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To cite this article: M A Abas *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **756** 012083

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Public satisfaction and willingness to pay (WTP) for better solid waste management services in rural area of Kelantan, Malaysia

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Abstract. In Malaysia rural area, the fixed-rate method is the waste charging approach adopted by the local authorities because of low administration cost, but it is ineffective and has caused many environmental issues. Therefore, this study was conducted to explore the public willingness to pay on better solid waste management services at rural area of Kelantan. A total of 911 respondents from three (3) districts (Jeli, Kuala Krai, Gua Musang) participated in this study. The results showed that most respondents (±75%) expressed their satisfaction on current solid waste management services provided. This study indicated that nearly 62% of respondents were willing to pay more for better solid waste management services. This study revealed that the estimated mean willingness to pay (WTP) for better solid waste management service is RM12.05 per household. Logistic regression model suggested that satisfaction on solid waste management services affected the WTP amount, apart from socio-economic factors such as educational level, type of houses, occupation and household income. The results can be useful for understanding the rural resident's attitudes and WTP for solid waste management services.

1. Introduction
In developing countries such as Malaysia, inefficient solid waste management is one of the issues contributing to environmental problems. Increasing population growth in one area is closely linked to the increase in solid waste generated. Failure to manage solid waste will significantly impact human health and the environment [1]. Currently, in Kelantan, domestic waste characteristics fluctuated wildly [2]. Public consciences of domestic waste properties and management were variable due to the rapid development of the rural economy and social transformation in rural areas [3]. Consequently, the local authorities have to deal with many environmental issues, especially with the growing domestic pollution effects from socio-economic variations in rural areas.

Generally, sustainable rural development requires an integrated waste management strategy that encompasses all stages from waste collection and transportation to waste processing and disposal [4]. Many previous studies focused on attention, participation, willingness to pay (WTP) and the readiness to collect waste in urban areas [5-7]. Few considered the willingness to participate in all waste management processes and its socio-economic influences in rural areas of developing countries. To

implement effective policy and establish proper facilities for solving domestic waste issues, the public WTP and willing to participate, as well as its socio-economic influences, must also be taken into account, or public policies and producers' participation cannot be effectively implemented.

2. Methodology

2.1. Study area
This study focuses on the rural area of Kelantan from villages that located at Jeli, Kuala Krai and Gua Musang districts. District council is the authority that responsibility for solid waste management services at these areas.

2.2. Questionnaire design and data collection
The primary sources for the data used in this study were questionnaires completed by 911 households from 3 districts (Jeli, Kuala Krai and Gua Musang). Only the head of households was asked to respond to the questionnaire. Stratified sampling method was adopted because rural residents presented different socio-economic development levels, occupation, different types of houses, and different cultures. The questionnaire consists of four sections such as socio-economic characteristics, satisfaction on the current solid waste management services, the WTP and the maximum value that could be paid.

Five-point Likert response scale was used to assess rural residents' satisfaction level on solid waste management services provided. In this research, the Contingent Value Method (CVM) was employed to evaluate the mean WTP to manage solid waste better. Due to its flexibility and ability to estimate total values [3], CVM has become one of the most widely used evaluation methods. Continuing CVM (open-ended questions) and Discrete CVM (Dichotomous Choice questions) are available for estimating WTP [8]. Continuous CVM allows interviewees to answer open questions by completing the maximum amount they wish to pay; data analysis is also straightforward.

The validation test was performed using the content validity. The internal consistency test to express the number of coefficients known as the alpha Cronbach coefficient was performed for testing reliability. The results for the designed questionnaire from the Cronbach alpha test were 0.698. In Starovoytova's [9] study, a value of 0.6 to 0.85 for the Cronbach-alpha is recommended by most authors as an acceptable value.

2.3. Data analysis
In the survey data description, descriptive statistics were employed to measure the central trend, including the mode, mean, median, and scatter measures like the standard deviation and scope describing proximity to central trends. The distribution that sums up each value's frequency or range of values of the variable displayed the percentages. The socio-demographic data have been presented in proportion. The mean of the data was also used to determine the data variability. The data were analysed to determine the distribution value centre. Mean values calculated to analyse respondents' perception and the average bid price will be payable by respondents.

Besides, the logistic regression model is a statistical process used to identify the determinant factors in households' WTP for improved services for solid waste management. In calculating WTP value for solid waste management, the data were analysed to determine the respondents' corresponding socio-economic attributes [8].

A bidding format has been used conceptually to get the value of willingness to pay [10]. The The single-bounded dichotomous choice contingent valuation (DCCV) model was used for analysing the data. For the DCCV model, there are two possible results, whether the respondent is unwilling to cover the fees offered or the respondent is willing to pay for the solid waste management budget's bid price level for better solid waste management services. For this model, two possible outcomes can be found. The bid price is dependent, where 1 = yes, and 2 = no. The prices are the dependent variable. The

estimated WTP measurements have, therefore, been computed with the logit regression model. In this study, SPSS 20.0 was used to calculate the respondent's willingness to pay binary logit regression.

Mathematical simplicity in comparison is often valued for providing simplified solutions, shorter evidence or more straightforward calculations. Next, asymptotic properties are increased and reduced until a particular value, such as asymptotic, is approached at the point where they are reduced. The logit model has a cumulative probability function capable of dealing with a dependent variable to evaluate the probability of an event occurring or not by predicting a binary dependent result from a set of independent variables [9]. Moreover, the logistic regression model provides information only about respondents' decision to pay or to not pay for the improved solid waste management (SWM) services like collection, transport and disposal. The logistic regression model or logit model to identify household's WTP for improved waste collection service can be stated as:

$$Y = \frac{1}{1 + exp^{-Z}} \tag{1}$$

where;

Y = Response of respondents to WTP such as sex, age, education, family size, monthly size, monthly income, present cleaning status and maximum amount of willing to pay for respondents to the willingness to pay question which was either Yes = 1 or No = 0)

Z = Summation of explanatory variables multiplied by their coefficient, for example.,

$$Z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_8 X_8 + \varepsilon i \tag{2}$$

Where;

β_0 = the intercept which is constant

$\beta_1 \ldots \beta_8$ = Coefficient of explanatory variables

$X_1 \ldots X_8$ = a set of independent variables

εi = Error term

It is impossible to use the logit parameters for interpreting the effects of the explanatory variable for each variable because this model is not linear to households that are willing to pay for improved services for solid waste management. Thus, marginal effects were calculated to determine the relative magnitude of the effects of the explanatory variable. The effects of the jth explanatory variable can be summarized as below:

$$\frac{1}{n}\sum_{i=1}^{n}\frac{\partial P\left[Y_i = 1\right]}{\partial X_{ii}} = \beta_j \frac{1}{n}, \tag{3}$$

i.e., the mean marginal effects over the sample of n individuals.

3. Results and Discussion

3.1. Respondent's profile
A total of 911 respondents took part in the study. The gender of respondents who answered the questionnaire is generally male (64.8%), indicating they are the family leader and the one who paid taxes and bills (Table 1). Furthermore, most of the female respondents are single mothers or lived alone unmarried. The range of respondent's age is 41-50 years old implies that most respondents are in their active age and can work to gain more income which can affect their decision to pay to have a better waste management services in the future. Most of the people live in the rural area of Kelantan are Malay with a little amount of another ethnicity like Siamese and Chinese.

3.2. Respondent's satisfaction on current solid waste management services
Table 2 shows the satisfaction of the respondents towards the current solid waste management services provided local authority. The majority of the respondents (±75%) are satisfied with the overall solid waste management services provided and less than 25% of respondents are not satisfied. Particularly, approximately 74% of respondents are satisfied with solid waste collection services which inducing the schedule of collection, and the location of bins. The study found out that the level of satisfaction of respondents on solid waste management services are moderate (3.31, SD=1.20).

Table 1. Socio-demographic of respondents.

Variables	Group	F / (%)	Variables	Group	F / (%)
Gender	• Male	591 (64.8)	House ownership status	• Own	700 (76.8)
	• Female	320 (35.2)		• Rent	211 (23.2)
Location of House	• Kuala Krai	300 (32.9)	Type of House	• Traditional House	355 (39.0)
	• Jeli	225 (24.6)		• Terrace House	171 (18.5)
	• Gua Musang	385 (42.5)		• Bungalow	385 (42.5)
Age	• 21-30	74 (8.1)	Number of household member	• 1-3	267 (29.3)
	• 31-40	156 (17.1)		• 4-6	419 (46.1)
	• 41-50	215 (23.6)		• 7-9	209 (22.8)
	• 51-60	244 (26.8)		• >10	16 (1.8)
	• >60	222 (24.4)			
Etnicity	• Malay	840 (92.2)	Household Income	• <RM500	156 (17.1)
	• Chinese	31 (3.4)		• RM501-RM2500	563 (61.8)
	• Siamese	40 (4.4)		• RM2501-RM4500	67 (7.3)
				• >RM4500	125 (13.8)
Education Level	• Primary School	156 (17.1)	Occupation	• Public Sector	109 (12.0)
	• Lower Secondary School (PMR)	104 (11.4)		• Private sector	74 (8.1)
	• Upper Secondary School (SPM)	333 (36.5)		• Entrepreneur	341 (37.4)
	• Certificate	74 (8.1)		• Unemployed	281 (30.9)
	• Diploma/Degree	147 (16.3)		• Retired	106 (11.6)
	• Unschooled	97 (10.6)			

Table 2. Satisfaction of respondents on solid waste management services provided.

Statements	Mean (SD)	Strongly not satisfied F (%)	Not satisfied F (%)	Moderately satisfied F (%)	Satisfied F (%)	Strongly satisfied F (%)
Satisfied with the solid waste management service provided at your home	3.41 (1.00)	30 (3.3)	133 (14.6)	303 (33.3)	319 (35.0)	126 (13.8)
Satisfaction on the solid waste collection time	3.25 (1.14)	67 (7.3)	163 (17.9)	297 (32.6)	244 (26.8)	140 (15.4)
Satisfaction with the solid waste collection services	3.18 (1.08)	59 (6.5)	193 (21.1)	281 (30.9)	281 (30.9)	97 (10.6)
Satisfaction on the location and accessibility of bin provided	3.43 (1.44)	148 (16.3)	111 (12.2)	126 (13.8)	252 (27.6)	274 (30.1)
Average Mean (SD)	3.31 (1.20)					

3.3. Respondent's willingness to pay for better solid waste management services

Statistics show that around 62% of respondents are prepared to pay for the bid given, and 38.2% are unwilling to pay for better solid waste services (Table 3). The results show a lower bid price and many participants are prepared to pay for the improved management of solid waste in the rural area of Kelantan. This study found that about 22.4% of the respondents were willing to pay for the first RM8 bidding level, and only 17.0% of them would not pay. When the bidding level increased to RM16, more people (23.7%) would be willing to pay, and only a small percentage (12.8%) would not be ready to pay for the bid level. Moreover, when the offer rose to RM10, 18.4% were prepared to pay, while 23.4% were not prepared to pay for the offer level at issue.

Besides, at the bid price of the RM12, 17.1% of respondents who were willing to pay for solid waste management services and 25.5% of respondents unwilled. Next, the RM14 bid level, 21.3% of respondents would avoid payment, and 18.4% would be prepared to pay. This result showed that the proportion of those who were unwilling to pay is increasing than the willingness to pay from the bid value of RM10 to RM14. The previous study stated that the household's response to the willingness to pay should be reduced as the bid value increases [10, 11].

Table 3. Frequency (F) and Percentage (%) of respond bidding price.

Prices (RM)		Yes	No	Total
		F (%)	F (%)	F (%)
8		126 (22.4)	59 (17.0)	185 (20.3)
10		104 (18.4)	81 (23.4)	185 (20.3)
12		96 (17.1)	89 (25.5)	185 (20.3)
14		104 (18.4)	74 (21.3)	178 (19.5)
16		133 (23.7)	45 (12.8)	178 (19.5)
	Total	563 (61.8)	348 (38.2)	911 (100)

Table 4. Logistic regression results.

Variable	B	Sig.	Exp(B)
Gender	0.633	0.207	1.884
Location	0.494	0.243	1.459
Age	0.260	0.215	1.297
Education Level	0.370	0.041*	1.447
Occupation	0.772	0.003**	2.164
Household Income Level	1.024	0.006**	0.359
Number of Household	0.434	0.202	1.543
Type of House	0.672	0.010*	0.511
Home status	0.987	0.156	1.683
Bid	0.088	0.279	1.092
Constant	-4.785	0.055	0.008
Pseudo R^2	0.409		
Log likelihood	-124.919		
Percentage of right prediction	71.5%		

Note: ** Significant at 0.01 level *Significant at 0.05 level

Table 4 shows the level of education, occupation, household income level and household type show statistical significance estimated based on the Contingent Valuation Method (CVM) dichotomous choice concerning the household's willingness to pay for better solid waste management (SWM) services. In the meantime, with 0.633, 0.494, 0.260, 0.434, 0.987 and 0.088 coefficient values respectively, gender, location, age, household number, home status and bid price had no significant effect on the amount of willingness to pay. The coefficient of education level shows a positive value of 0.370. Income is reported in the analysis with a value of 1.024 for the household income level context. Next, a positive value of 0.772 is shown by the occupation coefficient. The coefficient is set at a value of 0.672 for the type of house.

Parameters like education and type of house are statistically significant at the 0.05 level, and households' occupation and income are statistically significant at level of 0.01. Pseudo-R^2 gives the goodness of the fittest for the regression with 0.409 or 41%, meaning that at least one of the variables is different from zero because the model's independent variables can explain 41% of the variations in the willingness to pay for solid waste management in Jeli, Kuala Krai and Gua Musang rural area. This study's log-likelihood is -124.919, whereby higher likelihood means that the model has a better relative chance of producing the data. Besides, the percentage of correct prediction of this model is 71.5%.

The odds ratio for gender (1.884), location (1.459), age (1.297), level of education (1.447), occupation (2.164), household number (1.543) and home status (1.683) could be seen as more than 1, means that these factors were more likely to pay for improved SWM services, while household income

level (0.359) and house type (0.511) have less than 1 for odd ratio, which means that it is associated with lower odds. The bid price showed an odds ratio with a value of 1.092, which implies that exposure to this factor does not affect the odds of the SWM payment decision. However, the level of education, occupation, household income level and house type showed a statistically significant result in determining an additional amount for better solid waste management services by the WTP value of the households. The household has higher odd ratios of WTP compared to lower-income, according to Julius et al. [11]. It means that income is essential in influencing the household's desire to manage and preserve the environment's quality [12].

According to the outcome of logit regression, in this analysis, education level is a significant variable with a significance level value of 0.041. it means that respondents with a high level of education are willing to pay more than respondents with a lower education level [13]. The education level coefficient was positive, supporting the hypothesis that the probability of the respondents' willingness to pay increases with the level of education. The higher the level of education achieved, the greater the likelihood of the respondents' willingness to pay for improved services for waste disposal. Table 5 shows that respondents with a non-university education such as UPSR were prepared to pay RM8.33, followed by PMR (RM10.00), SPM (RM12.24), Certificate (RM11.70) and unschooled (RM6.69). Until then, respondents with a university education level (Diploma/Degree) were willing to pay RM 20.60 for waste management improvements. The outcome was important to demonstrate that respondents with a high level of income and education were statistically willing to pay more for SWM services than respondents with a lower level of income and education [14].

Table 5. Mean value of willingness to pay for solid waste management services based on significant socio-demographic.

Significant Socio-demographic	Mean (RM)	SD
Occupation:		
Public Sector	17.15	12.66
Private Sector	11.90	4.22
Self-employed	10.89	8.91
Unemployed	9.03	5.11
Retired	28.00	31.11
Education Level:		
Primary School	8.33	3.78
Lower Secondary School (PMR)	10.00	4.50
Upper Secondary School (SPM)	12.24	9.63
Certificate	11.70	4.94
Diploma/Degree	20.60	15.15
Unschooled	6.69	2.21
Household Income:		
<RM500	6.52	1.25
RM501-RM2500	10.20	4.88
RM2501-RM4500	18.00	12.61
>RM4500	24.00	17.17
Type of House:		
Wooden House	9.94	7.26
Terrace	16.57	14.03
Bungalow	12.00	8.81

This study found out that occupation has significant p-value 0.003. Occupation is positively linked to household willingness to pay to enhance waste management services. It implies that respondents with a better job that satisfy their household income will tend to agree and pay for enhanced SWM. Table 5 shows employed respondents who were willing to pay RM17.15 for the public sector, and private sectors were RM11.90 while self-employed were willing to pay RM10.89 in their housing area for better solid waste management. Besides, unemployed respondents are willing to pay RM9.03, including retired respondents willing to pay the highest amount of RM28.00.

Besides, this study also revealed that the different household income has significant (p-value 0.006) influence willingness to pay of respondents for SWM services. However, the coefficient value was positive, indicating that the level of income supports the hypothesis that the probability of respondents saying yes to the willingness to pay question increases with the level of income. Previous studies have shown that the positive relationship between income and the level of willingness to pay, which has lower income will have lower WTP [3, 11]. However, a study by Anjum [8] reported a negative relationship between income and willingness to pay due to less satisfaction in terms of facilities. Moreover, Table 5 indicates that the WTP based on the household's income. This study revealed that the household with less than RM500 income willing to pay RM6.52. Besides that, household income between RM501 – RM2500 willing to pay RM10.20 while household's income between RM2501 – RM4500 willing to pay RM 18.00. The household's income more than RM4500 per month is willing to pay RM24.00. The logistic regression analysis outcome shows that the household's average WTP is RM12.05 for better solid waste management services.

Table 5 shows that the wooden house participants have an average value to pay for RM9.94, the terrace is RM16.57 while the bungalow is RM12.00. According to Abas et al. [2] the bungalow houses were willing to pay lower than the terrace house because most of the respondents living in bungalow houses were satisfied with the local authority's SWM services.

The regression estimated that household income, education level, type of house and occupation with an average WTP value of RM12.05 per six months instead of RM8.00 per household. The increase of SWM services fee can beneficial the local authorities in improving its services [15].

4. Conclusion
This study successfully elicited the rural community had relatively moderate satisfaction on the solid waste management services provided by the local authority. However, the satisfaction of rural community in Jeli, Kuala Krai and Gua Musang is influenced by the respondents' demographic and awareness of environmental issues. This study revealed that most respondents highlighted that the current services provided by their district council should be improvised, and most respondents are willing to pay for better solid waste management services regardless of their demographic. However, the socio-demographic pattern, practices, services and perception of the people should be considered before performing any method to improve waste management. Therefore, this study's findings can help understand the issues, respondent's satisfaction, and willingness to pay for solid waste management services.

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