.8	22.7	
Income								
<RM3000	70.9	22.4	6.7	1.381 (0.710)	17.6	60.5	21.8	2.802 (0.591)[#]
RM3001–RM4500	74.1	16.7	9.3		11.1	75	13.9	
RM4501–RM6000	78.9	15.8	5.3		14.3	71.4	14.3	
RM6001 above	77.8	11.1	11.1		10	60	30	
Dwelling type								
Flat/apartment/condominium	69.1	24.7	6.2	9.205 (0.010)	13.5	70.3	16.2	8.731 (0.068)
Terrace house	83.7	12	4.3		24.1	58.6	17.2	
Town house/semi-D/bungalow	53.3	28.9	17.8		7	62.8	30.2	

EC environmental conservation, *CT* follow the current trend, *Fun* for fun/others, *NT* do not have time, *DK* do not know how to do, *Lazy* lazy to change/others

[#] Income RM6001 above is combined with RM4501-RM6000 due to the small number of respondents in that particular group for Chi-square χ^2computation

[a] Reason "for fun/others" is excluded from the Chi-square χ^2 computation

The residents were also asked if they separate their food waste in their daily life. The results indicate that only 30 % of residents separate their food waste in their daily life. The result of a Chi-square test of independence suggested a significant association between respondents who separate their food waste and their education level at the 5 % significant level ($\chi^2(2) = 8.315$, $p = 0.016$). Specifically, 40 % of residents with primary/secondary education level separate their daily food wastes while only approximately 25 % of residents who hold at least a degree do so. The hypotheses that differences in food waste separation are related to differences in gender, age, income and dwelling types are not supported even at the 10 % significant level.

In referring to Table 8, regarding the reasons for why residents sort their household wastes in their daily life, the survey results show that approximately two-thirds of respondents sort their household waste in their daily life due to "environmental conservation", 27.5 % of respondents sort their waste because they "follow the current trend",

Table 7 Attitudes on waste sorting: household waste and food waste separation

Category	Household waste sorting			Food waste separation		
	Percentage (%)		χ^2 (p val.)	Percentage (%)		χ^2 (p val.)
	Yes	No		Yes	No	
Gender						
Male	44.3	55.7	5.752 (0.056)	28.3	71.7	0.534 (0.465)
Female	42.3	57.7		31.6	68.4	
Age						
<30	39.0	61.0	0.162 (0.687)	27.7	72.3	3.682 (0.159)
31–40	52.4	47.6		30.9	69.1	
Above 40	50.0	50.0		40.7	59.3	
Education						
Primary/secondary	43.0	57.0	0.014 (0.993)	39.7	60.3	8.315 (0.016)
Pre-U/diploma	43.0	57.0		29.0	71.0	
Degree above	43.6	56.4		24.2	75.8	
Income						
<RM3000	43.5	56.5	0.879 (0.831)	33.5	66.5	4.223 (0.238)
RM3001–RM4500	40.0	60.0		22.2	77.8	
RM4501–RM6000	50.0	50.0		28.0	72.0	
RM6001 above	42.1	57.9		26.3	73.7	
Dwelling type						
Flat/apartment/condominium	40.6	59.4	0.814 (0.666)	30.0	70.0	5.708 (0.058)
Terrace house	44.4	55.6		24.7	75.3	
Town house/semi-D/bungalow	46.1	53.9		39.3	60.7	

while the remaining 5 % cited "just for fun" as the reason. Furthermore, the result of a Chi-square test of independence suggested a significant association between respondents' reasons for sorting their household waste in their daily life and dwelling type ($\chi^2(2) = 8.979$, $p = 0.011$). Specifically, about 45 % of town house/semi-D/bungalow dwellers claimed that they sort their household waste just because they "follow the current trend". The survey respondents were asked what they did after collecting recyclable waste. About 50 % of residents "send the waste to recycle centres/schools/NGOs", while the percentage of responses is roughly equal between "collected by schools/NGOs" and "sell to waste recycle companies" after collecting recyclable waste.

The survey also sought to determine the causes for not sorting household wastes in their daily life. Approximately 44 % of residents cited "do not know how to do" as deterring them from sorting daily household wastes, while about 34 and 22 % of residents claimed they "do not have time" and "lazy to change/others" for not sorting household waste. A significant association was found between the respondents' level of education and reasons for not sorting household waste ($\chi^2(4) = 14.982$, $p = 0.005$). Specifically, 28 % of residents with higher education level (degree and above) claimed that they do not sort their household waste as they are "lazy to change".

Next, the residents were asked to identify the reasons for practicing food waste separation in their daily life. The majority of residents (60 %) claimed that they separate their

Table 8 Reasons for and for not practicing waste sorting

Category	Reasons for practicing waste sorting				Reasons for not practicing waste sorting			
	Percentage (%)			χ^2 (p val.)[a]	Percentage (%)			χ^2 (p val.)
	EC	CT	Fun		NT	DK	Lazy	
Gender								
Male	67.1	28.0	4.9	0.016 (0.898)	33.7	43.2	23.2	2.259 (0.323)
Female	67.4	27.0	5.6		37.6	47.2	15.2	
Age								
<30	66.3	26.7	6.9	0.273 (0.872)	35.2	44.0	20.8	2.417 (0.660)
31–40	65.1	30.2	4.7		37.8	45.9	16.2	
Above 40	74.1	25.9	0.0		37.5	54.2	8.3	
Education								
Primary/secondary	66.0	30.0	4.0	4.997 (0.082)	33.3	52.2	14.5	14.982 (0.005)
Pre-U/diploma	53.5	37.2	9.3		35.7	57.1	7.1	
Degree above	75.6	20.5	3.8		37.9	33.7	28.4	
Income								
<RM3000	64.9	31.5	3.6	4.284 (0.117)[#]	31.0	46.2	22.8	12.668 (0.013)[#]
RM3001–RM4500	77.8	13.9	8.3		39.2	54.9	5.9	
RM4501–RM6000	69.2	15.4	15.4		53.8	38.5	7.7	
RM6001 above	37.5	62.5	0.0		55.6	0.0	44.4	
Dwelling type								
Flat/apartment/condominium	71.9	21.9	6.3	8.979 (0.011)	38.7	41.9	19.4	2.724 (0.605)
Terrace house	74.6	22.4	3.0		30.0	52.5	17.5	
Town house/semi-D/bungalow	47.5	45.0	7.5		35.9	40.4	19.1	

EC environmental conservation, *CT* follow the current trend, *Fun* for fun/others, *NT* do not have time, *DK* do not know how to do, *Lazy* lazy to change/others

[#] Income RM6001 above is combined with RM4501-RM6000 due to the small number of respondents in that particular group for Chi-square χ^2computation

[a] Reason "for fun/others" is excluded from the Chi-square χ^2 computation

food waste due to "environmental conservation", while the percentage of responses is equal between "follow the current trend" and "do not want to waste" for residents who separate their daily food waste. However, there is no significant relationship between their reasons for separating their daily food waste and all the examined demographic and housing characteristics. The residents in the survey were also asked to identify their action on the food waste collected. Approximately 75 % of residents used food waste "for planting" purposes, while the remaining residents used the collected food waste "for making washing liquid".

In addition, the majority of residents (56 %) reported that they "do not know how to do", 26 % claimed that they "do not have time", while the remaining (18 %) said they are "lazy to change/others" as the deterrent to food waste separation behaviour. In referring to Table 9, the results of a Chi-square test for independence suggested a significant relationship between the residents' reasons for not separating their food waste and education level ($\chi^2(4) = 14.982$, $p = 0.005$). In particular, approximately 35 % of residents who

Table 9 Reasons for and for not practicing food waste separation

Category	Reasons for practicing food waste separation				Reasons for not practicing food waste separation			
	Percentage (%)			χ^2 (p val.)	Percentage (%)			χ^2 (p val.)
	EC	CT	NW		NT	DK	Lazy	
Gender								
Male	67.9	13.2	18.9	3.244 (0.197)	27.3	53.9	18.8	2.118 (0.347)
Female	53.7	25.4	20.9		25.5	61.4	13.1	
Age								
<30	56.9	20.8	22.2	7.257 (0.123)	25.5	55.9	18.6	5.263 (0.261)
31–40	61.5	30.8	7.7		25.9	61.1	13.0	
Above 40	68.2	4.5	27.3		32.3	64.5	3.2	
Education								
Primary/secondary	66.0	19.1	14.9	3.004 (0.557)	21.9	64.4	13.7	11.424 (0.022)
Pre-U/diploma	51.7	27.6	20.7		15.9	69.6	14.5	
Degree above	59.1	15.9	25.0		34.4	48.1	17.6	
Income								
<RM3000	64.4	20.7	14.9	6.226 (0.183)[#]	21.2	60.0	18.8	7.270 (0.122)[#]
RM3001–RM4500	55.0	15.0	30.0		30.9	55.9	13.2	
RM4501–RM6000	50.0	25.0	25.0		31.3	68.8	0.0	
RM6001 above	25.0	0.0	75.0		46.7	40.0	13.3	
Dwelling type								
Flat/apartment/condominium	64.6	20.8	14.6	5.731 (0.220)	27.1	57.9	15.0	2.456 (0.652)
Terrace house	65.8	10.5	23.7		25.2	61.3	13.5	
Town house/semi-D/bungalow	47.1	29.4	23.5		27.3	50.9	21.8	

EC environmental conservation, *CT* follow the current trend, *NW* do not want to waste, *NT* do not have time, *DK* do not know how to do, *Lazy* lazy to change/others

[#] Income RM6001 above is combined with RM4501-RM6000 due to the small number of respondents in that particular group for Chi-square χ^2 computation

hold at least a degree claim that they did not separate their food waste because they "do not have time", compared to only 22 and 16 % of residents with primary/secondary and pre-U/Diploma, respectively.

3.6 Reuse and recycle behaviours

Recycling is processing used materials (wastes) into new products to prevent waste of potentially useful materials, reducing the consumption of fresh raw materials, reducing energy usage, reducing air pollution and water pollution by reducing the need for "conventional" waste disposal and lower greenhouse gas emissions compared to virgin production.

Logistic regression was used to determine the odds that a "Yes" response to residents' reuse or recycle behaviours was a function of a set of demographic and housing characteristics, including gender, age, education level, income level and dwelling type. Table 10 displays the findings concerning the reuse and recycle behaviour of the respondents. The model shows a positive relation between residents' age and reuse or recycles behaviour,

Table 10 Demographic and housing characteristics on the reuse or recycle behaviours

Variable	Estimated coefficient	Standard error	Wald	Sig.
Age	0.628	0.199	9.967	0.002
Gender	0.269	0.238	1.278	0.258
Education	0.466	0.149	9.767	0.002
Income	−0.024	0.154	0.025	0.875
Dwelling types	0.007	0.153	0.002	0.963
Constant	−1.218	0.710	2.945	0.086

−2 Log likelihood 436.554, *Nagelkerke* R^2 0.061

which indicates that residents aged 40 and above "reuse or recycle" more compared to residents aged <30 and 31–40. The results also show that residents' reuse or recycle behaviour is more positive for residents with a higher level of education.

4 Discussion

Overall, more than half of respondents were satisfied with their waste collection services. However, there are great opportunities for improvement in the satisfaction level with the attitude of garbage collectors, which explained 25 % of cumulative variance, collection time 23 % and collection services provided 22 %. The grassroots-level waste authorities are the foot soldiers in carrying out day-to-day waste management tasks. Therefore, their competency and professionalism very much determine the waste management outcome. The collection services on electronic and recyclable wastes as well as garbage collectors working attitude show a strong contribution to the satisfaction with waste management services. It is interesting to note that even though more than half of the respondents said they were satisfied with their waste services, a large percentage also reported having trouble managing large size solid waste (63 %), electronic waste (55 %) and recyclable waste (48 %). Therefore, the study suggests that waste authorities upgrade the current waste management collection system to cover a wider variety of solid waste. In addition, the research also founds that most of the respondents were neutral in their comments on garbage collectors attitude, 38 % of the respondents said that the garbage collectors do not ensure cleanliness in the dumping areas, 31 % said that the garbage collectors simply throw their rubbish bin everywhere, and 30 % of them said that the garbage collectors are lazy and slow. Therefore, the local waste authorities require more attention from the higher level government and waste management researchers. The waste management outcome of a community is very much determined by the local waste authorities. In developing countries, incompetence in management and technical skills are always found in local waste authorities and hence require urgent attention. Human capital development for waste administrators may be a better way to improve the waste management system in a community.

The majority (70 %) of the respondents were satisfied with their waste collection facilities. However, more than half of the respondents said that there is no public rubbish bin for large size solid waste, or reuse and recycling facilities in their housing area. In addition, the garbage collection vehicles do not have waste separation facilities. About 52 % of the respondents said that there is no public rubbish bin in their housing area and

48 % of them also said that the garbage collection vehicles are old, dirty and smelly. For recycling facilities, the study shows that 48 % of the respondents claimed that the recycling facilities are too far from their house, and 50 % of the respondents said that the recycling facilities in their housing area are limited to newspapers and related materials. The results from the factor analysis show that the garbage collection vehicles explained 25 % of the cumulative variance, recycling facilities 26 % and public rubbish bins 16 % in respect of the contributing dimensions affecting satisfaction with the waste management facilities. Why are the majority of the respondents satisfied with their waste collection facilities even though a larger percentage of respondents were complained about the waste services facilities? The contradiction of the above results may be due to the lack of waste collection awareness and limited waste management knowledge among the respondents. Collection facilities are crucial to complete the day-by-day waste management tasks. Insufficient facilities to provide the services, especially to the huge population living in cities in the Klang Valley, will deteriorate its waste management. The lack of trained and skilled waste management personnel to operate the facilities and its maintenance is also obstacles to improve the waste management. The study found that the condition of garbage collection vehicles, the location of recycling facilities and the size of public rubbish bins strongly contributed to the satisfaction with the waste management facilities.

Reducing the amount of waste generated is the most favoured option in waste hierarchy. The research used bringing one's own plastic bag or recyclable bag when shopping as a proxy for waste reduction behaviour. About half of the respondents practised waste reduction, which could be due to waste programmes through advertisements and education. There is a significant association between waste reduction behaviour and age. The majority of respondents aged 40 and above bring their own recyclable bag when shopping compared to <50 % of respondents aged below 30. This may be because those who are over 40 tend to be "housekeepers". Many previous studies also found that elderly people are more cooperative in waste reduction efforts than younger people. Scott (1999); Meneses and Palacio (2005); Saphores et al. (2006) found that older people are more likely to recycle waste than young people. Approximately 60 % of residents responded that they always forget to practise waste minimisation. The reasons given were mainly lifestyle factors, such as "lazy to change" (25 %). This shows that many respondents did not grasp the idea of the importance of reducing the amount of waste going to landfills. In addition, gender and dwelling type show a strong contribution to the reasons for not practicing waste minimisation. In conclusion, a more focused waste minimisation education programme is strongly needed, especially for the younger generation and men. The respondents who stayed in terrace houses, semi-D houses and bungalows tended to be short of time to do waste minimisation compared to those who stayed in flats, apartments and condominiums. These people may need to spend more time to work in order to support their higher living cost and higher housing price in the Klang Valley compared to those who stayed in flats, apartments and condominiums. Luxury lifestyle such as enjoying buying new products instead of repairing it maybe one of the reasons. In the current urbanisation and industrialisation era, the production of new products tends to result in a shorter lifecycle and higher repair cost, which will also contribute to higher waste generation. The potential for waste minimisation is often determined by lifestyle. Some people may view it as being wasteful to purchase new products for the sole purpose of following fashion trends when the older products are still usable. Adults who are working full time may purchase more convenient foods that require little preparation due to time constraints. To conclude, structured and effective waste minimisation support and facilities are needed to encourage public participation.

Waste sorting is a crucial step in ensuring that the waste generated is reused and, inevitably, will reduce the amount of waste going to landfill. The majority of the respondents do not sort their household waste in their daily life. There is a significant association between waste sorting behaviours and gender. Women are more likely to be involved in waste sorting activities than men. The result tallies with waste minimisation. For food waste separation, only 30 % of residents separate their food waste. The causes for not sorting food waste are mainly "do not have time" and "lazy to change". However, approximately half of the respondents do not know how to practise sorting waste. A structured waste sorting education programme is strongly needed for the country. The study found that there is a significant association between education and waste sorting for both household waste and food waste. It is interesting to note that people with lower education are engaged in waste sorting more actively as compared to those with higher education. The reasons behind this might be due to time–cost and lifestyle. Most of the time, waste sorting tasks tend to be conducted by older people or the maid living with the family.

Recycling is a time-consuming and unpleasant practice for some households (Shigeru 2011). Most of the recycling programmes require residents to sort their waste into recyclable and non-recyclable at home. However, most of the residents do not perform their sorting duties and thus dispose of mixed waste, which is problematic. Based on the study, environmental conservation is one of the main reasons why respondents sort their household waste in their daily life. The results show that age and education have a positive relation with reuse and recycling behaviour. This means that older people and higher educated people are more active in reuse and recycling. Higher educated people tend to be less active in waste sorting but more active in recycling. Higher time cost is one of the factors in waste sorting. Higher educated working adults prefer sending all the waste to recycling centres. If a person perceives that the time used in waste separation is a constraint, they have a high opportunity cost of time. Thus, they are less likely to sort the waste. There is also a significant association between waste sorting behaviour and dwelling type. The respondents who stay in semi-D houses and bungalows tend to be short of time to do waste sorting compare to those who stay in flats, apartments and condominiums. This result tallies with waste minimisation.

5 Conclusion

The research generated crucial information concerning the awareness, satisfaction and behaviour pertaining to waste management services and facilities, waste minimisation, waste sorting, reuse and recycling for today's population in the Klang Valley. The majority of the respondents were satisfied with their waste management services and facilities although many respondents reported difficulty in managing large-sized solid waste, electronic waste and recyclable waste. The local authorities require more attention from the higher level government and researchers as there are a number of complaints concerning the waste administrators. The condition of garbage collection vehicles, the location of recycling facilities and the size of public rubbish bins are among the most important variables pertaining to the satisfaction of waste management facilities, as more than half of the respondents said that there is no public rubbish bin for large-sized solid waste or reuse and recycling facilities in their housing area. The potential for waste minimisation and waste sorting activity are often determined by lifestyle and time cost factors, such as lazy to change and do not have time. Urgent attention needs to be given to the waste sorting

education programme, as approximately half of the respondents do not know how to practise waste sorting. In addition, effective waste minimisation support and facilities that suit the current working lifestyle and market environment, for instance lower repair cost, prolonging product lifecycle are needed to encourage public participation. Based on this study, older people are more actively involved in waste minimisation, sorting and recycling compared to young people; males tend to be lacking in waste minimisation, and people with lower education are more actively engaged in waste sorting compared to people with higher education, who are engaged in recycling more actively. Frequent collections for large-sized solid waste, electronic and recyclable waste are necessary.

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References

Alexis, M. T., & James, R. M. (2009). Sustainable recycling of municipal solid waste in developing countries. *Waste Management, 29*(2), 915–923.

Andrzej, M., & Arkadiusz, M. K. (2012). The problem of preparation the food packaging waste for recycling in Poland. *Resources, Conservation and Recycling, 69*, 10–16.

Asian Productivity Organization. (2007). Solid waste management: Issues and challenges in Asia. In *Report of the APO survey on solid-waste management 2004–05*. Tokyo: Asian Productivity Organization.

Borneo Post Online. (2013). Solid waste exceeds projected production in 2020. Resource document. Borneo Post Online. http://www.theborneopost.com/2013/08/27/2012-solid-waste-exceeds-projected-production-in-2020/. Accessed August 27, 2013.

Dongsu, K., Sunghye, S., Seungman, S., Jinshik, C., & Bongchan, B. (2002). Waste plastics as supplemental fuel in the blast furnace process: improving combustion efficiencies. *Journal of Hazardous Materials, B94*, 213–222.

Emery, A. D., Griffiths, A. J., & Williams, K. P. (2003). An in depth study of the effects of socio-economic conditions on household waste recycling practices. *Waste Management and Research, 21*(3), 180–190.

Johari, A., Saeed, I. A., Haslenda, H., Habib, A., & Mat, R. (2012). Economic and environmental benefits of landfill gas from municipal solid waste in Malaysia. *Renewable and Sustainable Energy Reviews, 16*, 2907–2912.

Joseph, K. (2006). Stakeholder participation for sustainable waste management. *Habitat International, 30*, 863–871.

Meneses, G. D., & Palacio, A. B. (2005). Recycling behavior: a multidimensional approach. *Environment and Behavior, 37*(6), 837–860.

Ngoc, U. N., & Schnitzer, H. (2009). Sustainable solutions for solid waste management in Southeast Asian countries. *Waste Management, 29*, 1982–1995.

Pek, C. K., & Jamal, O. (2011). A choice experiment analysis for solid waste disposal option: A case study in Malaysia. *Journal of Environmental Management, 92*(11), 2993–3001.

Rafia, A., & Muhammad, M. M. (2011). Using a contingent valuation approach for improved solid waste management facility: Evidence from Kuala Lumpur, Malaysia. *Waste Management, 31*(4), 800–808.

Saphores, J. D. M., Nixon, H., Ogunseitan, O. A., & Shapiro, A. A. (2006). Household willingness to recycle electronic waste: an application to California. *Environment and Behavior, 38*(2), 183–208.

Scott, D. (1999). Equal opportunity unequal results: determinants of household recycling intensity. *Environment and Behavior, 31*(2), 267–290.

Shahjahan, H. B. (2010). A crisis in governance: Urban solid waste management in Bangladesh. *Habitat International, 34*(1), 125–133.

Shigeru, M. (2011). Waste separation at home: Are Japanese municipal curbside recycling policies efficient? *Resources, Conservation and Recycling, 55*(3), 325–334.

The Star Online. (2010). New landfill site needed. Resource document. The Star Online. http://www.thestar.com.my/story/?file=%2F2010%2F2%2F2%2Fnation%2F5591952&sec=nation. Accessed February 2, 2010.

Zia, H., & Devadas, V. (2008). Urban solid waste management in Kanpur: Opportunities and Perspectives. *Habitat International, 32*(1), 58–73.