



The profiles of household solid waste recyclers and non-recyclers in Kuala Lumpur, Malaysia



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A B S T R A C T

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Malaysia has twice launched nationwide recycling campaign in 1993 and 2000. The result of the campaign to encourage household participation in recycling is inconclusive as the programs were concentrated only in urban areas. This study is an effort to conduct a comprehensive study on the effects of the recycling campaign and awareness on household recycling participation. A standard questionnaire survey was conducted on 460 households in selected residential areas that have active recycling programs in Kuala Lumpur Federal Territory (KLFT). The study identified the socio-economic characteristics of household recyclers and non-recyclers and their levels of knowledge on recycling by applying discriminant analysis. In addition, evaluation of the barriers and motivations of households performing recycling was investigated using factor analysis. The information was combined to form a profile of household recyclers and non-recyclers in urban Malaysia. Formulation was conducted on different recycling strategies and awareness campaigns at the household level to improve the existing recycling programs and facilities for the improvement of household participation. The study succeeded in forming a profile of household recyclers dominated by higher income earners with higher educational backgrounds, who owned houses and had deeper appreciation of recycling as a social norm. The non-recyclers had lower education and income, were tenants in one-storey houses, with little knowledge of recycling and its challenges. The study summarized the urgency for more strategic and targeted approach to recycling campaigns at the local level, taking into account the socio-economic backgrounds of the community, for more active participation in recycling at all levels.

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Introduction

Rapid urbanization and high commercial and industrial activities have resulted in the generation of large amounts of waste (Rockson, Kemausuor, Seassey, & Yanful, 2013) the composition of which is influenced by the nature of the economy (Othman, Noor, Abba, Yusuf, & Hassan, 2013). Improper solid waste management in Asia and Africa is a major challenge to governments in these continents (Calò & Parise, 2009; Zia & Devadas, 2008). The growing urban population in developing countries and the poor response of the authorities to the increasing demand for proper waste management services have been the twin dilemma facing cities in these countries (Ahmed & Ali, 2006; Gellynck, Jacobsen, & Verhelst, 2011; Owusu, Oteng-Ababio, & Afutu-Kotey, 2012). The consequences of

improper waste disposal include surface and groundwater contamination, air and soil pollution, spread of disease, aesthetics and odour problems, emission of methane that is a fire hazard and blockage of drains (Othman et al., 2013). Hence, there is the need for proper waste management (Kassim & Ali, 2006) as it is very essential in terms of safety, good environment and public health (Bhuiyan, 2010). The barriers to inclusive waste management include unhygienic waste collection methods, low quality and quantity of secondary materials, repressive policies and lack of evidence to support activity (Oguntoyinbo, 2012).

In proper solid waste management, the first step is a public awareness campaign to convince the populace of the benefits of recycling, followed by recycling and transportation plans (de Oliveira Simonetto & Borenstein, 2007). Recycling is the separation of domestic waste, glass, plastic, paper and other materials with the aim of returning them to the industry for benefit (de Oliveira & Borenstein, 2007). For a realistic recycling program, the national composition of the waste must be known (Burnley, 2007). As an option in the waste management hierarchy,

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recycling is regarded as sustainable (Bolaane, 2006; Nzeadibe, 2009). It is divided into formal and informal with households at the centre of each type. Municipal authorities play vital roles in formal recycling through the initiation and implementation of recycling schemes (Bolaane, 2006). It is further divided into making recyclables ready for reprocessing (the collection system), turning the materials into primary material substitute (reprocessing) classified as a pro-social behaviour with a moral domain (Thøgersen, 1996). Recycling reduces total disposed waste quantity, conserves natural resources, reduces demand for virgin materials, consumes less manufacturing energy, reduces environmental and economic costs, and health and environmental risks (Bolaane, 2006; Kinnaman, 2006; Martin, Williams, & Clark, 2006; Van den Bergh, 2008) and is a source of livelihood for scavengers (Wilson, Velis, & Cheeseman, 2006).

To be successful, recycling programs require active and sustained participation of people (Ittiravivongs, 2012). As part of these efforts, households are being encouraged in several countries to start recycling through the separate collection of different materials (Dahlén, Åberg, Lagerkvist, & Berg, 2009). Household wastes are defined as wastes that normal households generate (Dahlén & Lagerkvist, 2010). They are further subdivided into property-close (curbside) collection and drop-off points (bring systems) collection. There have been investigations on the behavioural elements of waste management as indices for understanding how to positively change such behaviours (Martin et al., 2006). Based on these investigations, a correlation of recycling behaviour was found between memberships of non-profit organizations, newspaper reading, religious activities, and politics. Other big impacts included age, education level, gender, and household income (Fiorillo, 2012).

Several studies on household participation in recycling/buy-back at designated centres show low participation. A study by Balqis (2009) on the recycling program in Pandan Indah residential area in KLFT showed inconsistency in the operational schedule of the recycling/buy-back centre due to the high operational costs. The buy-back centre was managed by Alam Flora Sdn Bhd (AFSB), a private solid waste concessionaire with the responsibility to manage, collect and dispose solid waste. Another problem identified was difficulty in locating recycling bins in a study of residential areas in Selangor, Ampang Jaya and Subang Jaya (Octania, 2005).

A statistical study on factors affecting recycling activities in a Malaysian middle-class municipality in Subang Jaya, Selangor, identified that awareness creation should be given high consideration (Chenayah, Agamuthu, & Takeda, 2007). The study suggested an increase in recycling facilities. Another study also suggested monetary incentives approach to boost recycling activities at the household level (Agamuthu, Fauziah, Khidzir, & Noorzamimah Aiza, 2007). None of the various studies conducted locally, investigated in detail the problems of the households carrying out recycling activities, considering the various recycling methods and socio-economic background and demography of such households.

This investigation set out to analyse the impacts of the nationwide recycling campaign on Malaysian households and to identify the underlying factors involved in recycling and those that are not categorized as recyclers and non-recyclers. For these latter groups, the reasons for non-involvement will be analysed and possible remedies will be identified. Specifically, the study will identify the characteristics of Malaysian recyclers and non-recyclers from their socio-economic backgrounds and their knowledge of recycling so as to obtain their profiles. The outcome of the study will be used to improve the existing recycling program and modify the applied strategy where necessary at the local level and specifically at the household level.

Background of the study

The first attempt in Malaysia to encourage household recycling activity was initiated in January 1993 through the National Recycling Campaign. The second nationwide recycling and awareness campaign was launched on the 2nd of December 2000 with the involvement of several stakeholders including local authorities, business enterprises, commercial centres, educational institutions and the private solid waste concessionaires with a view to enhancing community-based participation. The targeted household recycling participation rate by 2020 as spelt out in the 8th Malaysia Plan was 25% (Malaysia, 2001).

The past 10 years had seen a gradual increase in households performing recycling in Malaysia. This ranged from the old tradition of door-to-door itinerant buyers of old newspapers to the introduction of various recycling methods such as recycle bins, recycling centres or buy-back centres. These are in addition to the continuous educational and awareness recycling campaigns. There is still a lack of research to assess the impact of the recycling program on the society comprehensively by considering the various methods of recycling in this country.

The great potential of recycling is shown in the composition of MSW with about 45% food waste (or wet waste) and 24% plastics, 7% paper, 6% iron and glass and other types of waste (Noor, Yusuf, Abba, Hassan, & Din, 2013). Of this composition, 37% are potentially recyclable items that can be realized through source separation, fully dependent on the household's ability to undertake recycling.

The launching of the Solid Waste Management and Public Cleansing Act 2007 (Act 672) placed emphasis on source separation activities by households. As part of the strategic thrust of the Third Outline Perspective of Malaysia Solid Waste Plan, the government will not only consider the installation of incinerators for safe and efficient disposal of waste but will also formulate strategies for waste reduction, reuse and recycling as part of a comprehensive waste management policy (Yahaya, 2008). Recycling has been emphasized in the National Policy of Solid Waste Management in Malaysia that is conceptualized using the 3R (Reduce, Reuse and Recycle) approach.

Method

Three middle–high income residential areas in KLFT were selected: Bangsar, Taman Tun Dr. Ismail (TTDI) and Wangsa Maju. Besides the limited number of public recycling facilities, the three areas have been selected from the AFSB list of recycling/buy-back centres consisting of two fixed and eight mobile centres (Alam Flora, 2008). Other types of recycling facilities such as recycling centres and mobile recycling/buy-back centres provided by charity bodies and non-government organizations (NGOs) are also included. The conventional recycling collection by the formal sector and door-to-door itinerant buyers were also part of the study. A detailed recycling scenario in Malaysia is shown in Fig. 1. Two methods of recycling services to the households are door-to-door itinerant buyers and collection (workers collecting separated recyclable items in plastic bags put side by side with the residential garbage bins) (Zen, 2007).

The demography and socio-economic information of the research areas were as follows: The number of male and female residents was 64,005 (49%) and 66,618 (51%) respectively. The racial composition of the area is 38% Malay (*Bumiputra*), 43% Chinese, 10% Indian and 9% other races (*Annual Malaysian Statistical Book*, 2004). The age distribution of the residents showed that 27% of the residents are between 0 and 14 years old, 46% of the residents are between 15 and 39 years old, 23% are 40–64 years old and 4% are more than 65 years old. The monthly gross income of

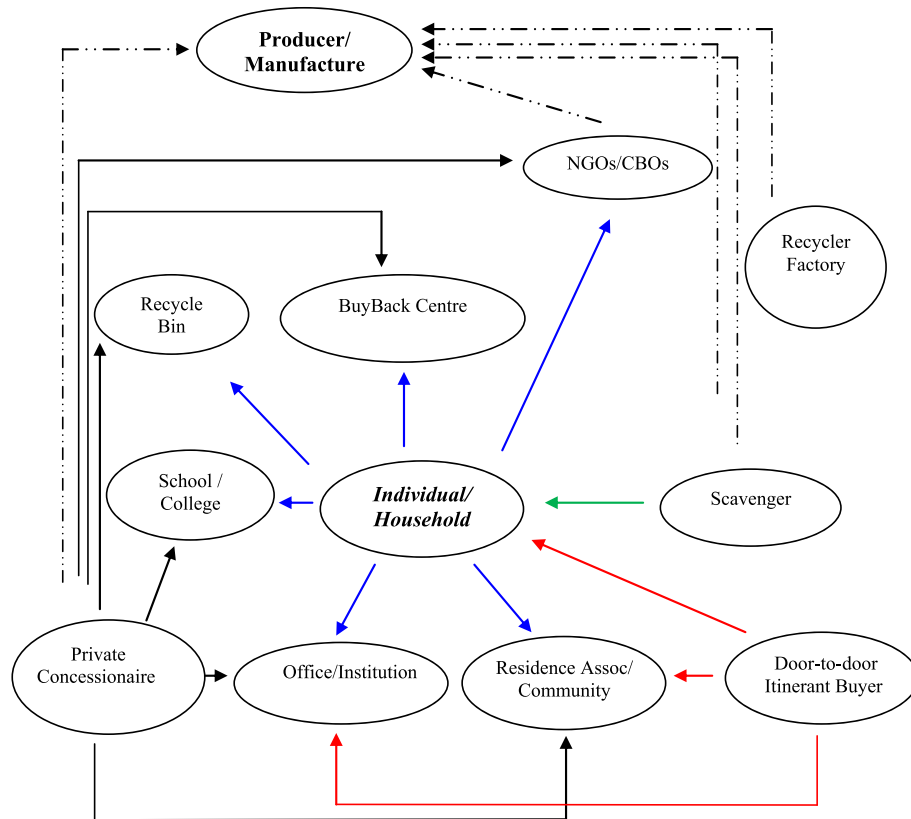


Fig. 1. The entity of Malaysia recycling society.

households for residential areas in KLFT was MYR 4105 (US\$1368.33) (Malaysia, 2001).

The sample size determination was generated from the total populations of the three residential areas of 130,623 (Annual Statistical Year Book, 2004). Using households comprising of five family members as a unit, the identified target population was 26,125 householders. Using the sample size generation formula from Mendenhall, Ott, and Scheaffer (1996) and to fulfil the analysis requirement, 460 sample sizes representing the households were used. The head of the household was prioritized to respond to the questionnaire. However, the wife/mother or any young adult over 18 years could be involved as a respondent when there was difficulty in interviewing the head of the family. The houses selected in the residential areas were based on their locations within a radius of 30 km from the recycling centre and were randomly selected.

Data analysis

Factor analysis was used to identify the underlying factors that motivate recyclers and inhibit non-recyclers from participating in recycling through the questionnaire on a Likert scale of 1–5. Earlier studies applied the same approach with different types of recycling activities and facilities (Bolaane, 2006; Dahlén & Lagerkvist, 2010; Ittiravivongs, 2012; Kassim & Ali, 2006; Martin et al., 2006). The analysis is needed for the practical information to strengthen and improve the existing recycling approach. The analysis discrimination method as applied in Lansana (1992) was used to differentiate recyclers and non-recyclers on the basis of socio-economic and knowledge attributes. The information gathered is important to identify the characteristics of the recycling society that makes the strategy more applicable to the existing community.

Results and discussion

Socio-economic profile of respondent

The socio-economic profile of the respondents is shown in Table 1. About 90.1% of the respondents had formal education with 32.6% having high school education and 22.8% degree holders. 82.2% own their own houses, 37% of the houses are two-storey terraced types, 20.4% are apartment/flats, 17.0% are one-storey terraced and 16.3% are condominium/apartments. Private workers (self-employed) make up the highest number of respondents with a total of 122 respondents (or 26.5%) out of the 460. The average household monthly income was MYR 5700.00 compared to MYR 4105 (US\$ 1368.33) stated in the Eighth Malaysia Plan (Malaysia, 2001).

In the three case study areas, about 23% of households practice 'bring-in' system, through public recycling facilities provided under the nationwide recycling campaign such as recycle bins or recycle/buy-back centre. About 31% of the recovered items are sold to door-to-door itinerant buyers and 19% of separated recyclable items are put near the marked garbage bins to allow garbage collectors to take them separately. There is no special recyclable collection provided by the solid waste company while some informal recycling practices have been performed by their collection crew as additional sources of income.

The descriptive analysis of the study revealed that 51.3% (236 respondents) were aware and 48.7% unaware of the facilities and recycling programs in their areas. Only 8% (36 respondents) of those who were aware of the facilities joined the program within the last 2–3 years and 7% (31 respondents) joined over the past one year. The two most popular recycling facilities of the formal recycling program are recycling/buy-back centre (48.3%) and recycle

Table 1
Comparison of socio-economic and knowledge characteristics of household recyclers and non-recyclers.

| Attribute and basic variable | Recyclers | Non-recyclers |
|---|---|--|
| Socio-economic attribute | Overall 62% of original grouping cases (recyclers and non-recyclers) can be classified by five variables. | |
| 1. Education | 28.8% Graduate | 81.4% HSC |
| 2. Type of House | 45% in two-storey terraced homes | 66.2% 1 one-storey homes |
| 3. Race | 45% Chinese | 70.3% Malay |
| 4. Monthly Household Income | 84.2% > MYR 3500.00 | 84.2% < MYR 3500.00 |
| 5. House ownership | 85.9% owners | 20.4% owners |
| Knowledge attribute | Overall 69.8% from original cases can be classified accurately using two variables. | |
| 1. Know types of recyclables | 77.5% know types of recyclables | |
| 2. Aware of recycling program in the neighbourhood. | | 64.3% not aware of recycling program in the neighbourhood. |

bins (43.2%). The average distance to the recycling centre is 2.10 km with 8.15 min of travel time while the average payment received from the buy-back centre was RM 5.74 per month.

Differentiation of household recycler and non-recycler

From the results of the questionnaires and oral interviews, 191 households (41.5%) carried out at least one form of recycling described in Fig. 1, and are classified as recyclers. Conversely, 269 respondents (58.5%) did not practice source separation and are categorized as non-recyclers. The 46% of canonical correlation value explains the differentiation ability of two discriminate functions, hence socio-economic and knowledge function. The result of discriminate analysis distinguished 62% of original grouping of recyclers and non-recyclers using five variables of socio-economic characteristics: education, type of house, race, house ownership, and monthly household income (Table 1). The Null hypothesis of equal populations of covariant matrix showed the significance of these variables.

In general, socio-economic characteristics of household recyclers showed that 84.2% of them are from the middle income group with an average monthly income above MYR 4000. 28% of them have tertiary education, 45% live in two-storey terraced houses, 45% are of Chinese origin and 85.9% reside in their own houses. Another positive factor is that Taman Tun Dr. Ismail and Bangsar residential areas have strong residential associations for community-based recycling activities. An earlier study by Jacobs, Bailey, and Crews (1984) observed positive relationships of household recycling participation with family income and higher education levels. Higher socio-economic status and house ownership (Forshaw, Hay, & Wright, 1991) generate more recyclable items.

The socio-economic profile of non-recyclers showed 81% to have STPM (Sijil Tinggi Pelajaran Malaysia) (equivalent to High School Certificate (HSC)), 70% are Malay, 66% live in one-storey houses and 84.2% have an average monthly income below MYR 4000.00. The non-recyclers in Malaysia are dominated by the low income group with lower educational levels, living in one-storey houses and are predominantly Malays. Forshaw et al. (1991) reported that non-recyclers are more likely to be under 24 years old, from lower socio-economic groups, single and twice as likely to live in council houses or flats. It is important to highlight the type of housing as it relates to storage and ease of collection from the household perspective.

The result of the study on the level of knowledge about recycling showed that 78% of the recyclers know the various types of recyclables compared to non-recyclers. 64% of the non-recyclers were not even aware of the recycling program in their neighbourhood compared to recyclers. A person's knowledge of the local recycling program, particularly what to recycle, is an important factor influencing recycling participation. Early researches conducted by

(Lansana, 1992; Scott, 1999; Simmons & Widmar, 1990; Vining & Ebreo, 1990) supported the statement. The study also intuitively showed that individuals who are more dedicated to the environment and proud of their environmental responsibilities would practice what they believe in. Furthermore, the identification of knowledge and commitment to recycling were used as the strongest predictors on internal facilitators (Hornik, Cherian, Madansky, & Narayana, 1995). Two of the attributes investigated in this study, 'recycling is important', and 'level of solid waste importance compared to other environmental problems' could not differentiate between recyclers and non-recyclers.

The results are in line with other recycling behaviour studies on the fact that recyclers are predominantly people with high income and education, own houses (Everett & Pierce, 1992; Forshaw et al., 1991; Lansana, 1992) and are concerned with the environment. Conversely, non-recyclers have lower education and income, are mostly tenants and consist of Malays. Most of the non-recyclers live in single storey houses. As such, they faced difficulties in storing the recyclable items.

Household recycler motivation

When factor analysis was conducted on the list of various reasons for recycling, six factors were shown as influencing recycling by households in Malaysia. The six underlying factors are concerns over solid waste management, concerns over environment, social influence, recycling facilities, monetary motivation and altruism. These factors were explained by 72.0% of explained cumulative variances (Table 2).

The six identified factors were considered as adequate in explaining variances in the item variables with KMO (Kaiser Meyer Olkin). The 0.766 (MSA) value shows that the distribution is adequate for conducting factor analysis and Bartlett's Test of Sphericity is significant at p value $0.00 < 0.05$. The determination of factor number with Eigen value of more than 1.0 (Kaiser, 1974) and the Scree Catell test (Catell, 1966) explained the variance percentage shown in Table 2 and describe the accuracy of the variables and reasons for households to recycle. The motivating factors affecting recycling are shown in Table 3.

Table 2
Determination summary of factor number with Kaiser Criteria or rule of Eigen value on motivation to recycle.

| Factor | Eigen value | Explained variance (%) | Cumulative variance explained (%) |
|--------|-------------|------------------------|-----------------------------------|
| 1 | 5.78 | 28.9 | 28.9 |
| 2 | 2.45 | 12.3 | 41.2 |
| 3 | 2.17 | 10.8 | 52.0 |
| 4 | 1.58 | 7.9 | 59.9 |
| 5 | 1.33 | 6.7 | 66.6 |
| 6 | 1.08 | 5.4 | 72.0 |

The first factor identified the concerns from the recyclers on various problems associated with MSW in Malaysia. This factor was found to be a materialization of the concerns on the negative impacts. It is shown in the form of responsibility by taking preventive action for self-improvement or altruistic behaviour (Schwartz, 1977). The factors cover 28% of the variances formed. High Cronbach's Alpha value of 0.89 showed strong correlation among the variables forming the factors. This result shows the sensitivity of households towards the current MSW management and has translated into the households' responsibility to overcome disappointment with the existing MSW trends by taking part in recycling. The individual's perception of certain waste diversion policies was found as the important predicting behaviour. Recyclers perceived a greater need than non-recyclers over recycling and indicated a commitment to further participation if recycling programs were expanded. This fact was shown in Lansana (1992) and Scott (1999).

The research established that the second factor, 'Concerns over Environment', contributed about 12.3% of the overall variance value. The high Cronbach's Alpha value 0.94 also showed the level of strong correlation between item variables. This factor is translated as altruistic behaviour as shown by Dunlap and (Corral-Verdugo & Armendaris, 2000; Scott, 1999; Scott & Willits, 1994). In the comparison of the factor variance percentages, the first factor explained 28.9%, and the second factor, 12.3% of the overall variance. This shows an awareness of the waste management problem at KLFT.

These findings showed that recycling activity has become a social norm for recyclers. The social environment for recycling with a strong community bond or society group will enhance recycling behaviour. The factor of 'social influence' is explained by 10.8% of variance and a strong correlation of 0.82 between variable items. The 'available facility' or service is the fourth factor for households to participate in recycling. It is explained by 7.9% of variance and a correlation of 0.94 between variable items. The fifth factor, 'monetary motivation', is also one of the main motivations for households to recycle with a Cronbach's Alpha value of 0.91 and a strong correlation between two variable items at 6.66%. These are indications

Table 3
Household recycler motivation.

| Name of factor | Alpha value |
|--|-------------|
| Factor 1: Concerns over solid waste management | 0.89 |
| Absence of basic rules in current solid waste management | |
| Plan for incinerator development | |
| Disappointment over current solid waste management | |
| Cost reduction in government spending for solid waste management | |
| Training youth to love the environment | |
| Factor 2: Concerns over environment | 0.94 |
| Depletion of natural resources | |
| Saving on landfills for disposal | |
| Improvement in environmental quality | |
| Saving energy in production | |
| Reduction of waste disposal problem | |
| Reduction in spread of waste residual | |
| Factor 3: Social Influence | 0.82 |
| Pressure/influence from friends | |
| Friends or neighbours practice recycling | |
| Pressure from family members | |
| Factor 4: Recycling Facility | 0.94 |
| Recycling facility nearby | |
| Availability of recycling facility/convenience | |
| Factor 5: Monetary Motivation | 0.91 |
| Receiving payment | |
| Generating extra income | |
| Factor 6: Altruism | 0.63 |
| Generating money for charity | |
| Satisfaction of involvement in community programs | |

Table 4

Summary of determining the number of factors using criterion of Kaiser or Eigen value for barriers to recycle.

| Factor | Eigen values | Explained variance percentage (%) | Cumulative explained variance percentage (%) |
|--------|--------------|-----------------------------------|--|
| 1 | 4.38 | 25.77 | 25.77 |
| 2 | 1.62 | 9.50 | 35.27 |
| 3 | 1.32 | 7.75 | 43.02 |
| 4 | 1.20 | 7.07 | 50.09 |

of the effectiveness of the door-to-door itinerant buyer in boosting recycling practice. The sixth factor, 'altruism', showed the least variance percentage of 5.4% and a moderate Cronbach's Alpha value of 0.63.

This study showed similar trends with other behavioural studies of recycling in the west with different types of recycling facilities. This effect of 'monetary incentive' was also noted by Agamuthu et al. (2007). Another study by (Oskamp et al., 1998) had an Alpha Cronbach value of 0.60 from the 'monetary motivation' factor and an explained variance percentage of 9.6%.

The ranges of Alpha Cronbach values for the other basic factors – 'altruism', 'money generation for charity' and 'satisfied with community program' were lower in comparison to the rest. This showed that the Schwartz altruism behaviour which was used as a guide to understand the individual behaviour of recyclers is not the main motivation for the households recycling practice in KLFT.

Barriers to household non-recyclers

The analyses of the basic factors show the fourth factor had an Eigen value of 1.20 (Kaiser, 1974). It is also supported by the Scree Catell test. The required criteria for significant factor load for every variable item is 0.40 for a sample size of 268. However, common requirements have to be taken into account for each variable. The first requirement of factor analysis involved the KMO (Kaiser Meiyer Olkin) Measures of Sampling Adequacy (MSA) test for distribution value. Extraction was made analysing the main components with Varimax rotation. The KMO value was 0.739 at the mediocre level and showed that the distribution value is adequate for conducting factor analysis and Bartlett's Test of Sphericity is significant at p value < 0.05.

From the varimax rotation and method determining the number of factors using the criterion of Kaiser or Eigen value, three basic factors were summarized as the reasons behind recycling barriers as shown in Table 4. The three factors are 'recycling is a burden', 'personal inconvenience', and 'recycling facility' with Alpha Cronbach value of 0.82, 0.53 and 0.49 respectively (Table 4). The three factors

Table 5
Recycling barriers of non-recyclers.

| Basic factor | Alpha value |
|---|-------------|
| Factor 1: Recycling is a burden | 0.82 |
| Recycling makes my house messy | |
| Recycling brings additional cost to me | |
| Recyclable items attract pests | |
| The incentive is not attractive | |
| No monetary incentive earned for recyclable items | |
| Factor 2: Personal Inconvenience | 0.53 |
| Recycling is a hassle | |
| No time to separate and collect recyclable items | |
| No storage for recyclable items at home | |
| Factor 3: Recycling facility | 0.49 |
| No recycling facility nearby | |
| No door to door recyclable collection | |

were formed from the ten reasons of barriers to recycling which explained about 50% of the variance (Table 5).

These factors consisted of several variable items such as recycling cost, messy houses and pests that make recycling less attractive to the households. The variable item of 'no monetary incentives earned for recyclable items' indirectly showed a lack of awareness of the non-recycler or inaccessible information about the existence of buy-back/recycling centres in the neighbourhoods.

The second factor, 'personal inconvenience' is related to the personal or individual inconvenience in recycling. The impact of personal inconvenience was also often stated by non-recyclers in the study by (Gamba & Oskamp, 1994) as 'no storage facility to keep recyclable items at home'. The third factor, 'inconvenient recycling facility' is related to the reason for not having recycling facilities nearby. The same reason has been mentioned in a study by Octania (2005) in a residential area in Subang Jaya, Selangor, Malaysia. That study showed the lack of recycling facilities in KLFT and Selangor area as inhibitors to recycling. The impact of 'Costly or less monetary incentive' as one of the basic factors observed in this study for non-recyclers is similar to the study of Vining and Ebreo (1990) and Gamba and Oskamp (1994).

Conclusion and policy implications

As source separation was stated in Act 672, where households have to do a separation of recyclable items from solid waste, this study provides useful information on the current practice of recycling in Malaysia. At the same time, the existing recycling strategy needs to improve household participation in Malaysia.

The study has been contributes to the existing literature of household recycling in profiling the recyclers and non-recyclers with more comprehensive information compared to local studies (Agamuthu et al. 2007; Balqis, 2009; Chenayah et al., 2007; Octania, 2005) and similar studies in other countries (Everett & Pierce, 1992; Forshaw et al., 1991; Lansana, 1992). It contains the difference in socio economics level, awareness level, knowledge related recycling acquired and motivation and barriers in performs recycling. In further, it has direct implication to the recycling policy strategic to improve current situation of recycling program and campaign in Malaysia.

To increase awareness, the study implies the need to strategize spreading information on recycling facilities and programs at the local level. This is because many non-recycling residents, are not aware of the recycling programs and activities in their areas. It can be done through leaflet distributions in the neighbourhoods or local communities or embedding the recycling programs into other community events.

The non-recycler group in Malaysia is dominated by the low income group with low levels of education, living in single storey houses and being predominantly Malay. The recycling programs currently provided largely depend on the household's willingness to bring the recyclable items to the nearest recycling buyback centre or bring-in system. In spite of this, the group believes that 'recycling is burden' and of 'personal inconvenience'. The low income group also cited 'recycling brings additional cost' and 'no monetary incentive earned for recyclable items' as their reasons for not recycling. Some of them are not even aware of the recycling facility in their neighbourhood. From the results, the urgency is felt to overcome the limited space for recyclable items in the households and the need to improve the existing recycling strategy that emphasizes on the benefit and ease in carrying out recycling.

On the other hand, from the total of 460 respondents, about 42% participated in the recycling program that largely depends on the informal sectors door-to-door itinerant buyers (31%), bring-in systems (23%) and adding recyclable items to plastic bags placed

next to the garbage bin (19%). The last one implies the needs of specific recycling facilities at the household level, while the largest percentage shows the domination of informal sector recycling followed by the use of recycle bins.

The household recyclers described in the socio-economic characteristics are a middle income group with high level of education and income. They are of the Chinese race, homeowners and live in double-storey houses. Investigated factors such as 'concern over waste disposal', 'concern over environment', 'social influence' and 'altruism' showed recycling practice to be a social norm among recyclers. The findings showed highly motivated household recyclers that carry out recycling despite the inconvenience of bring-in systems and lack of recycling facilities at the household level. The involvement of business enterprises in giving the economic incentives to encourage recycling participation, and how to formalize the informal sector recycling needs to be addressed in future Malaysian recycling scenarios to play a greater role in household recycling.

References

- Agamuthu, P., Fauziah, S. H., Khidzir, K. M., & Noorzamimah Aiza, A. (September 2007). *Sustainable waste management – Asian perspectives. International conference on sustainable solid waste management*, 5–7. Chennai: India. pp. 15–26.
- Ahmed, S. A., & Ali, S. M. (2006). People as partners: facilitating people's participation in public–private partnerships for solid waste management. *Habitat International*, 30, 781–796.
- Annual statistical year book(2004). Statistic Department of Malaysia.
- Alam Flora. (2008). *3R Annual Report 2007*, 3R Department, Alam Flora Sdn. Bhd.
- Shah Alam, Selangor.H. Balqis, household recycling in Pandan Indah. Undergraduate Thesis. Engineering Faculty, Technology University of Malaysia, 2009.
- Balqis, H. (2009). *Household recycling in Pandan Indah* (Undergraduate Thesis). Engineering Faculty, Technology University of Malaysia.
- Bhuiyan, S. H. (2010). A crisis in governance: urban solid waste management in Bangladesh. *Habitat International*, 34, 125–133.
- Bolaane, B. (2006). Constraints to promoting people centred approaches in recycling. *Habitat International*, 30, 731–740.
- Burnley, S. J. (2007). A review of municipal solid waste composition in the United Kingdom. *Waste Management*, 27, 1274–1285.
- Calò, F., & Parise, M. (2009). Waste management and problems of groundwater pollution in karst environments in the context of a post-conflict scenario: the case of Mostar (Bosnia Herzegovina). *Habitat International*, 33, 63–72.
- Catell, R. B. (1966). The screen test for the number of factors. *Multivariate Behavioral Research*, 1, 245–276.
- Chenayah, S., Agamuthu, P., & Takeda, E. (2007). Multi-criteria modelling on recycling of municipal solid waste in Subang Jaya. *Malaysian Journal of Science*, 26, 1–16.
- Corral-Verdugo, V., & Armendaris, L. I. (2000). The new environmental paradigm in Mexican community. *Journal of Environmental Education*, 31, 25–31.
- Dahlén, L., Åberg, H., Lagerkvist, A., & Berg, P. E. O. (2009). Inconsistent pathways of household waste. *Waste Management*, 29, 1798–1806.
- Dahlén, L., & Lagerkvist, A. (2010). Pay as you throw: strengths and weaknesses of weight-based billing in household waste collection systems in Sweden. *Waste Management*, 30, 23–31.
- Everett, J. W., & Pierce, J. J. (1992). Social networks, socio-economic status and environmental collective action: residential curbside block leader recycling. *Journal of Environmental Systems*, 21, 65–84.
- Fiorillo, D. (2012). Household waste recycling: national survey evidence from Italy. *Journal of Environmental Planning and Management*, 1–27.
- Forshaw, J., Hay, A., & Wright, G. (1991). Public participation and recycling performance: explaining program success. *Public Administration Review*, 51, 526–532.
- Gamba, R., & Oskamp, S. (1994). Factors influencing community residents' participation in commingled curbside recycling programs. *Environment and Behavior*, 26, 587–612.
- Gellynck, X., Jacobsen, R., & Verhelst, P. (2011). Identifying the key factors in increasing recycling and reducing residual household waste: a case study of the Flemish region of Belgium. *Journal of Environmental Management*, 92, 2683–2690.
- Hornik, J., Cherian, J., Madansky, M., & Narayana, C. (1995). Determinants of recycling behavior: a synthesis of research results. *Journal of Social Economics*, 24, 105–127.
- Ittiravivongs, A. (2012). Household waste recycling behavior in Thailand: the role of responsibility, 2012 International Conference on Future Environment and Energy, *International Proceedings of Chemical, Biological and Environmental Engineering*, 28, 21–26.
- Jacobs, H. E., Bailey, J. S., & Crews, J. (1984). Development and analysis of a community-based resource recovery program. *Journal of Applied Behaviour Analysis*, 17, 127–145.

- Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika*, 39, 31–36.
- Kassim, S. M., & Ali, M. (2006). Solid waste collection by the private sector: households' perspective — findings from a study in Dar es Salaam city, Tanzania. *Habitat International*, 30, 769–780.
- Kinnaman, T. C. (2006). Policy watch: examining the justification for residential recycling. *Journal of Economic Perspectives*, 20, 219–232.
- Lansana, F. (1992). Distinguishing recyclers from nonrecyclers: a basis for developing recycling strategies. *Journal of Environmental Education*, 23, 16–23.
- Malaysia. (2001–2005). *The eight Malaysia plan*. Kuala Lumpur: Government Printed, 2001.
- Mendenhall, W., Ott, L., & Scheaffer, R. L. (1996). *Elementary survey sampling*. California: Duxbury Press.
- Martin, M., Williams, I. D., & Clark, M. (2006). Social, cultural and structural influences on household waste recycling: a case study, resources. *Conservation and Recycling*, 48, 357–395.
- Noor, Z. Z., Yusuf, R. O., Abba, A. H., Hassan, M. A. A., & Din, M. F. M. (2013). An overview for energy recovery from municipal solid wastes (MSW) in Malaysia scenario. *Renewable and Sustainable Energy Reviews*, 20, 378–384.
- Nzeadibe, T. C. (2009). Solid waste reforms and informal recycling in Enugu urban area, Nigeria. *Habitat International*, 33, 93–99.
- Octania, P. R. (2005). *Household behaviour towards waste recycling in Ampang Jaya and Subang Jaya, Selangor*. Master Thesis. Faculty of Environment, Universiti Putra Malaysia.
- Oguntoyinbo, O. O. (2012). Informal waste management system in Nigeria and barriers to an inclusive modern waste management system: a review. *Public Health*, 126, 441–447.
- de Oliveira Simonetto, E., & Borenstein, D. (2007). A decision support system for the operational planning of solid waste collection. *Waste Management*, 27, 1286–1297.
- Oskamp, S., Rachel, L., Burkhardt, P., Schultz, W., Hurin, S., & Zelezny, L. (1998). Predicting three dimensions of residential curbside recycling: an observational study. *The Journal of Environmental Education*, 29, 37–42.
- Othman, S. N., Noor, Z. Z., Abba, A. H., Yusuf, R. O., & Hassan, M. A. A. (2013). Review on life cycle assessment of integrated solid waste management in some Asian countries. *Journal of Cleaner Production*, 41, 251–262.
- Owusu, G., Oteng-Ababio, M., & Afutu-Kotey, R. L. (2012). Conflicts and governance of landfills in a developing country city, Accra. *Landscape and Urban Planning*, 104, 105–113.
- Rockson, G. N. K., Kemausuor, F., Seasey, R., & Yanful, E. (2013). Activities of scavengers and itinerant buyers in Greater Accra, Ghana. *Habitat International*, 39, 148–155.
- Schwartz, S. H. (1977). Normative influences on altruism. In I. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 10; pp. 221–279). Academic Press.
- Scott, D. (1999). Equal opportunity, unequal results determinants of household recycling intensity. *Environment and Behavior*, 32, 267–290.
- Scott, D., & Willits, F. K. (1994). Environmental attitudes and behavior: a Pennsylvania survey. *Environment and Behavior*, 26, 239–260.
- Simmons, D., & Widmar, R. (1990). Participation in household solid waste reduction activities: the need for public education. *Journal of Environmental Systems*, 19, 323–330.
- Thøgersen, J. (1996). Recycling and morality. A critical review of the literature. *Environment and Behavior*, 28, 536–558.
- Van den Bergh, J. C. J. M. (2008). Environmental regulation of households: an empirical review of economic and psychological factors. *Ecological Economics*, 66, 559–574.
- Vining, J., & Ebreo, A. (1990). What makes a recycler? A comparison of recyclers and nonrecyclers. *Environment and Behavior*, 22, 55–73.
- Wilson, D. C., Velis, C., & Cheeseman, C. (2006). Role of informal sector recycling in waste management in developing countries. *Habitat International*, 30, 797–808.
- Yahaya, N. (Oct. 2008). Solid waste management in Malaysia: policy, issues and strategies. In *EA-SWMC EU – Asia Solid Waste Management Cycle Conference* (pp. 23–28). Casuarina Impiana Hotel, Perak.
- Zen, I. S. (2007). *Amalan Kitar Semula Isirumah di Kuala Lumpur*. Program Pengurusan persekitaran. Pusat Pengajian Siswazah. Universiti Kebangsaan Malaysia. ISBN 978-983-2975-96-0.
- Zia, H., & Devadas, V. (2008). Urban solid waste management in Kanpur: opportunities and perspectives. *Habitat International*, 32, 58–73.