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An Assessment of Household's Preference for Curbside Recycling Attributes in Putrajaya, Malaysia: A Choice Modelling Approach

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Abstract
This study evaluated attribute preference for curbside recycling among households in Putrajaya, Malaysia. The success of a recycling program hinges mainly on participation, which is influenced by supporting facilities. Providing appropriate facilities is necessary to motivate and encourage participation in curbside recycling. This study employed stated preference choice experiment technique on 431 randomly selected households in Putrajaya, Malaysia and Conditional Logit and Random Parameter Models were used to evaluate their attribute preference. The results obtained indicated that the utility derived from participating in curbside recycling increases most significantly with provision of multiple waste separation bins and frequency of collection. Interestingly the results also revealed that, respondents derive utility from increased number of waste separations. The outcome of the analysis also identified some heterogeneity in preference of the households for the attributes of curbside recycling. The outcome of this study can make-available to policy makers or solid waste service providers the much-needed waste separation facilities desirable to support households' waste separation activities. This will, equip policy-makers with the ability to match household demand for, and affordability in supply of the facilities. This will help to inspire waste minimisation philosophy, thereby maximising the social net benefit from recycling, and minimising the negative environmental impact of mixed waste disposal. This will ensure an efficient and sustainable solid waste management.

Keywords: Choice Experiment, Conditional Logit Model, Curbside Recycling, Household Preferences
JEL Classification Codes: C35, D11, C52, Q53

1. Introduction

Over the past decade, solid waste generation and disposal have evolved as a crucial health, environmental and economic concern in Malaysia. The amount of solid waste generated daily has reached about 33,000 tons, exceeding the forecasted amount of 30,000 tons by 2020 (Agamuthu & Fauziah, 2011, Solid Waste and Public Cleansing Management Corporation [SWcorp], 2015). Current projected waste generation is estimated at 49,670 tons/day by the year 2020 (Ministry of Housing and Local Government [MHLG], 2015). Solid wastes are mostly disposed via landfilling but this disposal method is not sustainable as most landfills are approaching or have already exceeded their maximum capacities (Moh & Abd Manaf, 2014). Additionally, opening up new landfills is challenging due to the rising opportunity cost of land and the negative externalities associated with landfilling activities. More so, new landfills located further away from urban areas lead to increased economic and environmental costs as a result of the transportation distance. This situation creates the need for more sustainable waste practices such as waste minimizing through reducing waste generation, reusing and most importantly, recycling.

Household wastes constitute an important segment of the municipal waste stream as households are the major producers of municipal waste in the country. Approximately 65% of municipal wastes are generated by households, 28% from the commercial and institutional sectors, and 7% from the industrial sector (MHLG, 2015) as shown in figure 1. Recyclables constitute about 70-80% of the waste generated by households and these materials unfortunately, end up in landfills (Moh & Abd Manaf, 2014). Thus, recycling offers a good option for managing waste problem in the country. Households can play a significant role in reducing waste by separating recyclable materials but this is only possible if the necessary facilities such as curbside collection are made available.

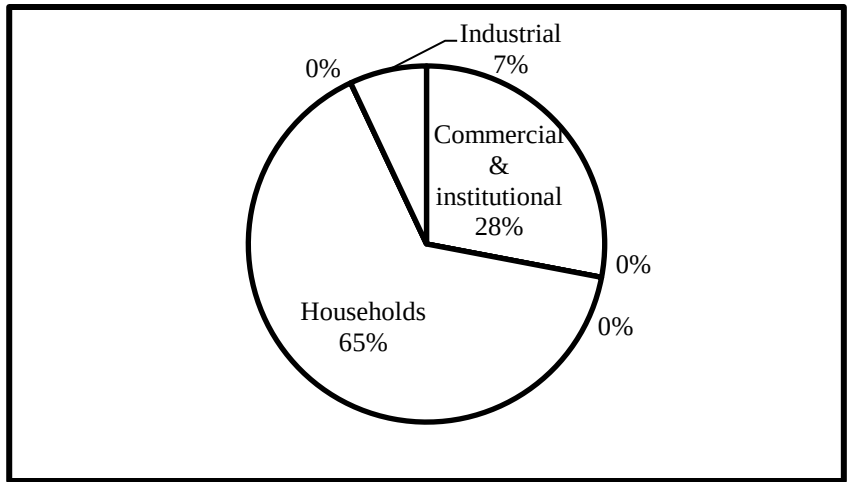

Figure 1: Sectorial Composition of Municipal Solid Waste
Source: MHLG (2015).

Curbside recycling contributes to municipal solid waste management by averting materials with economic significance from the waste stream, thereby, decreasing cost of collection and disposal. Curbside recycling is also identified to offer potential economic and environmental benefits such as providing greater quality and less contaminated recycling materials, lessen negative environmental and health impacts, and create jobs and revenue generation opportunities (Owusu, Adjei-Addo, & Sundberg, 2013; Fujii, 2008; Aphale, Thyberg, & Tonjes (2015). In order to promote sustainable waste management, the Malaysian government has implemented mandatory recycling program in selected states of the country of which Putrajaya is one of them. The programme, which was formulated under the Solid Waste and Public Cleansing Management Act 2007, makes it mandatory for households within the areas of jurisdiction to sort their waste into stipulated categories prior to curbside disposal (SWCorp, 2015). Despite the implementation of the separation at source program, waste separation practice is yet to succeed (Moh & Abd Manaf, 2017); Correspondence with officials of the SWCorp in 2017. One of the reasons cited was lack of household participation (Razali, Weng Wai, Daud, & Hon Choong (2017; Correspondence with officials of the SWCorp (2017) cite source saying that Putrajaya have not been successful).

According to Wright (2012), household participation in a curbside recycling program is more likely to increase when facilities most preferred by the households are incorporated in the program. Thus, in order to motivate households to participate in curbside recycling such as the recently

implemented waste separation at source programme in Putrajaya, it becomes necessary to evaluate their preferences of curbside recycling attributes. The curbside attributes include recycling bin design, frequency of collection, number of categories of recyclables and fee. This study employed a choice experiment (CE) technique to evaluate curbside recycling attributes most preferred by households and its relative utility value. The outcome of the study could provide useful demand-side information that can be incorporated for sustainable solid waste management design.

The remaining of this paper is structured as follows. Section 2 covers the empirical review and theoretical framework, while Section 3 discusses the methodology. Section 4 discusses the results of the study and finally section 5 concludes and provides some policy implications.

2. Empirical Review

A number of literatures have employed the CE to evaluate improvement in solid waste management services. Gebreeyosus and Berhanu (2019) employed the use of CE on a sample of 150 household to analyze their preferences for improved solid waste management in Akusum city, Ethiopia. Frequency of garbage collection, method of disposal, and the mode of transportation are among the suggested attributes taken into consideration for enhancements in the solid waste management service. The results from the study revealed that, in terms of improvement in waste management services, frequency of garbage collection per week valued highest followed by transportation mode and lastly disposal mechanisms. The study concludes that the outcome the study could help policy makers to set priorities as to which waste services to provide when face with budget constraints. They added that there is the need for policy makers to weigh the perceptions of households in developing waste management policies.

Nainggolan *et al*., (2019) analysed households' preferences for different waste sorting and handling scheme. The result of the CE analysis on a random sample of 1011 households in Denmark indicates that families have varying preferences when it comes to waste sorting programme design. Thus, the study concludes that there is the need to consider the preference of the households for more effective and successful waste sorting programme.

Yuan, Takahashi, and Yabe (2015) examined preferences for the attributes of household kitchen waste source separation services in China. The attribute for kitchen waste source separation considered in the study are: frequency of collection, time of collection, instructor manual, container and compensation. A sample of 401 households was surveyed in the central urban area of Beijing. The findings of the CE study indicated that the

proposed kitchen waste separation programme with regular evening collection is more likely to be embraced by young, educated individuals who have some experience with kitchen waste separation. Nonetheless, this set of responders does not indicate a preference for attributes like a compensation package, a waste-separation container, or an instructor manual. On the other hand, the less educated with less experience in kitchen waste separation experience prefer attributes such as frequent collection, provision of plastic bags, and compensation. The research findings indicate that there exists considerable room for enhancement in Beijing's source separation programme. Moreover, the frequency of collection significantly influences the household participation in the kitchen waste separation at source programme.

Czajkowski, Hanley, and Karine (2015) evaluated the determinant of pro-environment behaviour on households recycling activities in Poland. The study considered number of categories in which waste will be sorted, frequency of collection, and the cost to the households per month as attributes of the proposed waste separation programme. Based on a postal survey conducted among 800 randomly selected houses, on average household preferred more categories than fewer, and they also preferred that the sorted waste be collected twice or four times a month as opposed to only once. The authors concluded that, because sorting at home is thought to be more thorough than sorting at a central facility and they indicated preference for more categories of sorted waste, it is assumed that the households place a high value on doing waste sorting.

Lane and Wagner (2013) used the CE technique to examine the impact of recycling container attributes on households recycling rates in 48 states and the District of Columbia of United States. Using a sample of 879 in US, the results of their research showed that larger, wheeled recycling containers with lids have a greater impact on household recycling rates because they facilitate easy mobility, offer protection from vectors, and lessen the effects of water-logged materials and wind-blown litter. According to the study's findings, making recycling more convenient will ostensibly make trash disposal less convenient. Nevertheless, solid waste authorities ought to carry out more controlled pilot surveys in various communities to determine which container attribute is most cost-effective in raising overall recycling rates and participation.

Karousakis and Birol (2008) employed the CE technique to study the households' preferences for kerbside recycling services in London. The estimate of the CE, which used a sample of 188 homes in the London area, showed that, on average, households are WTP the most for an increase in the quantity of dry materials collected like Paper, glass, aluminium and

textiles, as well as for compost collection. The study also showed that the respondents prefer fortnight collection as compared to weekly collection of recyclables. Additionally the study revealed that significant preference heterogeneity was observed across London. The study concludes that the findings from the study would help local authorities to prioritise their kerbside recycling services and infrastructures. The study further concludes that introduction of deposit refund programme will go a long way at encouraging recycling as opposed to pay-as-you-throw or unit pricing scheme

Othman (2007) aimed to estimate the implicit price for each solid waste management service attributes in Malaysia. The study took into account the following attributes: 1) frequency of collection; 2) mode of transportation; 3) availability of facilities and containers to aid in trash separation at the source; and 4) trade-offs between these attributes. A total of 600 houses in the municipalities of Kajang and Seremban were surveyed. The survey discovered that families place a high value on improvements in solid waste management plan, as seen by their preference for better trash disposal techniques, more frequent waste collection, and better modes of transportation. The assessment also showed that having recycling facilities on hand will promote recycling.

2.1 Theoretical Framework

This study's objective was to analyze household's preference for curbside recycling attributes using choice experiment where specific attributes of the curbside recycling were presented and utility obtained from the recycling activities is determined by the respondents' choices and selection. Choice experiment technique also referred to as choice modelling (CM) is a family of the stated preference techniques of non-market valuation. The technique was initially used in marketing and transportation economics literature, but it became increasingly adopted in areas such as; agricultural, health and environmental economics literature (Bennett & Birol, 2010). The theoretical underpinning of this technique lays in the Lancaster (1966) characteristic theory of value or the theory of consumer demand attributes and its econometric basis is rooted in McFadden (1973) random utility model. The characteristics theory of value shows that individuals gain utility from the characteristics or attributes of the commodities rather than the actual goods themselves. The theory proposed that goods possess a bundle of attributes variously preferred by different individuals. The theory allows the prediction of how preference will change when the options presented to the consumers change by varying characteristics that make the goods.

The choice experiment method is established on the assumption that, programmes, products, or services can be described in terms of their characteristics or attributes and levels they take. Following the identification of the levels and attributes, various profiles of products, services, policies, and programs are created using experimental design, taking into account the levels and attributes that each attribute takes. After that, these profiles are put together into a choice set, which is presented to the intended respondents, who are asked to select the option that offers them the greatest utility out of the available options. An important attribute in CM study is the monetary attribute in the form of tax or price. The monetary attribute makes it possible to estimate welfare in terms of compensation for changes in the degree of attributes of products, services, policies, or programmes, expressed as willingness to pay (WTP) or willingness to accept (WTA) (Hanemann, 1984). Thus, regarding households' waste separation practices, utility might be affected by the attributes, including how frequently the waste is collected, the design or number of recycling bins provided, and several categories of separations subject to their budget constrain.

3. Methodology

The CE survey was conducted from late July to October 2017. This was preceded by a pilot study which allowed for testing the respondents understanding of the survey question most especially the CE questions. Stratified random sampling based on house type was used to determine the number of households to be interviewed in each residential precinct. Systematic random sampling was subsequently employed for data collection, where the first house was randomly selected and subsequently every fifth house was selected. A target of 431 households was predetermined to be surveyed. A face-to-face data collection was conducted through a household door-to-door survey by trained enumerators. This method is noted to be more appropriate (Karousakis & Birol, 2008) as it results in high response rate and usable questionnaires. The response rate was generally high (90%). This is probably due to the method employed or the households' interest in curbside recycling owing to the fact that it is a newly introduced program.

3.1 Study Area

Putrajaya is the third Malaysian federal capital territory after Kuala Lumpur and Labuan. It is situated 25 km south of Kuala Lumpur and 20 km north of Kuala Lumpur International Airport (KLIA), at latitude 2.9264oN and 101.6964oE. Of its entire land area, about 4,931 hectares are converted into parks, lakes, and wetlands. The remainder, which makes up the 20

precinct, is set aside for public utilities, business and residential spaces, and government buildings Putrajaya low carbon green city initiatives report (2018). As a planned city that is serving as the federal administrative center of Malaysia and with the aspiration of being Malaysians green and intelligent low carbon city; Putrajaya under Putrajaya Corporation has undertaken various initiatives aimed at reducing landfill disposal by 50% by the year 2025 Perbadanan Putrajaya (Putrajaya Holdings, 2012). Among the initiatives include; a separation at source pilot program in August 2009 involving 400 homes in precinct 8 and 9 and setting up of buyback center. Despite these initiatives, voluntary recycling practices among the households still remain low. In an effort to increase participation among households, Putrajaya is among the 7 states that consented to the enforcement of the separation at source program in 2015. This is to ensure that the city continues to develop in a balanced and sustainable way in line with its aspiration of being a prior green city in Malaysia.

3.2 Attributes Selection

The purpose of this study is to ascertain household preferences for curbside recycling attributes in Putrajaya, Malaysia, using the CE approach. Determining the curbside recycling facilities' attributes and their levels is the first step in the CE design. A thorough review of the literature and focus group discussion conducted in March and April 2017 were used to identify and choose the attributes employed in this study. Attributes including frequency of collection, number of separation, bin design, and the fee were identified as important for promoting household participation in curbside recycling. Table 1 shows attributes and levels of curbside facilities used in the CE survey.

Table 1: **Attributes and Level used in the Study**

Attributes	Levels	Description
Frequency of collection	2	Once a week (FC1); Twice a week (FC2)

Number of separation	2	Separate waste into 3 (NOS1)and 4(NOS2) categories
Container type	3	Single bin separate bins(CWS1); aesthetic multiple waste separation bin (stack bins and racked plastic bin(CWS2))
Fee per month (percentage increase over the current fee)	4	5, 7.5, 8.75, 10

Note: Italic represents the status quo levels.
Source: Authors Computation

3.3 Model Specification

To illustrate the CE model as used in this study, we assume households were required to make a choice among alternative scenarios which are described in terms of curbside recycling service. The respondent is assumed to have a utility function expressed as:

$$u_{ij} = v(x_{ij}, s_{ij}) + e_i \quad (1)$$

The function implies that for any given alternative *i,* a given level of utility is associated with any alternative curbside recycling service *j*. Utility derived from any of the household recycling depends on the attributes (*X*) of the curbside recycling such as the frequency of collection, container for waste sorting, number of waste separations and the fee associated with each alternative as well as socio-economic characteristics (*S*).

The theoretical basis for the integration of socio-economic characteristics with economic valuation in CE studies is grounded in the random utility theory (Karousakis & Birol, 2008). According to the random utility approach, the utility of a choice comprises two parts: the first part consists of a deterministic and observed component and the second part is the error component e_i (Villalobos & Huenchuleo, 2010). The presence of an error component implies that prediction cannot be made with certainty (Karousakis & Birol, 2008) Thus, the choice of a particular alternative *j* will be a function of the probability that the utility associated with a particular alternative (*j*) is higher than that associated with other alternatives. This is expressed as:

$$prob_i(j/C) = prob(V_{ij} + e_{ij} > V_{ik} + e_{ik}) \quad (2)$$

where C is the complete set of alternatives (*j* and *k*).

Therefore, the probability that alternative *j* will be chosen over all other alternatives as the most preferred choice can be expressed in terms of logistic distribution and can be estimated using the conditional logit model (CLM). This is based on the assumption that the relationship between the

utility and characteristics are linear in parameter and variable functions, and that the error terms are identically and independently distributed (McFadden, 1973; Greene, 2003; Bateman, Carson, Day, Hanemann, Hanley, Hett, Jones-lee, Loomes, Mourato, & Ozdemiroglu, 2003; Karousakis and Birol, 2008) which is expressed as:

$$prob_i(j/C) = \frac{\exp(\mu V_{ij})}{\sum \exp(\mu V_{ic})} \quad (3)$$

The conditional indirect model is estimated as:

$$V_{ij} = \beta_1 X_1 + ... + \beta_n X_n + \beta_b I_2 + ... + \beta_m I \quad (4)$$

where *n* represents the number of curbside recycling facilities, s represents the socio-economic characteristics of the respondents employed to explain the choice of curbside recycling services. β_1 to βn and βa to βm represent the vector of the coefficient of the attributes variables (X) and the interaction terms (*I*).

4. Results and Discussion

4.1 Descriptive Statistics of Respondents

Table 2: Descriptive Statistics of Respondents

Variables	Putrajaya		
	Frequency	Percentages	Mean
Gender			
Male	214	54	
Female	182	46	
Age			37.60
18-30	103	24	
31-45	213	54	
46-60	66	18	
61 and above	14	4	
Race			
Malay	372	94	
Chinese	12	3.0	
Indian	19	2.5	
Others	2	0.5	
Level of education			
Primary	8	2	
Secondary	30	8	
Diploma	97	24	
Degree	181	46	
Postgraduate degree	80	20	

Type of dwelling			
Terrace	247	62	
Semi-detached (SD)	118	30	
Bungalow	21	5	
Townhouse	10	3	
Employment			
Government sector	173	44	
Private sector (full time)	90	23	
Private sector (part-time)	8	2	
Self-employed	28	7	
housewife	16	4	
Retired	26	6	
Other	54	14	
Number of persons in household			4.30
Active environmental organization			
Yes	187	47	
No	209	53	
Income			9537.60
<3000			
3000-6000	16	4	
6001-9000	113	7	
≥9000	189	89	

Source: Authors Computation

In addition to the CE questions, data were collected on the respondents' socio-demographic characteristics and recycling activities. The descriptive analysis of the respondents' socio-demographic characteristics is presented in table 2. The analysis revealed that 54% of the respondents were males while 46% were females. The respondents mean age was approximately 38 years. An overwhelming majority of the respondents were Malay (94%), while the Chinese and Indians were 3% and 2.5% respectively. Approximately 46% of the respondents were degree holders, while 20% were postgraduate degree holders, 24% were diploma certificate holder; while the remaining 10% were secondary school certificate holders and less. Approximately 62% of the respondents dwell in terrace houses, 23% in semi-detached houses (SD), 5%, and 3% dwell in bungalow and townhouses respectively. About 86% of the respondents were government employees, 25% private sector employees, 4% are self-employed, 7% are retirees and 14% comprised of other forms of employment including students. The average household size for the sampled population was 4.29. On the average the respondents mean income is RM9537.60

4.2 Conditional Logit Model and Random Parameter Logit Model

Table 3: CLM, RPL and RPL with Interaction

Variables	Coefficient (S.E)		
	CLM	RPL model	RPL with interactions
FC2	0.28***(0.08)	0.17***(0.08)	1.83**(0.87)
NOS2	0.49***(0.13)	0.42***(0.22)	1.94***(0.65)
CWS2	0.56***(0.10)	1.06***(0.10)	4.28***(0.33)
FEE	-0.05***(0.03)	-0.072***(0.01)	-0.072***(0.01)
FC2_Age			-0.50**(0.21)
FC2_NIH			0.65***(0.16)
NOS_AEO			0.28**(0.13)
CWS2_AEO			0.10***(0.04)
CWS2_NU6			0.21*(0.12)
		Standard deviation	
FC2		1.61***	1.57***
NOS2		0.14	0.01
CWS2		3.76***	3.61***
Observation	2376	2376	2376
Log-likelihood	-1259.96	-967.87	-134.56
PseudoR^2	0.010	0.25	0.26

Source: Authors Computation Nlogit

Note: *10% level of significance, **5% level of significance***1% level of significance.

The estimate of conditional logit model (CLM) is depicted in the second column of table 3. The model was specified so that the probability of selecting a particular curbside recycling service was a function of its attributes. The CLM was estimated using Nlogit 4 with 2376 choice elicited from 396 respondents. All the explanatory variables were found to be significant determinants of choice at less than 5% level of significance. This implies that any single attribute increases the probability that a particular curbside attribute will be chosen. The results shows that the respondents prefer services that provide aesthetic multiple waste recycling bins, increase in the number of separation and higher frequency of collection. All coefficient signs were in accordance with a priori expected sign. The negative sign of the fee coefficient indicates that respondents prefer alternatives that are less costly. However, the model fit as measured by Mcfadden's ρ^2 value is low (.010).

Hensher, Rose, and Greene (2005) proposed that the ρ^2 value in a multinomial logit model is similar to R^2 in ordinary least squares; the values of ρ^2 between 0.2 and 0.4 are considered an extremely good fit. Besides, (Hausman & McFadden, 1984) test for independence of irrelevant attributes (IIA) for the appropriateness of the CLM reveal IIA was violated. Therefore, the RPL model which relaxes the IIA assumption was estimated. The RPL model does not only relax the IIA assumption but also account for unobserved, unconditional heterogeneity in preferences across respondents (Train, 1998). Compared to the ρ^2 in the CLM, the ρ^2 in the RPL model as shown in the third column of table 3 showed significant improvements from

0.01 in the CLM to 0.25 in the RPL model. Additionally, the log likelihood ratio test comparing the CLM and the RPL model revealed that the RPL model is a better fit for the data estimation. The RPL estimated results also revealed substantial heterogeneity in the respondents' preference for all the curbside attributes as shown by the statistical significant standard deviations. As with the CLM respondents prefer services that provide aesthetic multiple waste recycling bins, increase in the number of separation and more frequent collection.

Though the RPL model is able to account for heterogeneity among the respondent, it fails to identify the source of the heterogeneity. One way to resolve the source of heterogeneity problem while accounting for unobserved heterogeneity is to include interaction of respondent specific characteristics with choice-specific attributes (Das, Birol, & Bhattacharya (2008) . The RPL model with interaction can detect preference variation in terms of random heterogeneity and individual characteristics thereby improving the model fit (Revelt & Train, 1998). Consequently, socio-demographic characteristics of the respondents were included as interaction terms to account for source of heterogeneity and robustness check for improvement in the model fit.

The results of the RPL interactive model as shown in the fourth column of table 3 indicated improvement in the model fit with the inclusion of the interaction terms as measured by the ρ^2 (0.26). The Swait-Louviere log-likelihood ratio test comparing the RPL and RPL with interaction models revealed that the RPL model with interaction is a better fit for the data estimation. Overall, the result of the RPL model with interaction revealed that respondents with larger numbers in the household (NIH) have a higher preference for more frequent collection (FC2); while on the other hand, respondents belonging to active environmental organization (AEO) derive utility from more waste separation activities (NOS) and would prefer multiple designed recycling bins (CWS2). Additionally, respondents with children under the age of 6 (NU6) indicated preference for multiple designed recycling bins. The negative and significant sign for the interaction between age and more frequent collection may suggest that older respondents tend to prefer lesser frequency of collection as they tend to generate less waste as compared the younger respondents.

4.3 Marginal Willingness to Pay

The parameter estimate obtained from RPL model was used to obtain the implicit price (part-worth) for each of the attribute levels. The implicit price represents the marginal rate of substitution or the marginal welfare measure for a change between each non-market attribute and the

monetary attribute. Therefore, the implicit price reflects households' WTP for the presence of an additional unit of the non-market attribute, in other words, it reflects a change in utility evaluated in terms of price ceteris paribus (Othman, 2007). The estimation of implicit prices for each non-market attribute is presented in table 4.

Table 4: **Implicit Prices**

Attributes	RPL (MYR)
FC2	2.37
NOS2	5.85
CWS2	14.76

Source: Authors computation Nlogit
Note: MYR4.15= 1USD.

The MWTP implies that ceteris paribus, households derive increased utility from curbside recycling with the provision of multiple waste separation bins for easy curbside recycling with MWTP of MYR14.76. Similarly, households derive increased utility with more frequent collection from once a week to same day collection with other households' waste which is twice a week with a MWTP of MYR2.37. Additionally, the households derive increased utility with a MWTP of MYR5.85 for increased number of waste separation from three categories to four categories.

4.4 Discussion of Findings

The outcome of this study provides an insight into the attributes of waste separation facilities and service preferred by the households to enhance their waste sorting practices. The outcome of the analysis revealed that design of waste sorting bin is the most preferred attribute that would motivate waste sorting practices by the household. This finding is in line with the that of Lane and Wagner (2013). However while this study considered multiple designed waste bin, Lane and Wagner (2013) considered wheeled recycling containers with lids as having a greater impact on household recycling rates. On the contrary Yuan, Takahashi, and Yabe (2015) found out that household do not indicate preference for the design of waste sorting container.

More so, the result from this study revealed frequency of sorted waste collection as yet another important determinant of household waste sorting practices. This finding is in line with the finding by Gebreeyosus and Berhanu (2019); Yuan, Takahashi, and Yabe (2015); Czajkowski, Hanley, and Karine (2015); and Karousakis and Birol (2008) who recommended that the frequency at which sorted waste is collected enhances waste sorting

practices of the households. In addition to frequency of collection, specifying the number of items which waste can be sorted into is another attribute preferred by the households. This outcome is in line with the findings of the study by Czajkowski, Hanley, and Karine (2015) and Karousakis and Birol (2008) in which the revealed that households place importance in more sorting categories as against fewer categories.

The study also analyzed heterogeneity in preference of attributes, in which it was observed that larger households prefer more frequent collection, while households with members belonging to active environmental organization derive utility from more waste separation activities and prefer multiple designed recycling bins. Additionally, households with children under the age of 6 indicated preference for multiple designed recycling bins. More so, the findings revealed that households with older individuals prefer lesser frequency of collection as they tend to generate less waste as compared the younger households.

5. Conclusion and Recommendations

Solid waste management in Malaysia is a major environmental, health and economic problem needing great attention. Committed to ensuring sustainable solid waste management practices, the Malaysia government under the national waste minimization master plan and Action plan for beautiful and clean Malaysia (National Strategic Plan for Solid Waste Management, 2005) set the target of 22% recycling rate by the year 2020. However, recycling rate remains low at 10%. Attempts to instill recycling habit among the populace resulted in the implementation of the separation at source program which mandates sorting of waste at the point of generation.

This paper employed the choice experiment to identify the household preferences for attributes of curbside recycling including frequency of collection, number of separations and bin design for waste separation in Putrajaya, Malaysia. All the curbside recycling attributes were found to be significant predictors of the respondents' choice and also conform to economic theory. However, multiple designed waste separation bin was found to be the most preferred curbside recycling attribute, followed by number of separations and lastly frequency of collection. More so, considerable heterogeneity was observed across the households. Despite the heterogeneity in the preferences of the respondents, they generally do care about improvement in curbside recycling. The result revealed that households on the average derive utility with an implicit price of MYR2.37 per month for an increase in the frequency of collection from once to twice a week. On the other hand, households derive positive utility from the

provision of multiple designed recycling bins with an implicit price of MYR14.76. Additionally, the household derive utility of MYR5.85 from increased number of waste separation.

The positive and significant preference for increased number of separation is an indication that the separation at source programme will achieved significant success with the provision of appropriate facilities and services. Therefore, to enhance participation in waste separation activities, there is the need to provide the households with multiple designed bins for waste separation. Providing the households with multiple designed bins will ease waste sorting, consequently contributing to management of municipal solid waste by decreasing cost of collection and disposal, and diverting materials with economic importance from the waste stream. More so, improved service delivery in terms of frequency of collection is also an important incentive; as a regular and efficient collection of separated waste could ensure the confidence of the household in the programme. The outcome of this analysis can be employed by policymakers such as the National Solid Waste Management Department and the Solid Waste and Public Cleansing Management Corporation (SWCorp) Malaysia who are saddled with the responsibilities of proposing policies, plans and strategies, and implementation of the proposed policies respectively; as well as solid waste service providers to identify and avoid a mismatch between the services they provide and what the household actually want. This will ensure an efficient and sustainable solid waste management practices.

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