TOWARDS SUSTAINABLE HOUSEHOLD WASTE MANAGEMENT IN URBAN AREAS: DETERMINANTS THAT HINDERED THE RECYCLING ACTIVITIES IN THE CITY OF JOHOR BAHRU, MALAYSIA

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Abstract

In Malaysia, household waste generation has increased manyfold over the last few decades. Regardless of composition and type, waste is mostly dumped in open areas and no significant attempts are being made to recycle. I more recent years, however, a paradigm shift from conventional waste collection to recycling has received more attention. This study assessed the determinants that were hindering household recycling at the city level.

As one of the most rapidly developed urban areas in Malaysia, Johor Bahru City, the capital of Johor state, was selected as the case study. A total of 1,158 respondents participated in the research, which took the form of a face-to-face survey completed in various parts of Johor Bahru. The survey questionnaire was designed to identify the factors that might be restraining the progress of recycling activities in residential areas of the city.

The survey data analysis found that the main determinants which were hindering recycling behavior among the city dwellers were: an improper implementation of the current "2+1" system, which in turn was not facilitating recycling activities in the surveyed areas; a lack of information about efficient and appropriate recycling methods; weak legal instruments related to recycling; the non-provision of bins for recyclable items in the surveyed areas; and low levels of awareness among the residents on recycling processes or methods.

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Introduction

The city is a man-made ecosystem, in which people draw upon the natural resources of land, water, air, and other organisms. But cities are also symbols and engines of societal progress. Sulong (1985) found that the development activities in urban areas were linked with the rate of urbanization. Therefore, urbanization is often seen as a measure of progress.

Meanwhile, capitalist systems assume that consumption will increase steadily as people seek to improve their lives, and enhance their standards of living. But there is an inherent conflict: In urbanized areas, the management of solid wastes is a major challenge, particularly in the rapidly growing cities of the developing countries (Foo, 1997). Urbanization directly contributes to waste generation, and unscientific waste handling causes health hazards and urban environment degradation. Significant increases in solid waste generation have been viewed as a major drawback of Malaysia's rapid urbanization (Murad and Siwar, 2007). Phrased more positively: to maintain high living standards in our cities, we need efficient ways to dealing with the wastes generated by those cities.

Sixty-five per cent of the Malaysian population resides in cities and towns (Department of Statistic, 2011; Afroz and Masud, 2011). Kuala Lumpur, Melaka, and Selangor are amongst the states that generate the highest percentages of Municipal Solid Waste (MSW) in the country (see Table 1). Since these states are also experiencing the fastest urbanization and economic growth rates in the country, it is likely that they will continue to produce high MSM in the future. Waste generation in these centers has increased more than 91 percent between 2000 and 2009 (Abdul Jalil, 2010) with most of the wastes dominated by recyclable materials, as shown in Table 2. This is mainly due to (1) the rapid development of urban areas, in large part the results of rural–urban migration; (2) an increase in per capita income; and (3) changes in consumption patterns brought about by development (Abdul Jalil, 2010; Periathamby et. al, 2009; Zamali et al., 2009).

The statistics are compelling. In the last two decades, the amount of MSW generated in Kuala Lumpur has increased by a factor of six. Agamuthu and Fauziah (2011) reported that the amount of MSW generated in Kuala Lumpur was 586.80 tonnes per day in the year 1990, and it reached 3631.00 tonnes per day in 2009.

Clearly, solid waste management is one of the most critical environmental problems faced by the local municipalities, and—arguably—is becoming the single biggest environmental threat to the country (Osman et. al, 2009). Overall waste composition in Malaysia is dominated by municipal solid wastes (64 percent), followed by industrial wastes (25 percent), commercial wastes (8 percent) and construction

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wastes at 3 percent (EU-SWMC, 2009). About 80 percent of municipal solid wastes that are disposed at landfills are recyclables (MHLG, 2006).

Residential areas are one of the primary sources of municipal solid wastes, followed by institutional and commercial wastes (Tariq and Mostafizur, 2007). Municipal solid wastes generally consist of some 20 different categories: food wastes, paper (mixed), cardboard, plastics (rigid, film ,and foam), textile, wood wastes, metals (ferrous or non-ferrous), diapers, newsprint, high grade and fine paper, fruit wastes, green wastes, batteries, construction wastes and glass; these categories can be further grouped into organic and inorganic (Amin and Go, 2012).

Urban Center	MSW generated tonnes/day				
	1970	1980	1990	2002	2006
Kuala Lumpur	98.90	310.50	586.80	2754.00	3100.00
Johor Bahru (Johor)	41.10	99.60	174.80	215.00	242.00
Ipoh (Perak)	22.50	82.70	162.20	208.00	234.00
Georgetown (Pulau Pinang)	53.40	83.00	137.20	221.00	249.00
Klang (Selangor)	18.00	65.00	122.80	478.00	538.00
Kuala Terengganu (Terengganu)	8.70	61.80	121.00	137.00	154.0
Kota Bharu (Kelantan)	9.10	56.50	102.90	129.50	146.00
Kuantan (Pahang)	7.10	45.20	85.30	174.00	196.00
Seremban (Negeri Sembilan)	13.40	45.10	85.20	165.00	186.00
Melaka	14.40	29.10	46.80	562.00	632.00

Table 1. Generation of MSW in major urban areas in peninsular Malaysia from 1970 to 2056[i]

Waste Composition	Years						
	1975	1980	1985	1990	1995	2000	2005
Organic	63.70	54.40	48.30	48.40	45.70	43.20	44.80
Paper	7.00	8.00	23.60	8.90	9.00	23.70	16.00
Plastic	2.50	0.40	9.40	3.00	3.90	11.30	15.00
Glass	2.50	0.40	4.00	3.00	3.90	3.20	3.00
Metal	6.40	2.20	5.90	4.60	5.10	4.20	3.30
Textiles	1.30	2.20	NA	NA	2.10	1.50	2.80
Wood	6.50	1.80	NA	NA	NA	0.70	6.70
Others	0.90	0.30	8.80	8.80	4.30	12.30	8.40

Table 2. Waste composition (% of relative weight) in Malaysia from 1975 to 2005

Regardless of their composition or type, wastes for the most part are simply dumped in open areas, without any attempt at recovering or recycling (Amin and Go, 2012). By one estimate, more than 90 per cent of

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total wastes in Malaysia are disposed of in landfill sites (Afroz and Masud, 2011). Most landfill sites, moreover, are open dumping areas, and thus represent serious environmental and social threats (Manaf et.al, 2009; Yunus and Kadir, 2003).

Recycling as a sustainable waste management strategy presents a major paradigm shift (Bolaane, 2006). Experience elsewhere suggests that waste separation and recycling can yield huge economic and environmental benefits (Afroz and Masud, 2009). Quantifying the social benefits of recycling, however, can be difficult. For example: the pollution that is avoided through recycling is "invisible" (because it never existed). The reduced resource depletion that results from recycling is equally hard to discern, because the environmental damage that has been avoided would have been scattered over many jurisdictions, both at home and abroad.

But the hard-to-quantify is no less real, nor are benefits that happen to be shared broadly. There is ample scientific evidence demonstrating that virgin material extraction is resource-intensive and carries with it many adverse environmental impacts. By contrast, the recycling of metal, glass, and plastics nationwide saved 24.7 million metric tonnes (MMT) of CO_2 equivalent in 2012, with 20.7 MMT coming from metal recycling alone (U.S. EPA, 2013). Furthermore, recycling could potentially reduce waste disposal and transportation costs, and prolong the lifespans of landfills (Folz, 1991; Muttamara et al., 1994; Suttibak and Nitivattananon, 2008).

To date, most studies of the waste challenge in Malaysia have focused on the status of solid waste management, rather than on recycling. As a result—and especially in the absence of any systematic analysis or periodic documentation from any local authority—information on recycling is limited and outdated (Nasir et al., 2000). Most benchmarking and standards regarding household solid waste recycling are the products of overseas research, which is not particularly relevant to the contemporary Malaysian experience.

What is needed at present, therefore, is a reliable overview on the existing household solid waste recycling policy in Malaysia. Such an overview could serve as a baseline for initiatives going forward, and provide the facts needed for policy makers, researchers, and others seeking to promulgate guidelines for the future.

Current status of waste recycling in Malaysia

In recent years, as noted, the state of recycling in Malaysia has not been encouraging. In 2008, for example, only 5.5 percent of total wastes were recycled. This compares with recycling rates twice as high, or higher, in neighbouring countries such as Singapore (11 percent), the Philippines (12 percent), and Thailand (14 percent) (MHLG, 2011; Periathamby et.al, 2009). To achieve its ambitious recycling target of 22 percent by 2020,

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Malaysia will need to make dramatic changes in its approach to waste management.

Toward that end, the public will have to come to think of recycling as the norm, rather than the exception (Octania, 2005). A first step in that direction came with the passage in 2007 of Act 672 on Solid Waste and Public Cleansing Management (SWPCM) Act 2007. This law mandated waste separation at the source for every household, beginning in September 2012, with a fine of RM1000 being imposed on households that disregarded the law.

SWPCM was reviewed for 10 years before it was finally approved in August 2007. It was based on similar laws in other developed countries, such as Japan, Denmark, Switzerland, Germany and the United States. It adopts the best management practices in solid waste management from these countries (Abdul Jalil, 2010) to sanitation in Peninsular Malaysia and the Federal Territories of Putrajaya and Labuan.

Simply stated, the law attempted to standardize solid waste management, with enforcement to be conducted in stages. It was expected to ensure proper household waste management through the so-called "3Rs strategy": reduction, reuse, and recycling.

Under the terms of SWPCM, a waste bin with a capacity of 120 liters and equipped with wheels would be provided, for free, to each household by the private concessionaires in each state.[ii] The distribution these waste bins was to be conducted in stages between October 2011 and 2014. Every household was expected to manage waste separation at source, which would be collected by selected private concessionaires based on the "2 + 1" collection system. Under this system, the collection of non-recyclable materials disposed by households was to happen twice per week, while the collection of recyclable materials would take place once a week. Booklets on solid waste separation, recovery a,nd recycling were distributed to households, with the objective of introducing and showing them to manage and separate their solid wastes correctly.

Aside from implementation challenges, this plan had clear limitations. For example, source separation targeted only urban areas. Moreover, households in Malaysia are currently required to pay for collection services as part of the annual assessment tax, which is set by the local authorities with service providers. The assessment and classification of properties vary with each local authority. As a result, households do not make a separate payment for solid waste management services, and are unaware of the amount of tax being paid for their waste collection service (Othman, 2002). More fundamentally, the amount that should be contributed by each household for waste management has not been determined. In short, fundamental controls are lacking.

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Overview of the study

As one of the most rapidly developed urban areas in Malaysia, Johor Bahru (JB) City, the capital of Johor, has been selected as the case study for this research effort. In 2010, the areas managed by the Johor Bahru City Council had a population of 497,097. The larger Johor Bahru—also known as Iskandar Malaysia—had a population of 1,455,389 (Department of Statistic, 2011), making it the third largest metropolitan center in Malaysia.[iii] In 2006, Johor Bahru generated about 242 tonnes per day of MSW (Periathamby et. al, 2009) and this has increased steadily as the city experiences rapid urbanization, as well as population increases and economic growth. The state's garbage collection, waste disposal, and upkeep of drains have been contracted to Southern Waste Management (SWM) since 1997. Currently, the MSW from JB City is disposed of at the Seelong Sanitary Landfill (SSL), which was constructed jointly by the Johor Government and SWM. Construction began in June 2003, and the first cell commenced operation in January 2004. Today, SSL encompasses a land area of some 275 acres situated at Seelong, Mukim Senai, Kulai, about 30 km from JB City. Original plans called for the construction of 13 cells over time, which were assumed to be capable of disposing of 15 million tonnes of waste over some 20 years. With the city's rapid increase in MSW generation, however, SSL is likely to have shorter a lifespan than was originally estimated.

This also reflects a changing context. SSL was conceived as a central sanitary landfill to accommodate solid wastes from three local authorities in Johor: Majlis Bandaraya Johor Bahru (MBJB), Majlis Perbandaran Johor Bahru Tengah (MPJBT) and Majlis Perbandaran Kulai (MPKu). But with the anticipated closure of the Tanjung Langsat Sanitary Landfill—located in Pasir Gudang—by the end of year 2016, SSL will also accommodate MSW from Majlis Perbandaran Pasir Gudang (MPPG).

Despite what appears to be a looming crisis, the residents in JB City are not participating actively in recycling, despite the 2 + 1 waste collection system that has been in place since 2013. This is puzzling, because the city is flourishing economically, and the educational levels and standard of living of the city's residents have improved tremendously over the past few decades. It is a populace, in other words, that understands its self-interest, and might be expected to embrace recycling—but does not. This begs the question: what are the underlying factors that have hindered the active participation of JB City residents in recycling?

This study seeks to answer that question. It analyzes the significant role of demographic variables, awareness, and other challenges that may have discouraged residents from embracing recycling.

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Methodology

The study was conducted at Johor Bahru City, with 1,158 respondents taking part. Survey questionnaires were designed to assess the determinants that may challenge the progress of recycling activities in the city. The questionnaire consisted of four parts: demographic information, awareness, attitudes, and challenges on recycling solid wastes. The questionnaires were administered in face-to-face interviews.

The Statistical Packaging for the Social Science (SPSS) software program was used to analyze survey data, with simple descriptive statistics and correlations also being developed. Additionally, secondary data were collected—from government agencies and the relevant literature—to provide a baseline for this study.

Results and discussion

Demographic information

The demographic information collected in this study includes gender, age, types of housing, ethnicity, educational level, occupation, and the number of people in the household. Table 3 displays this information. It should be noted that the questionnaire results may have been affected by somewhat skewed percentages of respondents among the respondents—e.g., more male respondents than female.

Demographic Information		Number of Respondents	Percentage (%)
Gender	Male	602	52.0
	Female	534	46.1
	Unidentified	22	1.9
Age	18–25 years old	184	31.0
	26–40 years old	409	35.3
	41 years old and above	368	31.8
	Unidentified	22	1.9
Type of Housing	Bungalow	184	15.9
	Semi-detached	157	13.6
	Double-storey terrace house	164	14.2
	Single-storey terrace house	240	20.7
	Condominium	92	7.9
	Apartment	148	12.8
	Flat	140	12.0
	Others	10	0.9

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	Unidentified	23	2.0
Ethnicity	Malay	530	45.8
	Chinese	299	25.8
	Indian	281	24.3
	Others	22	1.9
	Unidentified	26	2.2
Education level	Primary	209	18.1
	Secondary	355	30.7
	Tertiary	570	49.2
	Unidentified	24	2.1
Occupation	Stay home	530	45.8
	Professional	602	52.0
	Unidentified	26	2.2
Number of Persons in Household	0	67	5.8
	1	124	10.7
	2	159	13.7
	3	201	17.4
	4	209	18.0
	5	201	17.4
	6	109	9.4
	7	30	2.6
	> 7	29	2.5
	Unidentified	29	2.5

Table 3. Distribution of respondents in accordance to demographic information

Awareness of recycling solid waste

This study looked into the awareness of the residents of Johor Bahru regarding the recycling of solid wastes. As shown in **Table 4**, respondents of this study showed a good basic awareness about recycling. This conforms with the study conducted by Othman and Yuhaniz (2013), in which they concluded that most of the respondents in Shah Alam have a basic knowledge, and understood the main objective, of recycling.

Question	Priority Weight (%)	
	Yes	No
Do you understand the meaning of "recycling"?	97.4	2.6
Do you practice recycling own solid waste?	82.1	17.9
Do you know how to recycle your own solid waste?	77.5	22.5
Are you aware of the importance of recycling?	82.6	17.1

Table 4. Response rate (%) of basic awareness towards recycling

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From Figure 1, it can be concluded that neighbours and students are the most likely players to encourage others to practice recycling. This is in agreement with the study conducted by Vicente and Reis (2008), which found that friends and neighbours have the strongest positive effect on recycling participation. In other words, people feel obligated to do recycle when they are convinced that recycling is everyone's responsibility, or when they see their neighbours recycling.
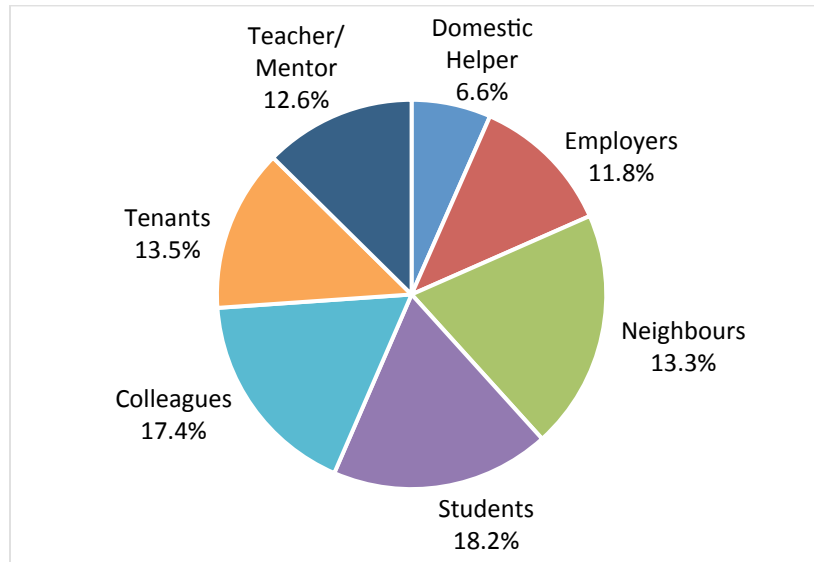
Figure 1. Percentage distribution of different categories of members of society that help encourage recycling behaviour

Referring to **Figure 2**, the largest percentage of respondents recycled their own domestic wastes by putting the recyclable goods in recycle bins (20.8 percent), while using food wastes as fertilizer had the smallest percentage of adherents (8.6 percent). These findings are in agreement with a study conducted by Omran and Mahmood (2003), which identified the most common recycling methods practiced in Malaysia as being selling the recyclable goods to vendors; collection of recyclables by the local municipality, which then sells them into the recycling market; and finally, sending their recyclable goods to drop-off centres.
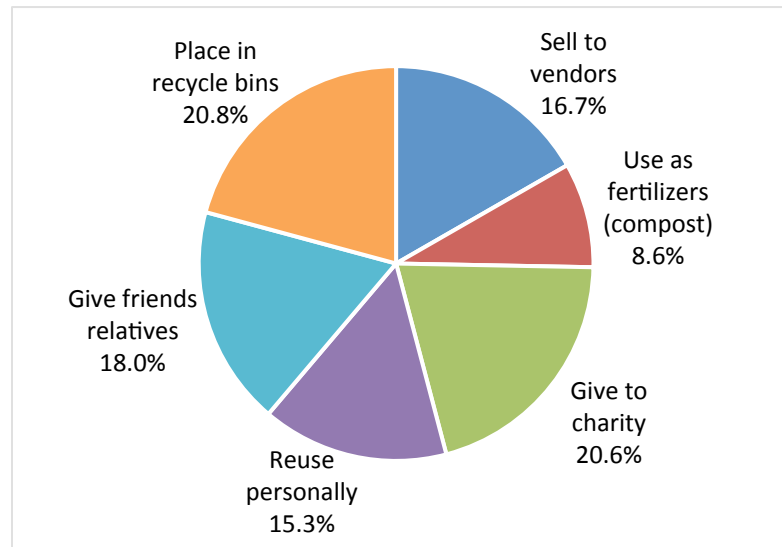
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Figure 2. Percentage of distribution of common methods to recycle household wastes

The "2+1" waste collection system, mentioned earlier, is a waste collection system in Iskandar Malaysia whereby waste collectors pick up wastes from each household three times a week. Household wastes are collected twice a week, and recyclables are collected once a week. The local municipality of Johor Bahru launched this system in 2013. However, referring to **Table 5**, fewer than half of the respondents know what the "2 + 1" waste collection system is, and less than a quarter of all respondents know the schedule of the waste collection system. Arguably, both of these knowledge deficits drive down consumer participation in the system.

Question	Response Rate (%)	
	Yes	No
Do you know what "2+1" is?	49.7	50.4
Do you know if your local municipality has a "2+1" waste collection system?	43.8	56.2
Do you know the schedule of "2+1" waste collection?	23.6	76.4

Table 5. Response rate (%) of the awareness towards "2+1" waste collection system

On the positive side, the respondents in this study know and understand regarding which item can be recycled, as can be seen in **Figure 3**. The most common items that the respondents think can be recycled are: aluminium drink cans (n = 429), newspaper (n = 374), paper bags (n = 357), paper (n = 356) and food containers (n=330). It is also clear that the respondents are aware that batteries—one of the most hazardous household wastes—can be recycled. This shows that the

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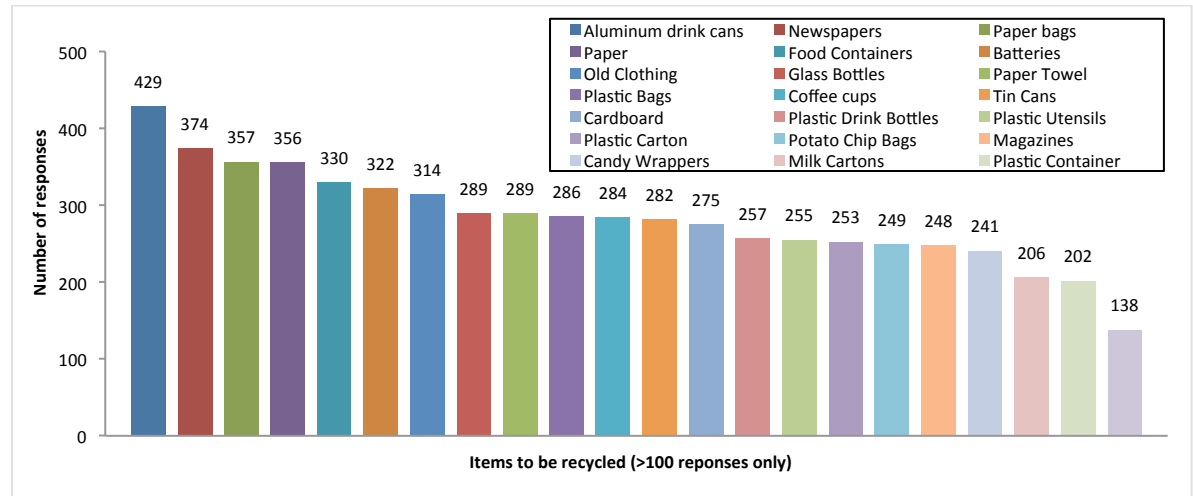survey respondents have good basic understanding of which items can be recycled.

Figure 3. Different types of recyclable items

Attitude on recycling solid wastes

To understand better the recycling culture in Johor Bahru, this study looked into the attitudes of the residents in Johor Bahru on recycling solid waste. It was found that 61.6 percent (n = 713) of respondents agreed that recycling would save them money, which motivated them to start practice recycling (Table 6). This is in agreement with the findings of Holmes *et al.* (2014) that financial incentives are useful tools to promote recycling. In that spirit, the United Kingdom's Secretary of State for Communities and Local Government in August 2014 established a £5 million fund to help local authorities in that country use financial incentives to boost recycling rates (Kane, 2014).

Question	Response Rate (%)		
	Disagree	**Neutral**	**Agree**
I started practicing recycling because I want do my part to save the environment.	8.0	30.9	61.1
I started practicing recycling because I believe it is the right thing to do.	5.8	23.5	70.6
I started practicing recycling because it is more convenient than throwing my rubbish away.	5.7	27.1	67.3
I started practicing recycling because recycling saves/earn me money.	7.1	31.3	61.6

Table 6. Response rate (%) of attitude towards starting recycling

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The reasons why some respondents chose *not* to recycle their solid wastes were also looked into. See Table 7.

Question	Response Rate (%)		
	Disagree	**Neutral**	**Agree**
I do not recycle because there is no legal enforcement to recycle my waste.	19.6	29.0	51.4
I will recycle more if there are better instructions on handling my recyclable goods.	4.5	28.3	67.1
I will recycle more if more of my friends/relatives recycle.	5.8	31.5	62.6
I will recycle more if I know more on what kind of waste can be recycled.	9.7	39.3	51.0

Table 7. Response rate (%) of attitude towards not practicing recycling and practice recycling more

From **Table 7**, it can be seen that to promote recycling, detailed and effective instructions on handling recycling goods have to be developed, and involvement of families and friends in recycling has to be taken into account. Vicente and Reis (2008) found that providing sufficient information is the most effective way to encourage participation in recycling, and that involvement of friends and neighbours also boosted participation in, and cooperation with, waste recycling.

Challenges in recycling solid wastes

By any measure, participation of activities related to recycling solid wastes in Johor Bahru was low. The top three reasons identified by the survey data analysis were:
- recycling is unhygienic and dirty (65.6 percent),
- practicing recycling is troublesome (53.7 percent), and
- lack of drop-off and buy-back centres nearby (44.5 percent) (Figure 4).

These finding are consistent with those in a study by Gamba and Oskamp (1994), in which they found that hygienic concerns, real or perceived lack of cleanliness, efficiency of the recyclable collection system, and availability of drop-off centre were some of the key reasons hindering people from practicing recycling. They also found that a lack of sufficient recyclables in home, a lack of storage space, and insufficient time to prepare materials for recycling were additional reasons that people tend not to participate. Omran and Gebril (2011) found that the main reasons for those who did not participate in recycling activity were (1) inconvenience, and (2) lack of facilities.
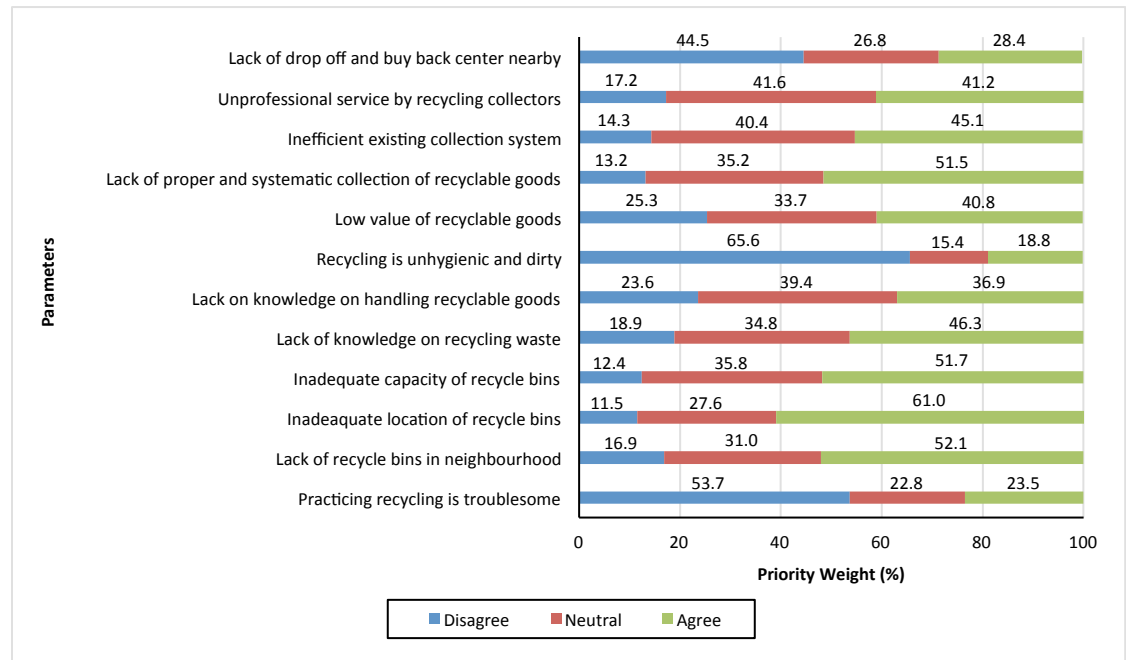
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Figure 4. Priority weight (%) distribution of parameters on challenges to recycling solid waste

Relationships among age, understanding the meaning of "recycle," and awareness of the importance of recycling **Figure 5** shows that although 18-to-25-year-olds reported the lowest levels of understanding the meaning of recycling, they also had the second highest number level of awareness about the importance of recycling. This conforms with the findings of Prestin and Pearce (2010), who concluded that junior high and high school students were aware of the benefits of recycling and the consequences of not recycling, but they had comparatively less knowledge about recycling.
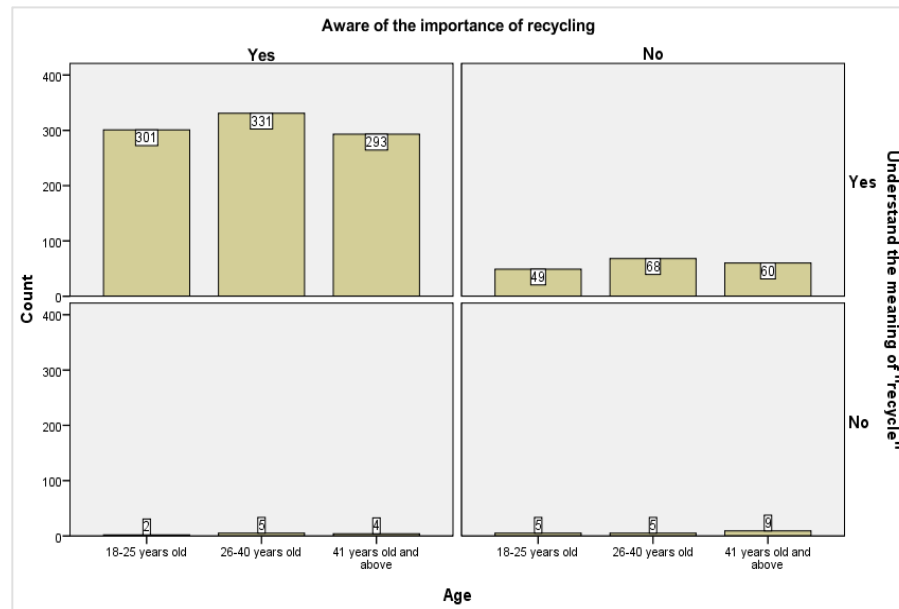
Figure 5. Relationships among age, an understanding of the meaning of "recycling," and an awareness of the importance of recycling

Relationships among age, a commitment to recycling, and a knowledge of how to recycle

Although the 18-to-25-year-olds surveyed had the second-highest awareness of how to recycle (n = 25), they also comprised the largest number of respondents (n = 49) who didn't personally recycle. (See Figure 6.) The same general pattern holds true for older age cohorts: they know how to recycle, but most of them did not.
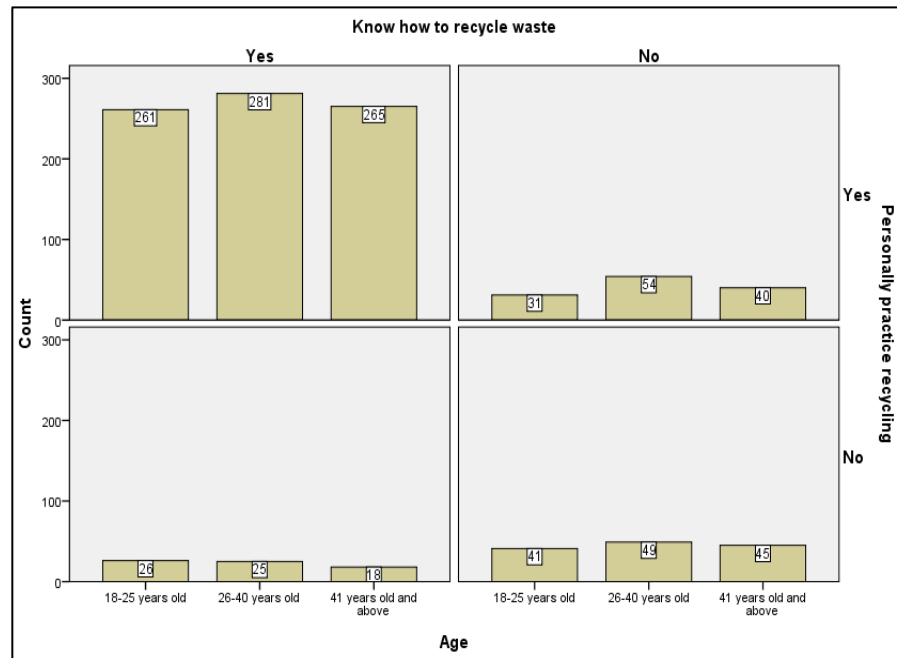
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Figure 6. Relationships among age, personally practicing recycling, and knowing how to recycle waste

Relationships among age, knowing how to recycle waste, and an awareness of the importance of recycling

Respondents 41 years old and older had the highest awareness of how to recycle wastes; however, they had the lowest awareness of the importance of recycling, as depicted in **Figure 7**. Interestingly, this contradicts the findings of Prestin and Pearce (2010), who found that younger people were not practicing recycling compared to mature people. The contradiction can perhaps be explained through lack of practice, which in turn shapes people's habits. Among the mature residents of Johor Bahru City, not practicing and participating in recycling actively may have made them indifferent towards recycling, despite knowing how to conduct it properly.
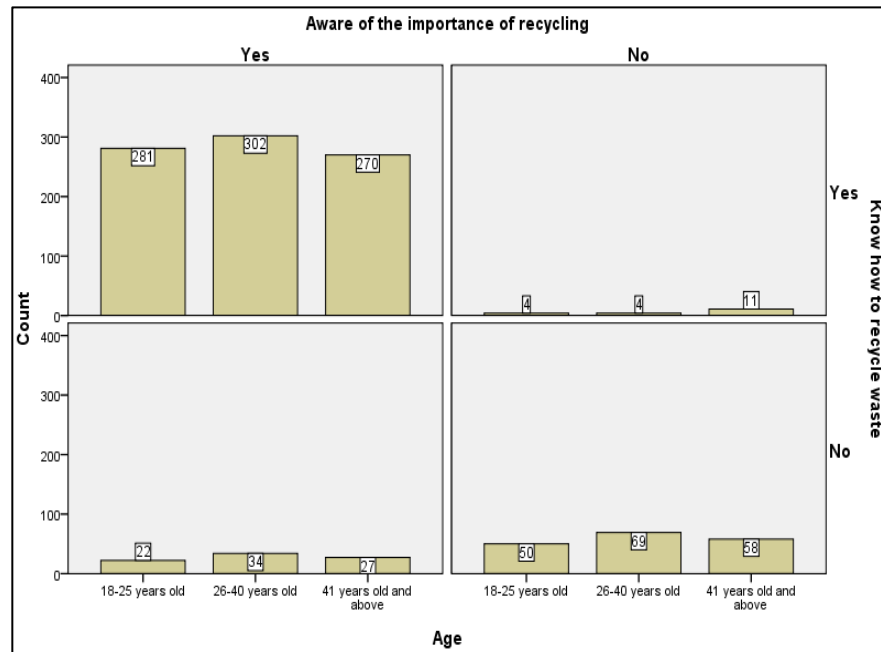
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Figure 7. Relationships among age, knowing how to recycle waste, and being aware of the importance of recycling

Conclusions and recommendations

The main determinants that hindered the recycling behaviour among Johor Bahru City residents were:

- ineffective implementation of the current 2 + 1 system
- a lack of information about how to recycle properly and efficiently,
- a lack of legal instruments aimed at enforcing recycling
- a shortage of recycling bins, which compels residents to use their own disposal bags/container to segregate and put the recyclables out for collection.

Despite knowing how to recycle properly, certain age groups lacked awareness about the importance of recycling, and the potential impacts of unsustainable waste management on the environment.

It appears that the rate of recycling among the Johor Bahru city residents may be enhanced by promoting the concept among the younger age groups, since they are more aware of the importance of recycling and can easily be encouraged. This educational effort can be carried out through the schools, colleges, and universities.

More broadly, neighbours are the people who are most likely to influence recycling behaviour. Friends and family therefore need to be taken into account when local authorities attempt to promote the recycling of solid wastes.

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The existing collection system needs to be improved to allow for more effective and efficient collection of both commingled wastes and recyclables. Stronger linkages need to be established among the main governmental and non-governmental players (federal government, concessionaires, local government, and NGOs). And finally, those involved in waste management and handling need training to improve their knowledge of best practices for the collection and disposal of wastes.

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NOTES

[i] Periathambly et al. (2009)

[ii] The exceptions were the states of Pulau Pinang, Selangor, and Perak, which had
their own enforcement approaches.

[iii] In terms of ethnic background, that population is 47.5 per cent Malay, 34.2 per
cent Chinese, 9.0 per cent Indian, and 0.6 per cent other minorities. (Department
of Statistics, 2011).