Journal of Sustainability Science and Management
Volume 18 Number 10, October 2023: 35-48
eISSN: 2672-7226

ANALYSIS OF HOUSEHOLDS' WILLINGNESS TO PAY FOR SOLID WASTE MANAGEMENT SERVICES IN KUALA NERUS, TERENGGANU

NAZATUL FAIZAH HARON[1]*, MAHIRAH KAMALUDIN[2], SURAYA MAHMOOD[1] AND NOOR AINA AMIRAH MOHD NOOR[1]

[1]Faculty of Business & Management, School of Management Sciences, Universiti Sultan Zainal Abidin, 21030 Kuala Nerus, Terengganu, Malaysia. [2]Faculty of Business, Economics & Social Development, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia.

**Corresponding author: nazatulfaizah@unisza.edu.my*
Submitted final draft: 27 May 2023 *Accepted: 30 June 2023* http://doi.org/10.46754/jssm.2023.10.003

Abstract: Solid Waste Management (SWM) is a multifaceted development issue that municipal authorities face, particularly in emerging nations like Malaysia. The population's willingness to pay was determined using a double-bounded dichotomous choice approach to obtain responses for a finance mechanism to improve SWM services in Kuala Nerus. A structured questionnaire survey was conducted on 300 households, including all the major towns and villages. According to the bid questions, most respondents (72.48%) said they would be willing to pay RM2 for solid waste management in their area, and 27.52% were not willing to pay RM2. For bid2, 65.74% of the respondents were willing to pay RM4 for the solid waste management. As a result, 30.9% of respondents stated they did not want to pay for solid waste management in their area. The survey found that when the bid was high, the respondent's WTP value decreased from 72.48% (bid1) to 65.74% (bid2). This research adds to the body of knowledge on a key aspect of the financing mechanism, WTP, for better SWM services. The findings will benefit efforts to build a long-term finance structure for waste management services in Kuala Nerus, Terengganu.

Keywords: Sustainability, collection facilities, domestic waste.

Introduction

Willingness-to-pay refers to the greatest price a consumer will pay for a single unit of products or services. WTP (willingness to pay) is another significant component of consumer demand, and it is crucial information for a company pricing its goods. When a product or service is introduced to the market, demand is considered to determine the ideal price that will satisfy both the manufacturer and the consumer. Designing competitive strategies, generating new commodities, and undertaking value audits all require understanding how much consumers are ready to pay for anything. Meanwhile, price has a significant impact on both consumer purchasing decisions and production activities. It has an impact on margins, product placement, and sales volume. It is critical to get a precise reading of consumer price expectations. Marina Le Gall-Ely, Associate Professor of Management Sciences, Marketing, and Consumer Behavior at the University of Western Brittany in France, wrote an article titled 'Definition, Calculation, and Determinants of the Consumer's Willingness to Pay: A Vital Synthesis and Directions for Further Research' in Recherche et Applications in Marketing (2009) SAGE Publications says "Ability to measure WTP enables calculation of the demand curve consistent with price and to line a price that gives the simplest possible margin. When prices are often customised, knowing the WTP could optimise sales volumes and margins."

In this study, we use willingness to pay as a core subject to attain the price for solid waste management in Kuala Nerus, Terengganu. Examining waste services is crucial since Malaysia continues to progress towards development and shows a remarkable change in its performance through national transformation in all sectors. Achieving the developing status has shown the earnest efforts of the government to stabilise the economy and infrastructure to build the nation towards the Vision 2020. However, environmental pollution arises when

development occurs. Rapid urbanisation and increasing volume of consumption in daily activities will drive exponential growth of waste production coupled with environmental problems if the wastes from these activities are not managed properly. As a result, solid waste management continues to be a significant concern (Das *et al*., 2019).

In Kuala Nerus, Terengganu, the collection of solid waste is scheduled and managed by the Kuala Terengganu Municipal Council (KTMC). The schedule is prepared for three types of collection: (1) Waste collection from home to home, (2) waste collection of business premises in the city, and (3) regular collection for main roads and hallways. The waste collection schedule for home-to-home is on Sunday, Tuesday, and Thursday, while the waste collection of business premises in the city is done daily with monthly charges of RM3 and RM6, respectively. Therefore, with the continuous economic and population growth in Kuala Nerus, the local government faces a tremendous challenge in handling municipal solid waste disposals, particularly domestic household wastes. As the primary solid waste producers, households may suffer from the effects of uncollected solid waste and the impacts will continue to affect the environment, which finally will disturb their daily life activities with the smell pollution. As the population increases, solid wastes also increase, becoming a significant issue in environmental management. In this study, households' attitudes and willingness to pay were analysed by using the contingent valuation method (CVM) to elicit the monetary value that households are willing to contribute to a better solid waste management system in Kuala Nerus, Terengganu. According to the Department of Statistics Malaysia (DOSM), solid waste was 3,108.9 thousand tonnes in 2019, an increase of 0.33% compared to 3,098.7 thousand tonnes in 2018[1]. The amount is projected to continue to rise due to population growth, industrialisation activities, and increased quantity and variation in the types of waste generated. Meanwhile, the World Bank reported that around 0.74 kg per person of waste will be generated and it is expected to increase to 3.40 billion tonnes by 2050[2]. These growing trends may cause multiple environmental impacts, including ocean plastic accumulation, greenhouse and gas emissions, infectious diseases, land and water pollution,

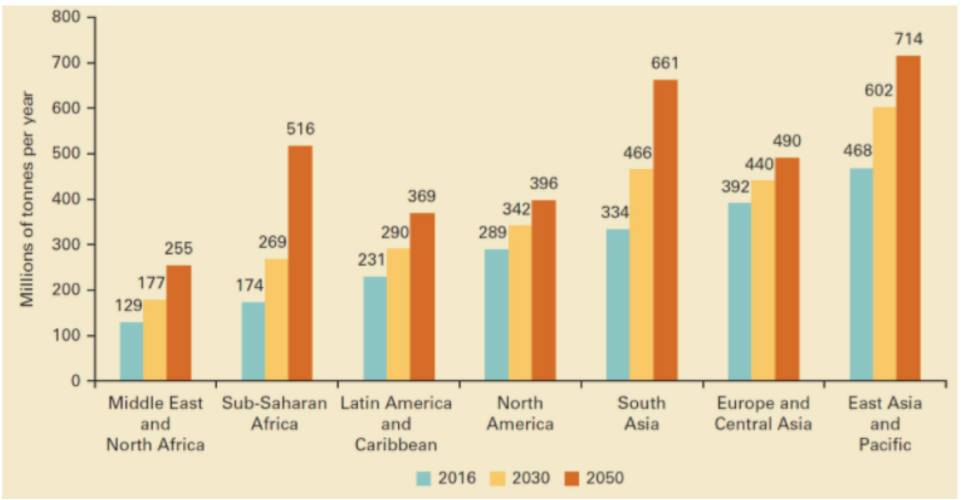

Figure 1: Projected waste generation (World Bank, 2018)

[1] https://www.dosm.gov.my
[2] https://www.worldbank.org/en/topic/urbandevelopment/overview

and nitrogen pollution. Therefore, the additional payment was suggested in this study to secure a better place and environment.

A survey was conducted on the households in Kuala Nerus, Terengganu. Kuala Nerus is the youngest district of Terengganu with an area of 397.5 km^2. It was declared as a separate district in 2014. Random sampling was applied to select the respondent with equal chances to be selected in this survey.

Solid Waste

Solid waste management is frequently defined as the major management of waste generation, collection, storage, transfer and transport, processing, and disposal (Tchobanoglous *et al*., 2014). Despite Malaysia's rapid economic growth, the country's solid waste management remains deplorable (Nesadurai, 1999). The selection and execution of appropriate waste management methods, technologies, and management programmes to meet stated waste management goals and objectives is also known as integrated solid waste management. Solid waste management is one of the most pressing environmental issues (Mazzanti & Zoboli, 2008). This is especially true in cities, where the population is rapidly increasing and rubbish production is at an all-time high (Kathiravale & Yunus, 2008). The present population of the Earth is 6.8 billion people, with roughly half of them residing in metropolitan areas[3]. Solid waste is often regarded as an urban issue, according to Marshall and Farahbakhsh (2013), which found that it is closely linked to urbanisation, economic wealth, living standards and consumption of goods and services, resulting in a proportionate increase in the volume of waste produced. The urban population of the world has risen significantly from 1.019 billion in 1960 to 4.274 billion in 2019, while the rural population has declined[4].

Waste management become complicated, and the facilities available to keep up with the rising demand. As a result, the optimum strategy should be executed as soon as possible, considering environmental, social, and economic considerations (Aye & Widjaya, 2006). Agamuthu *et al*. (2009) outlined the drivers for sustainable waste management, which include human, economic, institutional, and environmental factors all play a role. Because each community's solid waste management may differ, the study advises that each drive group be examined in its local context. Meanwhile, in 1995, the integrated, long-term waste management system was implemented to replace the previous system, which failed to consider the specific characteristics of each community, economy and environment.[5] For example, to build sustainable societies, effectively manage resources, tap into the economy's innovative potential, and ensure prosperity, environmental protection, and social cohesion in their system SWM, European countries have used a variety of system assessment techniques and engineering models (Pires *et al*., 2011). In addition, Asian countries have focused on developing national legislative frameworks, regulating institutional, technological, operational, and budgetary concerns, and increasing public knowledge and engagement (Shekdar, 2009). Many studies, such as those for India (Hazra & Goel, 2009), Portugal (Magrinho *et al*., 2006), Canada (Wagner & Arnold, 2008) and Malaysia (Agumuthu, 2003), have been undertaken on present waste management systems, obstacles, and potential (Samsudin & Mat Don, 2013). These studies allow for comparison, allowing for the application of the best practice whenever possible.

Solid Waste Generation

When constructing a solid waste management system, trash generation is the most crucial element to address. Depending on culture, public awareness, and garbage management, waste creation varies greatly between countries (Magrinho, 2006; Wagner & Arnold, 2008; Hazra

[3,4] https://www.worldbank.org/en/topic/urbandevelopment/overview

[5] https://www.gdrc.org/uem/waste/ISWM.pdf

& Goel, 2009). The amount of waste generated by fast urbanisation, industry, population growth, and improved lifestyles has increased substantially in recent years, making municipal solid waste a serious concern. Most municipal solid waste is generated by households, but it also includes waste generated by offices, hotels, retail malls/stores, schools, institutions, and municipal services like street cleaning and park management.[6] Indonesia produces 64 million tonnes of urban waste per year, followed by Thailand (26.77 million tonnes), Vietnam (22.02 million tonnes), the Philippines (14.66 million tonnes), Malaysia (12.84 million tonnes) and Myanmar (841,508 tonnes), while Lao PDR generating the least (77,380 tonnes).[7]

Developed countries produce much waste, but developing countries have difficulty implementing waste management systems (Bai & Sutanto, 2002; Hazra & Goel, 2009). This involves inefficient policy implementation, poor enforcement, and a lack of technology (Agamuthu *et al*., 2009). Low and irregular garbage collection, uncontrolled air and water pollution in open dump areas, the proliferation of flies and insects, and poor waste management are all challenges these countries are dealing with (Manaf *et al*., 2009). Given the current trend of waste generation in developed nations, other emerging and transitional countries are expected to follow suit. Waste production has been increasing until now, and it is expected to continue. Authorities throughout the world are concerned about this.

Malaysia Solid Waste Management

Meanwhile, Malaysia's major environmental concern is the country's poorest solid waste management (Saeed *et al*., 2009). The qualities of solid waste created are important to consider in all aspects of solid waste management (Manaf *et al*., 2009). The solid waste stream should be described in terms of generation rates, content, sources, and waste categories generated.

Table 1: Amount of Waste Generation of MSW in ASEAN (United Nations Environment, 2017)

Countries	Per Capita MSW Generation (kg/ day)	Annual MSW Generation (tonnes)	Annual Hazardous Waste Generation (MT)	Annual E-waste Generation (Metric Kiloton)
Brunei	1.4	210,480		
Cambodia	0.55	1,089,429		
Indonesia	0.70	64,000,000		
Lao PDR	0.69	77,380		8.00
Malaysia	1.17	12,840,000	1517434.06	
Myanmar	0.53	841,508		
Philippines	0.69	14,660,000	1693856.72	39000
Singapore	3.763	7,514,500	411180	110
Thailand	1.05	26,770,000	3300000	368.314
Vietnam	0.84	22,020,000		1609.775

[6,7] https://environment.asean.org/wp-content/uploads/2020/03/Summary-Report-Waste-Management-in-ASEAN-Countries-UNEP.pdf

These data are necessary for monitoring and controlling waste management systems and making regulatory, financial, and institutional decisions. The sources of MSW in Malaysia differ based on the local authority region, the size of the city, and the country's economic standards (Haron *et al*., 2018).

Waste Generation in Malaysia

According to the statistics agency, Malaysia's population is predicted to be 31.95 million in 2019. In 2019, Malaysia generated a total of 4.0 million tonnes of trash.[8] There were 2.3 million tonnes of planned rubbish from the power plant, metal refineries, chemical, and electrical and electronics industries (Saeed *et al*., 2009). In the states that ratified the treaty in 2019, the Solid Trash and Public Cleansing Management Act 2007 (Act 672) produced 3109.9 thousand tonnes of solid waste, compared to 3098.7 thousand tonnes in 2018.[9] The concurrent list of the federal constitution's 9th schedule governs solid waste management in Malaysia (Hassan *et al*., 1999; Saeed *et al*., 2009; Amirah *et al*., 2020). This list allows the federal, state, and local governments to carry out public health and sanitation activities such as waste collection, transportation, treatment and disposal. Malaysia's economic development has provided affluence; it has also begun to impose prices for industrial pollution and urban environmental degradation (Hassan *et al*., 2000; Saeed *et al*., 2009). The local government and its department responsible for urban cleansing and services in Malaysia oversee solid waste planning and management. Solid waste management is concerned with preventing and controlling waste generation (Tchobanoglous *et al*., 2014; Kamaludin *et al*., 2020). Despite the country's tremendous economic expansion, Malaysia's solid waste management remains inefficient and unorganised (McFadden, 1973). Malaysia's waste minimisation policy intends to meet the UN Agenda 21 human and environmental goals in the coming years.

Table 2 shows household trash generation per capita by strata and dwelling type in Peninsular Malaysia. With a population of 22 million people, home garbage creation is around 18,129 metric tonnes per day, resulting in waste generation per capita of about 0.8 kg per day. Urban creation is 0.83 kg/capita/day on average, higher than rural waste generation, which is just 0.73 kg/capita/kg.

Materials and Methods

The survey was conducted on the Kuala Nerus, Terengganu residents to elicit their WTP for any changes of nonmarket goods to gain benefits.

Contingent Valuation Method (CVM)

The goal of contingent valuation is to measure the compensating or equivalent variation for the good in question by asking a person to report a willingness to pay the amount. Formally, WTP is defined as the amount that must be taken away from the person's income while keeping his or her utility constant:

$$V(y - WTP, p, q_1; Z) = V(y, p, q_0; Z)$$

V = indirect utility function
y = income
p = a vector of prices faced by the individual

q_1 and q_0 are the alternative levels of the good or quality indexes (with $q_1 > q0 \rightarrow q_1$ refers to improved environmental quality i.e. water quality).

Z is a vector of individual characteristics

Following Haab and McConnel (2002), the j^{th} contribution to the likelihood function is:

$$Lj = (\mu/t) = \Pr(\mu+\varepsilon_{1j} > t_1, \mu_2+\varepsilon_{2j} < t_2)^{YN}$$
$$*\Pr(\mu_1+\varepsilon_{1j} > , \mu_2+\varepsilon_{2j} \geq t_2)^{YY}$$
$$*\Pr(\mu_1+\varepsilon_{1j} > , \mu_2+\varepsilon_{2j} < t_2)^{NN}$$
$$*\Pr(\mu_1+\varepsilon_{1j} > , \mu_2+\varepsilon_{2j} \geq t_2)^{NY}$$

where YY=1 for a YES-YES answer, 0 otherwise, NY = 1 for a NO-YES answer, 0 otherwise, and so on.

[8,9] https://www.dosm.gov.my

Table 2: Malaysia's Average Household Waste Generation (Survey on SW Composition, Characteristics & Existing Practice of SW Recycling in Malaysia, 2012)

Housing Type	Urban			Rural			Overall		
	Population	Per Capita (kg/day)	Total (MT/day)	Population	Per Capita (kg/day)	Total (MT/day)	Population	Per Capita (kg/day)	Total (MT/day)
Low-cost Landed	2,284,650	0.78	1,772	1,395,530	0.73	1,024	3,680,180	0.76	2,797
Low-cost High-rise	3,279,077	0.65	2,139	452,967	0.77	350	3,732,044	0.67	2,490
Medium-cost Landed	6,888,828	0.93	6,414	2,298,782	0.72	1,647	9,187,610	0.88	8,061
High-medium Cost High-rise	2,012,187	0.91	1,826	-	-	-	2,012,187	0.91	1,826
High-cost Landed	2,526,676	0.76	1,933	1,430,647	0.72	1,023	3,957,324	0.75	2,956
Total	16,991,419	0.83	14,083	5,577,926	0.73	4,045	22,569,345	0.80	18,129

This strategy aims to determine how many people are prepared to pay for nonmarket products or services and accept being deprived of the same resources if denied access to those goods or services. Numerous elicitation processes, such as market research and data collection, can be employed in the construction industry. These are examples of direct questioning, bidding games, payment cards, take-it-or-leave-it approaches, and contingent ranking methods. When additional values are unavailable, the CVM provides preliminary estimates of value that might benefit project planning. The CVM was used in this study to construct a financial mechanism for solid waste management in Kuala Nerus, Terengganu.

The CVM has often been conducted as part of economic analysis to support decisions on whether to approve a project. Valid and robust CVM studies and the Willingness-to-pay (WTP) estimates they produce have several uses. The results of a CVM study can be a very powerful project design tool that can determine the appropriate scale, timing, and the nature and type of projects. WTP estimates can also be used in negotiations, i.e. as a discussion tool. For instance, these estimates can be used to set tariffs and taxes or as input in the bargaining stages of eco-compensation or payment for ecosystem services schemes.

Theoretical Model

The dichotomous choice contingent valuation technique uses random utility theory (DC-CVM). The notion is that selections are based on utility comparisons between available options, with the option that provides the most utility being chosen. (Louviere & Hensher, 1983; Cameron, 1988; Adamowicz *et al*., 1994). The derivation of the utility function can be expressed in Equation 1 (Kamaludin *et al*., 2021):

$$U_i^c = V_i^c + \varepsilon_i^c \qquad (1)$$

Equation 2 can be used to represent the probability as a parametric function of general form:

$$Prob_i^c = f\ (x_i^c, x_j^c; i \neq j, \beta) \quad (2)$$

$Prob_i^c$ = Probability of respondent selecting option *i*

= Parameter of observable characteristics of alternative *i* for consumer *c*

= Parameter of observable characteristics of alternative *j* for consumer *c*

With the random term present, the probability that consumer *c* chooses alternative *i* over alternative *j* may be stated as Equations 3 to 5:

$$Prob_i^c = Prob\left\{(V_i^c > U_j^c)\right\} \quad ; i \neq j \quad (3)$$

$$= Prob\left\{(V_i^c + \varepsilon_i^c) > (V_j^c + \varepsilon_j^c)\right\} \quad ; i \neq j \quad (4)$$

$$= Prob\left\{(V_i^c - V_j^c) > (\varepsilon_i^c - \varepsilon_j^c)\right\} \quad ; i \neq j \quad (5)$$

Equation 2 reflects the likelihood of consumer *c* referring to option *i* in the decision set rather than alternative *j*. because it is a cumulative distribution ($V_i^c - V_j^c$) which implies that the likelihood of observed quantity is significantly greater than the probability of random error term ($\varepsilon_i^c - \varepsilon_j^c$).

The term ε_i^c has an extreme value distribution based on the Conditional Logit (CL) model, and the density function can be started as follows:

$$f(\varepsilon_i^c) = \exp\{-\varepsilon_i^c - \exp\{-\varepsilon_i^c\}\} \quad (6)$$

As a result, Equation 7 shows the probability of consumer *c* preferring option *i* over alternative *j* in the choice set *C* in this analysis:

$$Prob_i^c = \frac{\exp(\mu V_i^c)}{\sum_j^J \exp(\mu V_j^c)} \quad (7)$$

The V_i^c is assumed to be a linear parameter in this study, and the generalised utility function specification can be stated as Equation 8:

$$V_i^c = \beta_1 x_i^c + \beta_2 x_i^c + \beta_3 x_i^c + \cdots + \beta_s x_{si}^c \quad (8)$$

where β is the vector of parameters to be estimated and *x* signifies all explanatory variables in the model

$$Prob_i^c = \frac{\exp(\beta' V_i^c)}{\sum_j^J \exp(\beta' V_j^c)} \quad (9)$$

where:

$Prob_i^c$ = Probability of consumer *c* chooses alternative *i*

x_i^c *and* x_j^c = Vectors expressing the attribute *i* and *j*

B = Vector of coefficient

As a result, the log-likelihood function is used to estimate by maximising over the parameters. As demonstrated in Equation 10, the function can be represented as a log-likelihood function:

$$\log L(\beta) = \sum_{C=1}^{N} \sum_{j=1}^{J} \log prob_i^c \quad (10)$$

As a result, this study uses the log-likehood function to select option *i* when maximising over *c* and 0 otherwise. Then *N* is the number of consumers in this sample size.

The taste of parameters, which are features that directly impact utility, is represented by the coefficients in Equation 7. As a result, the Marginal Rate of Substitution (MRS), or the rate at which consumers are willing to trade one characteristic for another, can be calculated. Equation 11 explains how to get the substitution rate by multiplying by 1 and dividing the coefficient by another coefficient (monetary characteristic):

$$\rho_k^c = \frac{\frac{\delta V}{\delta x_{c,s}}}{\frac{\delta v}{\delta P_{c,s}}} = \frac{-1\ \beta_{c,s}}{\beta_{c,s=p}}$$

$$= \frac{\beta_{attribute}}{\beta_{monetary}}\ x - 1 = -\frac{\beta_{attribute}}{\beta_{monetary}} \quad (11)$$

This study adds a monetary attribute to illustrate the number of consumers willing to pay for a higher status quo. Equation 10 shows how the implicit prices of the qualities have changed with the current situation. As a result, Equation 10 shows how the attribute's implicit price has changed to its current state.

Sampling Method

This study uses simple random sampling since the survey sample is from a broad population and it is problematic to identify every member

of the population. The population in Kuala Nerus was about 145,643 in 2020, according to the Department of Statistics Malaysia (DOSM). There are two reasons to show the importance of sample size. First, the precision of estimated values can affect their usefulness in policy analyses. Second, statistical precision can affect the ability to detect differences among value estimates in methodological studies.

The respondents of this study were households in Kuala Nerus. Respondents came from four mukims in Kuala Nerus: Batu Rakit, Kuala Nerus Town, and Pakoh (Belara). They were told that the study would help with recycling service improvement. For this study, the sample consists of 300 respondents. Based on Joseph *et al*. (2010). The recommended sample size is at least 200 per group and the minimum sample size is 50 respondents. Hence, the sample size is reliable enough to meet the objective of the study.

Data Collection

A face-to-face survey was conducted on 300 households who resided in Kuala Nerus, Terengganu, Malaysia. A simple random sampling was used to assess the willingness to pay for solid waste management. The survey began in October 2019 and continued until December 2019. Enumerators assisted the survey sessions if the respondents did not comprehend the questions. If an unfinished question arises, the enumerators will request the respondents to complete it. All data given by the respondents were treated as private and confidential.

Results and Discussion

The sample comprises 300 respondents from urban and rural areas in Kuala Nerus, Terengganu, Malaysia. The respondents were randomly selected using a field survey with face-to-face interviews and a structured questionnaire. Dividing and randomising offered price bids were tested in a pre-test survey to avoid confusion and bias. The Stata econometric software was used to regress and analyse the data. The respondents were also enlightened that this study will benefit the endangered species towards conservation associated with human activities.

Socio-demographic of Respondents

Table 3 shows that the respondents of this study comprised 186 females and 115 males. This research study found 104 respondents were nongovernment employees or those working in the private sector, while 59 were government employees. Among the respondents, 62 of them own a business. In general, the results from the survey reveal that the majority of the respondents (28.6%) had an average income of RM501-RM1000, followed by RM1001-RM1500 (23.9%), below RM3001-RM4000 (68.4), and above the bracket (31.6%).

Most respondents have 4 to 6 household members (44.2%). However, 99 respondents (32.9%) have 1 to 3 members in their household and only 69 respondents (22.9%) have more than 7 members in their household.

Table 4 shows that 98.7% of respondents agreed that the maintenance of solid waste management should be managed and continued to maintain the cleanliness of the environment. They demand that action to have life free from smell pollution, which is 99.1% stands for this reason. Furthermore, 98.8% of the respondents agreed that the availability of solid waste disposal services can maintain the quality of nature.

Data Analysis of Contingent Valuation Method (CVM)

The community in Kuala Nerus inferred their willingness to pay for solid waste disposal services using a discrete choice Contingent Valuation (CV) scenario in this study. The scenario estimates an aggregated value for all these benefits, though a regression analysis of the answers to the CV question disaggregated the contribution of singular components to this aggregated value.

Table 3: Socio-demographic of respondents

Variable		Frequency	(%)
Gender:			
i.	Female	186	38.2
ii.	Male	115	61.8
		301	
Age:			
i.	20 and below	19	6.3
ii.	21 – 30	122	40.5
iii.	31 – 40	74	24.6
iv.	41 – 50	32	10.6
v.	51 – 60	37	12.3
vi.	61 and above	17	5.6
		301	
Status:			
i.	Single	123	40.9
ii.	Married	167	55.5
iii.	Divorced	11	3.7
		301	
Occupation:			
i.	Government employees	59	19.6
ii.	Private sector workers	104	34.6
iii.	Secondary school	62	20.6
iv.	College	7	2.3
v.	Others	69	22.9
		301	
Education:			
i.	Primary school	9	3
ii.	Elementary school	8	2.7
iii.	Secondary school	93	30.9
iv.	College	39	13
v.	University	144	47.8
vi.	Others	8	2.6
		301	
Income:			
i.	RM500 and below	19	6.3
ii.	RM501 – RM1000	86	28.6
iii.	RM1001 – RM1500	72	23.9
iv.	RM1501 – RM2000	35	11.6
v.	RM2001 – RM3000	32	10.6
vi.	RM3001 – RM4000	20	6.6
vii.	RM4001 – RM5000	13	4.3
viii.	RM5001 – RM6000	5	1.7
ix.	RM 6001 and above	19	191
		301	
Number of households:			
i.	1 – 3	99	32.9
ii.	4 – 6	133	44.2
iii.	7 and above	69	22.9
		301	

Table 4: Descriptive statistics on the "*respondent's view on the maintenance of solid waste management*"

Variable	Mean	SD	%
The purpose of maintaining the cleanliness of the environment.	4.69	0.637	98.7
Will keep the drainage system from clogging due to waste.	4.62	0.675	97.9
To become a civilised human being in terms of cleanliness comes from religious values.	4.60	0.698	98.0
The purpose of having a life that is free from smell pollution.	4.65	0.639	99.1
To facilitate recycling activities.	4.48	0.790	98.0
To ensure continuous well-being and cleanliness for future generations.	4.60	0.722	97.7
To minimise landfill waste.	4.48	0.786	98.0
The purpose of having a better life.	4.62	0.670	98.7
The purpose of maintaining the quality of nature.	4.66	0.661	98.8
Long-lasting benefits for everyone.	4.67	0.665	98.7

Two groups of price bids were provided for the solid waste disposal services in Kuala Nerus, Malaysia. Table 5 shows the distribution of price bids for conservation ranging from RM2 and RM4. Respondents were required to answer "Yes" or "No" to the offered price bids. Every individual was given different price bids to avoid bias in the survey. As expected, as the price bid amount of solid waste disposal services increases, the proportion of individuals responding to positive answers decreases. This is in line with the demand theory, which states that as the price increases, the quantity demanded decreases. This shows that the respondents are sensible to the price bid amount offered during the survey.

All respondents were asked about their WTP value to manage and conduct solid waste collection on a scale basis in the respondent's area. This part used a referendum followed by a dichotomous choice technique. A dichotomous choice structure was used to extract bids (prices) for WTP value of resources. The dichotomous choice approach supplements the initial DC questions with a follow-up question. Overall, 69.1% of respondents said "Yes" to the values given to them to manage solid waste in Terengganu, Malaysia. The current protest rate appears to be relatively low when contrasted with prior studies that have estimated the willingness-to-pay (WTP) for environmental goods, as reported by Song *et al*. (2012) and Cho *et al*. (2005). The absence of universally recognised criteria in the international literature regarding the threshold of protest that undermines the validity of a willingness-to-pay (WTP) study remains a significant challenge (Brouwer *et al.*, 2008).

Table 5 shows the result of the bid question for a preferred price to pay. Based on these bid questions, most respondents (72.48%) were willing to pay RM2 for the solid waste management activity in their area. Meanwhile, 27.52% of the respondents were not willing to pay RM2. For bid2, 65.74% of the respondents were willing to pay RM4 for the solid waste

Table 5: Respondents' responses on the solid waste disposal services

Answer/Bid	RM2	RM4	Total
No	27.52	34.21	30.90
Yes	72.48	65.79	69.10
Total	100.00	100.00	100.00

management. Therefore, 30.9% of the respondents did not prefer to pay for solid waste management in their area. The survey found that when the bid was high, the respondent's WTP value decreased from 72.48% (bid1) to 65.74% (bid2).

The respondents who answered "Yes" in the CV question were further asked to explain why. Table 6 shows that the most selected reason by respondents was *"to manage and conserve the environment in that area"*, followed by *"the importance of solid waste to manage well"*. All non-paying respondents (non-response) were also asked for their reasons for refusing to pay (Table 5). *"I believe it is the government's responsibility"* was the most common argument given, followed by *"I cannot afford it"* and *"I am willing to pay but not that amount."*

To calculate the mean of the willingness-to-pay (WTP), this study follows Cameron (1988) as shown in the following Equation:

$$WTP = \frac{\beta_0 + \sum_{i=2}^{n} \beta_i X}{-\beta_1}$$

In order to explore the factors influencing willingness-to-pay (WTP) for solid waste management, a regression model was developed. Respondents were asked to indicate their WTP by selecting one of two options: Willing to pay or not willing to pay, resulting in a binary dependent variable in the regression model. Given this binary form, researchers may employ either logistic or probit regression. This study used the logistic regression method to analyse the data (Wang *et al*., 2011). The willingness to pay for solid waste disposal services was RM8.27, according to Table 7. However, after considering other factors such as income, education, age, gender and occupation, the willingness-to-pay amount decreased to RM7.16. This shows that these characteristics positively influenced the respondents' WTP (Song *et al*., 2016).

This study utilised an elicitation format in which respondents were presented with a sequence of two bids and asked a question twice, with the second question being dependent on the response to the first (Hanemann *et al*., 1991; Cameron *et al*., 1998). Depending on the initial response, the respondent was presented with a new bid either higher or lower. This approach was more efficient than a single dichotomous choice model due to increased responses. The use of response sequences such as no-yes or yes-no, as well as yes-yes and no-no pairs, further enhanced the efficiency of the model by improving the accuracy of estimates for willingness to pay (WTP). Additionally, the greater number of responses obtained facilitated fitting a given function by providing a larger number of observations (Haab *et al*., 2002). The willingness to pay for solid waste disposal services dropped to RM7.05 in bid2. As the bid2

Table 6: Logistic regression on price bid

Response 1	Coefficient	Std. Err	P > |z|	[95% Conf. Interval]	
Price Bid	-0.952666	0.0758172	0.000***	-0.243865	-0.053332
Constant	0.7877905	0.2429816	0.000***	0.311555	1.264026

Note: Significance at 5% level (***).

Table 7: Estimation of the WTP price bid in the CVM

Answer	Coef.	Std. Err.	z	P > |z|	[95% Conf. Interval]
WTP	8.269329	4.232947	1.95	0.051	-0.270953
WTP1	7.162188	2.703854	2.65	0.008	1.862732
WTP2	7.057233	0.9014559	7.83	0.000	5.290411

amount increases, the respondents would be less WTP and that is consistent with the law of demand states that there is an inverse relationship between the price of a good or service and the quantity of that good or service that consumers are willing and able to buy. In other words, as the price (bid2) increases, the probability of the amount of WTP will decrease (Wegedie *et al*., 2020). This value indicates that people are willing to contribute to ensuring the surrounding areas are clean and well-maintained.

Conclusion

Solid Waste Management (SWM) is required to safeguard a good quality environment that should be embraced by every household and business owner worldwide. Waste management is how solid waste can be shifted and sometimes used as a valuable resource. In Kuala Nerus, Terengganu, this study assesses household willingness-to-pay (WTP) to enhance solid waste management. The estimation was conducted through the application of double-bounded CVM. The value of WTP in the single-bounded and double-bounded CVM was RM7.16 and RM7.05, respectively. The monetary values indicate that the public is willing to contribute to improvements in SWM services in Kuala Nerus with an increase in collection frequency from the existing schedule and collection areas are further expanded at other settlements. The amount is guaranteed to offer sustainable financing for the services, which the management can use to channel the waste into valuable resources through recycling processes. An efficient municipal waste disposal and management strategy can provide better answers to various waste-related issues. This can be accomplished by implementing a waste management plan that includes adequate monitoring and regulation of municipal solid and food waste, livestock waste, clinical waste, industrial waste, and other types of waste. The introduction of the CVM technique into this study was determined to be a significant instrument to communicate the solid and deep feelings towards solid waste management services by their readiness to pay for contribution to control a sustainable waste management service from the respondents' perspective. This research provides empirical evidence to suggest a mechanism that the government and private organisations can use to support long-term efforts and secure the necessary budget for waste management services.

Acknowledgements

This study was funded by an internal grant from Universiti Sultan Zainal Abidin, project number UniSZA/2017/DPU/66. The author wishes to express her gratitude to the Faculty of Business and Management, Center for Research Excellence and Incubation Management (CREIM) members and everyone else who helped her complete this research.

References

Adamowicz, W., Louviere, J., & Williams, M. (1994). Combining revealed and stated preference methods for valuing environmental amenities. *Journal of Environmental Economics and Management*, *26*(3), 271-292. https://doi.org/10.1006/jeem.1994.1017

Agamuthu, P. (2003). Editorial. *Waste Management & Research: The Journal for a Sustainable Circular Economy*, *21*(6), 487-487. https://doi.org/10.1177/0734242x0302100601

Agamuthu, P., Khidzir, K. M., & Hamid, F. S. (2009). Drivers of sustainable waste management in Asia. *Waste Management & Research: The Journal for a Sustainable Circular Economy*, *27*(7), 625-633. https://doi.org/10.1177/0734242x09103191

Amirah, N. A., Him, N. F. N., Tambi, A. M. A., Haron, N. F., & Badrul, N. S. (2020). Developing safety culture framework for the Malaysian port industries. *Jour of Adv Research in Dynamical & Control Systems*, *12*(3).

Aye, L., & Widjaya, E. R. (2006). Environmental and economic analyses of waste disposal

options for traditional markets in Indonesia. *Waste Management*, *26*(10), 1180-1191. https://doi.org/10.1016/j.wasman.2005.09.010

Bai, R., & Sutanto, M. (2002). The practice and challenges of solid waste management in Singapore. *Waste Management*, *22*(5), 557-567. https://doi.org/10.1016/s0956-053x(02)00014-4

Brouwer, R., van Beukering, P., & Sultanian, E. (2008). The impact of the bird fluon public willingness to pay for the protection of migratory birds. *Ecological Economy*, *64*, 575-585.

Cameron, T. A. (1988). A new paradigm for valuing non-market goods using referendum data: Maximum likelihood estimation by censored logistic regression. *Journal of Environmental Economics and Management*, *15*(3), 355-379. https://doi.org/10.1016/0095-0696(88)90008-3

Cameron, T. A., & J. Quiggin. (1998). Estimation using contingent valuation data from a "Dichotomous choice with follow-up" questionnaire: Reply. *Journal of Environmental Economics and Management*, *35*(2), 195-199.

Cho, S. H., Newman, D. H., & Bowker, J. M. (2005). Measuring rural homeowners' willingness to pay for land conservation easements. *Forest Policy and Economics*, *7*, 757-770.

Das, S., Lee, S.-H., Kumar, P., Kim, K.-H., Lee, S., & Bhattacharya, S. (2019). Solid waste management: Scope and the challenge of Sustainability. *Journal of Cleaner Production*, *228*, 658-678. https://doi.org/10.1016/j.jclepro.2019.04.323

Haab, T. C., & McConnell, K. E. (2002). *Valuing environmental and natural resources: The econometrics of non-market valuation*. Edward Elgar Publishing.

Hanemann, M., J. Loomis & B. Kanninen. (1991). Statistical efficiency of double-bounded dichotomous choice contingent valuation. *American Journal of Agricultural Economics, 73*(4), 1255-1263.

Haron, N. F., Sidique, S. F., & Radam, M. A. (2018). Factors influencing household electronic waste (e-waste) recycling participation. *The Turkish Online Journal of Design, Art and Communication - TOJDAC*. *Special Edition*, 1552-1557. ISSN: 2146-5193.

Hassan, M. N., Rahman, R. A., Chong, T. L., Zakaria, Z., & Awang, M. (2000). Waste recycling in Malaysia: Problems and prospects. *Waste Management and Research*, *18*(4), 320-328. https://doi.org/10.1034/j.1399-3070.2000.00133.x

Hazra, T., & Goel, S. (2009). Solid waste management in Kolkata, India: Practices and challenges. *Waste Management*, *29*(1), 470-478. https://doi.org/10.1016/j.wasman.2008.01.023

Kamaludin, M., Razali, M. A., Faizah Haron, N. F., & Azlina, A. A. (2021). Energy efficiency labelling: Investigating students' preferences and awareness on the energy-efficient electrical appliances in hostel. *International Journal of Energy Economics and Policy*, *11*(2), 300-308. https://doi.org/10.32479/ijeep.10824

Kathiravale, S., & Muhd Yunus, M. N. (2008). Waste to wealth. *Asia Europe Journal*, *6*(2), 359-371. https://doi.org/10.1007/s10308-008-0179-x

Louviere, J. J., & Hensher, D. A. (1983). Using discrete choice models with experimental design data to forecast consumer demand for a unique cultural event. *Journal of Consumer Research*, *10*(3), 348. https://doi.org/10.1086/208974

Magrinho, A., Didelet, F., & Semiao, V. (2006). Municipal solid waste disposal in Portugal. *Waste Management*, *26*(12), 1477-1489. https://doi.org/10.1016/j.wasman.2006.03.009

Mahirah, K., Nazatul, F. H., & Mohd, A. S. R. (2020). Tourists' preferences for preservation

of World Heritage Site Stadthuys, Malacca. *Journal of Environmental Management & Tourism*, *11*(2 (42)), 281-289.

Manaf, L. A., Samah, M. A., & Zukki, N. I. (2009). Municipal solid waste management in Malaysia: Practices and challenges. *Waste Management*, *29*(11), 2902-2906. https://doi.org/10.1016/j.wasman.2008.07.015

Marshall, R. E., & Farahbakhsh, K. (2013). Systems approaches to integrated solid waste management in developing countries. *Waste Management*, *33*(4), 988-1003. https://doi.org/10.1016/j.wasman.2012.12.023

Mazzanti, M., & Zoboli, R. (2008). Waste generation, waste disposal and policy effectiveness. *Resources, Conservation and Recycling*, *52*(10), 1221-1234. https://doi.org/10.1016/j.resconrec.2008.07.003

McFadden, D. (1973). *Conditional logit analysis of qualitative choice behavior*. Univ. of California.

Nesadurai, N. (1998). "*The 5R approach to environmentally sound solid waste. In: Local Communication and the Environment"*, Oct 24-25. Shah's Village Hotel: EPSM.

Pires, A., Martinho, G., & Chang, N.-B. (2011). Solid waste management in European countries: A review of systems analysis techniques. *Journal of Environmental Management*, *92*(4), 1033-1050. https://doi.org/10.1016/j.jenvman.2010.11.024

Saeed, M. O., Hassan, M. N., & Mujeebu, M. A. (2009). Assessment of municipal solid waste generation and recyclable materials potential in Kuala Lumpur, Malaysia. *Waste Management*, *29*(7), 2209-2213. https://doi.org/10.1016/j.wasman.2009.02.017

Samsudin, M. D., & Mat Don, M. (2013). Municipal solid waste management in Malaysia: Current practices, challenges and prospects. *Jurnal Teknologi*, *62*(1). https://doi.org/10.11113/jt.v62.1293

Shekdar, A. V. (2009). Sustainable solid waste management: An integrated approach for Asian countries. *Waste Management*, *29*(4), 1438-1448. https://doi.org/10.1016/j.wasman.2008.08.025

Song, Q., Wang, Z., & Li, J., (2012). Residents' behaviors, attitudes, and willingness to pay for recycling e -waste in Macau. *Journal of Environmental Management*, *106*, 8-16.

Tchobanoglous, G., Theisen, H., & Vigil, S. A. (2014). *Integrated solid waste management: Engineering principles and management issues*. McGraw-Hill Education (India) Private Limited.

Wagner, T., & Arnold, P. (2008). A new model for solid waste management: An analysis of the Nova Scotia MSW strategy. *Journal of Cleaner Production*, *16*(4), 410-421. https://doi.org/10.1016/j.jclepro.2006.08.016

Wang, Z., Zhang, B., Yin, J., & Zhang, X. (2011). Willingness and behavior towards e-waste recycling for residents in Beijing city, China. *Journal of Cleaner Production, 19*, 977-984.

Wegedie, K. T., Eyasu, A. M., Yizengaw, Y. S., & Shiferaw, G. A. (2020). Analysis of households' willingness to pay for improved solid waste management services in Gondar city, Ethiopia: Evidence from a double-bounded dichotomous contingent valuation method. *Research Square.*