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Using Choice Experiment for Wastewater Treatment and Service Valuation in Selangor, Malaysia

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Abstract

A functional and modern sewerage system is essential for ensuring that wastewater is appropriately treated before it is released into the drainage system or river. This research was done to assist related service providers and governmental organisations in identifying households' willingness to pay for enhanced wastewater treatment and services. Attributes such as (i) environmental improvement (sludge), (ii) additional monthly payment, (iii) distance of treatment plant (odour impact), (iv) standard time for repair (response time), and (v) river water quality (effluent) were selected based on Focus Group Discussions. Six hundred households in the Malaysian state of Selangor that had completed the Choice Experiment questionnaire. The quality of river water (effluent) is a vital attribute according to the implicit price of wastewater treatment service features based on Multinomial Logit regression. According to Compensating Surplus estimates, families are willing to spend a 54% premium over the market rate to acquire the additional services.

Keywords: *Choice Modelling, Discrete Choice Model, Multinomial Logit (MNL), Wastewater Treatment, Willingness-To-Pay*

Introduction

Wastewater treatment is central to human, environmental health and it is essential for sustainable development. Wastewater treatment is the conversion of wastewater into effluent that can be discharged into the water cycle with minimal environmental impact (Ramli and Abdul Hamid, 2017). In Malaysia, Indah Water Konsortium Sdn Bhd (IWK) is the national sewerage operator tasked with operating and maintaining a modern and efficient wastewater system for all Malaysians. Although the majority of Malaysian households and businesses are connected to the sewerage network, many still use individual septic tanks and pour-flush toilets. These two approaches necessitate regular manual desludging. However, many households do not perform this desludging

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as required, which can lead to environmental pollution as wastewater from septic tanks can enter main water sources or surface. Water and wastewater play a critical role in a green economy, as they are linked to sustainable development goals including health and environmental well-being. IWK is responsible for maintaining the nation's connected sewerage system and individual septic tanks (IST), as well as processing wastewater before it is released back into the environment.

Malaysian households and businesses generate an estimated 6,000 MLD of wastewater per day, which must be passed through sewage treatment plants (STP) before being released back into the water cycle. (IWK, 2021).

Despite Malaysia's current water quality regulations, the Department of Statistics (DOE, 2020) has continued to monitor and detect changes in river water quality. In 2020, river water quality was assessed using 8,098 samples collected from a total of 1,353 manual monitoring stations on 672 rivers in Malaysia. Of the 672 rivers monitored, 443 (66%) had good water quality, 195 (29%) were slightly polluted and 34 (5%) were polluted. Many of these rivers had high Biochemical Oxygen Demand (BOD) and were polluted by Ammonium Nitrogen (AN) and Suspended Solids (SS). Domestic sewage has been identified as the main cause of the problems, and the number of polluted rivers can be linked to the discharge of treated and untreated sewage into the rivers.

On the other hand, the pollution of the Sungai Selangor watershed has been steadily expanding over the past decade due to increasing urban, industrial, agricultural, commercial, and residential activities (Chowdhury et al., 2018). Selangor is a highly urbanised state in Peninsular Malaysia, and the most populous state in Malaysia, with a population of 6.99 million (Department of Statistics, 2022). The amount of wastewater generated and the number of people affected by the consequences of wastewater pollution are growing in step with the population. In 2020, 104 of the 368 marine water quality monitoring stations were classified as excellent, 56 as good, and 190 as moderate. The remaining 18 stations were rated poor, with Selangor having the worst stations (DOE, 2020).

Sabeen et al. (2018) analysed the level of pollutants in the final treated wastewater from the sewage treatment plants in Malaysian urban areas and compared it with the Malaysian standard A and B effluents. The results showed that phosphorus and nitrite levels in some WWTPs were slightly higher than the prescribed effluent standard for Malaysia. Due to population growth in most urban areas in Malaysia, more and more pollution is being generated that is likely to affect human health. According to Cassidy et al. (2020), there is a need for sludge management improvements, and the oversizing of the wastewater treatment (WWT) plant is lowering efficiency. Due to the unrestricted entry of wastewater into the environment, environmental protection necessitates implementing efficient purification systems for microbiological agents (Aghalari et al., 2020).

To date, most of the literature has discussed the impacts of sewage pollution on human health and ecosystems, but no study of household willingness to pay for the value of improved wastewater treatment and service has been conducted using the choice experiment method. However, any improvements, would almost certainly result in higher charges for households. Thus, the objective of this study is to examines households' preference for specific improvements in wastewater treatment and service attributes and their willingness to pay in acquiring these upgrades.

Literature Review

In developing countries, poor sanitation and wastewater management pollutes fresh water sources, is a major cause of disease and mortality, and has an impact on eco-system health. Furthermore, 80-90 percent of all wastewater is discharged directly into surface water bodies without treatment (ESCAP, 2015). Wastewater treatment plants are critical to ecosystem quality Environmental damage and adverse human health effects may arise if plant operations managers do not respond effectively to plant conditions (West and Mangiameli, 2000). To improve overall environmental performance, wastewater reclamation and reusable water, should be improved. In addition, the use of sewage sludge for energy recovery should be addressed (Kamble et al., 2018). There are numerous issues with wastewater treatment technologies, such as the larger space and energy requirements and sludge disposal. Moreover, these technologies have significant practical obstacles, such as inadequate removal of complex organic compounds, inability to treat wastewater that exceeds the specified design capacity, and lack of professionally trained personnel (Tripathi et al., 2023). The use of solid byproducts from Hydrothermal Liquefaction (HTL) of sewage sludge as a source of valuable nutrient recovery and as a substitute for fossil-derived adsorbents used in tertiary wastewater treatment has the potential to improve the economics of the HTL process and wastewater treatment plants while increasing resource recovery and sustainability (Saner et al., 2022).

Despite the fact that surveys and research to determine consumer preferences for domestic water and wastewater services are regular practise among water utilities in many countries, little of it makes it into either academic or practitioner literature. Potable water attributes that are frequently studied include supply security, interruptions, drinking water quality, water pressure, and leakage, whereas wastewater attributes include internal sewer flooding, external sewer flooding, nuisance from wastewater treatment works, and pollution incidents (Sayles et al., 2021). According to Ariffi and Sulaiman (2015), apart from public awareness, an increasing number of people are unwilling to pay desludging fees and only seek service when their septic tanks are in trouble. Public criticism has also resulted in a three-fold reduction in the country's sewerage service charge, which has a severe impact on service providers' finances. In Malaysia, it seems that full cost recovery for sewage treatment is still a long way to be achieved.

Methodology

Study Area and Sampling Strategy

The research design and approach for this study is quantitative and qualitative based where the data were gathered through interviews and Questionnaire. A pilot survey was conducted to fine-tune

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the questionnaire. The pilot survey helped determine the adequate number of choice sets. This study focused on households connected to the central sewerage system, particularly paid MYR 8 (terrace houses and double-storey houses) per month for sewerage services. The survey was finished in a month with the help of six enumerators who randomly selected respondents from developed district (Shah Alam), a moderately developed district (Bangi and Kajang), and a less developed district (Banting) in Selangor, Malaysia. Total 165 respondents selected from developed area, 380 respondents selected from moderately developed area and 55 respondents selected from less developed district. Considering the budget constraints and high survey cost, the sample size was considered sufficient for use in environmental valuation surveys in Selangor, Malaysia. Banting is the smallest of the three types of districts, so its samples were smaller than those of the other two.

Attributes Selection

One of the most crucial elements when developing a choice experiment is the selection of attributes through qualitative methods (Koemle and Yu, 2020). This study considered expert opinions, guided focus groups, and literature reviews to ensure that appropriate levels were selected and significant attributes were identified for the choice experiment. Eight technical specialists engaged in WWT and services in Malaysia were interviewed in-depth. These sessions listed customer expectations, customer services, current policies, technological characteristics, and wastewater systems on WWT and service. The technical specialists also helped determine the relative level of human and environmental harm linked with each wastewater system and the probability of other features.

The consumer focus group discussion were held in small groups of selected Selangor households to understand better the consumers' perspectives on wastewater treatment. The goal of the focus sessions was to identify the levels of household wastewater systems and relevant attributes from the respondents' perspectives. The demographics and social status of focus group participants varied. Each session initiated with current topics in Malaysian household WWT systems, followed by choice set of examples. Next, respondents were requested to speak openly about the issues they believed needed to be addressed to enhance present wastewater services and systems. Respondents were requested to examine the possible service levels for every attribute. Subsequently, they were asked to provide a total price for the monetary attribute (additional monthly payment for an improved WWT system) to achieve the said improvement. The challenge of participants in consistently identifying the range of pricing attributes was also discovered during these focus group sessions. However, the upper and lower limits suggested by participants for this additional payment attribute were MYR 5 - MYR 1 per month. Based on the consumer-focused sessions, this research includes one monetary attribute and four non-monetary attributes in the final choice experiment. These include additional payment, distance (distance of treatment plant from housing area), standard repair time (response time), environmental improvement (sludge treatment), and river water quality (effluent).

Design of the choice experiment

According to Vega and Alpizar (2011), choice experiments are the simplest of the choice-based approaches in terms of the cognitive demands placed on respondents. Moreover, choice experiments reflect real market situations and are consistent with welfare economics. In a choice experiment, subjects are asked to choose their preferred alternative from a set of options, and they are typically asked to respond to a set of such choices. A monetary value is included, as one of the attribute for choice experiment. As a result, when people make decisions, they implicitly make trade-offs between the levels of attributes in the different alternatives presented in a choice set (Alpizar et al, 2001). Designing a choice experiment involves four steps: (1) defining attributes and attribute levels, (2) experiment design, (3) experiment context and questionnaire preparation, and (4) sample selection and sampling strategy.

Choice Modelling

Choice Modelling included in the study with attributes beneficial to the management and policymakers to measure consumer preferences. Each attribute should have a range of levels to allow empirical estimation of part-worth utility (Yu et al., 2006). In a choice experiment, it is assumed that consumers will allocate utility to different attribute levels before developing a total utility for a specific service or product, which can be hypothetical or actual (Crase et al., 2002). Therefore, if we consider household WWT and services using choice experiment would allow us to assign a monetary value to its attributes and assess their relative importance to households. The flexibility of choice modelling enables it to assess the welfare consequences of various alternative management options and the marginal values of environmental attributes. Discrete choice models estimate how much a person is willing to accept (WTA) or willing to pay (WTP) to obtain some benefit or avoid some cost from a specific action. This method offers several benefits over other approaches to valuing non-marketable goods. Aristodemou and Rosen (2022) stated that the model can be applied in situations where consumers must choose between products from various brands, each of which presents a menu of ordered choices, such as by providing goods of varying quality.

Most importantly, it allows for simultaneous presentations of multiple substitutes or alternative services/goods. Respondents must consider the complementary and substitution effects when considering this benefit in their decision-making process. Incorporating the attributes into the alternative set used in the choice experiment could mitigate bias concerns. Furthermore, compared to a traditional contingent valuation method, the choice experiment allows respondents to determine the various trade-offs more flexibly and realistically between alternatives (Rolfe et al., 2002). According to consumer decision theory, consumers make decisions based on product attributes (Kaul & Rao, 1995); (Cooper, and Crase, 2008).

According to Hanley et al. (2001), beginning with assigning service or product attributes to levels, the estimation, preference measurement, the construction of choice sets, and experimental design are all steps in the choice experiment procedure. In the context of environmental valuation, the

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utility for option i is determined by socioeconomic characteristics (S) and environmental attributes (Z) and can be calculated as follows:

$$U_{in} = V(Z_{in,} S_n) + \varepsilon(Z_{in,} S_n) \quad (1)$$

The probability that individual n will select option i over option j is calculated as follows:

$$Prob(i/c) = Prob\{V_{in,} + \varepsilon_{in} > V_{jn,} + \varepsilon_{jn}; j \in C\} \quad (2)$$

whereby C denotes represents the complete set of choices. The utility function's error terms are assumed as independent and identically distributed (IID), with the independence of irrelevant alternatives (IIA) property. According to the IIA property, choosing an alternative depends on the respective options' utility. The probability of selecting option i is expressed as follows:

$$P(i) = \frac{\exp^{\mu V_i}}{\sum_{j \in C} \exp^{\mu V_j}} \quad (3)$$

where,

$$V(i) = V_i = V(Z_i, S) \quad (4)$$

and μ is a scale parameter assumed to be 1, indicating a constant error variance, S is a socioeconomic characteristic and vector of market goods, Z_i is a vector of environmental goods, and V_i is the utility function. If the options adhere to the IID property, this probability is calculated using multinomial logit regression. The utility function V(i) is an additive structure that only includes attributes from the choice sets.

$$EV(i) = C + \sum \beta_k Z_k \quad (5)$$

From the above equation, β is the coefficient, and C is an alternative specific constant (ASC). The ASC accounts for any systematic change in choice observations linked with an alternative that cannot be explained by observed socioeconomic factors of respondents or attribute variation. There is the possibility of j-1 ASC in a multinomial logit with j options. It is also feasible to include socioeconomic variables and environmental attitudes into utility functions by predicting the variables interactively, with any attributes or the ASC from a choice set. For example,

$$V(i) = ASC + \sum_j \gamma_j ASC^* S_{jn} + \sum \beta_k Z_k \quad (6)$$

S_{jn} denotes the socioeconomic or environmental attitudinal variables j for the n^{th} individual. According to Jamal et al. (2004), a nested logit estimation procedure is appropriate if the IID assumption is violated. Our study constructed the choice sets and design of the experiment according to the compensating surplus (CpS). CpS calculates the required income changes to render a person indifferent to a modification (between the first condition of poorer WWT service quality and succeeding situations of enhanced WWT service quality), presuming the individual's entitlement to the initial utility level. The CpS can be calculated using the indirect utility function:

$$V_0(G_i, Z_0, M) = V_0(G_i; Z_1, M - CpS) \quad (7)$$

where G_i represents other marketed goods, Z_0 and Z_1 symbolise different levels of an environmental attribute, while M is the income. The CpS can be calculated using the below equation, as proposed by Morrison et al. (1999) and Boxall et al. (1996):

$$CpS = \{-1/(|\beta_M|)\}(V_0 - V_1) \quad (8)$$

where V_1 and V_0 represent subsequent and initial states, respectively, and β_M is defined as the marginal utility of income and is the coefficient of the monetary attribute.

Results and Discussion

In addition to the choice experiment questions, data on the households' demographic characteristics, economic, and social were collected. Table 1 summarises the sample's descriptive statistics. The respondents were spouses or heads of household, with an average age of 48 years in the overall study area. Malay respondents made up most of the survey's race composition, accordant with the urban distribution of this race's population. Most respondents held a secondary school certificate, and roughly one-third had a bachelor's degree, indicating a high literacy rate. Respondents were mainly from the private sector, most in professional or management positions. The average household income (overall study area) was MYR 3500 for a family of five, with 55 per cent of respondents living in two-story homes.

Table 1: Respondents' socio-demographics

Variables	**Developed District**	**Moderately Developed District**	**Less Developed District**	**Overall Study Area**
Gender	Male (84.2%)	Male (85.4%)	Male (90.9%)	Male (85.6%)
Household head age	43	50	47	48
Race	Malay (75.2%)	Malay (46.6%)	Malay (45.5%)	Malay (54.3%)
Household size	5	5	4	5
Educational level	Degree/ professional courses (49.6%)	Cert/diploma (32.6%)	Degree/ professional courses (40.0%)	Degree/ professional courses (33.3%)
Household monthly income	MYR 4500 (34.5%)	MYR 3500 (33.3%)	MYR 2500 (50.9%)	MYR 3500 (34.1%)
Type of house	Double-story house (56.4%)	Double-story house (52.1%)	Terrace house (70.9%)	Double-story house (55.0%)
Ownership of residents	Owner (55.8%)	Owner (86.3%)	Owner (90.9%)	Owner (78.3%)

Volume: 8, No: 2, pp. 634-648
ISSN: 2059-6588 (Print) | ISSN 2059-6596 (Online)

Household Choices of WWT Services

Table 2 depicts a cross-tabulation of respondents' preferences for WWT service improvement alternatives defined by choice sets and the additional price, which aids in explaining the trend of respondents' preferences.

The outcome of cross-tabulation shows the precise pattern of respondents' choice when the price increases from MYR 1 to MYR 5, the percentage of votes decreases from 40.27% to 15.80%.

However, service improvement with additional payment MYR 5 was the least preferred option among the three alternatives in every district.

Table 2: Cross-tabulation of household choice option

Price of WWT services	Developed District (%)	Moderately Developed District (%)	Less Developed District (%)	Overall Study Area (%)
No additional charges	26.30	14.79	15.64	18.03
MYR 1.00	37.21	39.74	53.09	40.27
MYR 3.00	22.91	27.26	25.45	25.90
MYR 5.00	13.58	18.21	5.82	15.80

Model Results

Multinomial logit regression (MNL) was used in the CM analysis to estimate two equations econometrically. The first MNL basic model was a basic specification demonstrating the importance of the attributes in respondents' choice of the three different WWT technology and service options. The environmental, attitudinal variables and socioeconomic were incorporated into the second MNL extended model.

The inclusion of these variables aids in the capture of preference heterogeneity. These variables also aid in estimating the effects of attribute changes on the possibility that the base or improved option will be selected. The parameter estimates are unbiased when the MNL regressions do not violate the IID assumptions. Without nested logit regressions, unbiased estimates cannot be generated.

MNL Basic Model

The MNL models yielded three indirect utility functions, each representing a different resource use option. Option 1 thus referred to the baseline or status quo, whereas Options 2 and 3 referred to improvement plans with improved environmental attributes and services. The attribute levels in the choice sets determine the utility of each function:

$Vi = C_0 + \beta_1{*}TIME + B_2{*}DIST + B_3{*}EFFL + B_4{*}ENV + B_5{*}ADPY$

for i = 1, 2, 3 and $C_0 = 0$ for $V_i = 0$.

Volume: 8, No: 2, pp. 634-648
ISSN: 2059-6588 (Print) | ISSN 2059-6596 (Online)

ASC_0	**Alternative Specific Constant (ASC) of one (0) for the baseline option and zero (1) for the improved option**
TIME	The standard time for repair (Response time)
ADPY	Additional charges for WWT service improvement
ENV	Environmental Improvement (Sludge treatment)
EFFL	River water quality (Effluent)
DIST	Distance of treatment plant (Odour impact)

Table 3 shows that all attributes were significant and showed the expected signs. The negative coefficient signs for the monetary payment attributes in both the primary and extended models indicate that utility decreased as price increased (WWT charges). Hausman and McFadden (1984) test revealed that at the 1% level, the baseline model estimation did not violate the IID assumptions.

Table 3: Multinomial logit model results

Variables	**Overall Study Area**	
	Basic model	**Extended model**
ASC_0	1.2752*** (0.1339)	1.4558*** (0.2909)
ASC_0AGE		0.1060* (0.0560)
ASC_0RACE		0.1114 (0.0991)
ASC_0RESD		- 0.3426*** (0.0768)
ASC_0OWNHSE		0.2532* (0.1172)
ASC_0TYPHSE		0.4969*** (0.0819)
ASC_0AKAD		- 0.1814* (0.1086)
ASC_0HHICM		0.0423 (0.1046)
TIME	0.0669* (0.0376)	0.0696* (0.0376)
DIST	0.1245*** (0.0380)	0.1288*** (0.0381)
EFFL	0.5819*** (0.0356)	0.5820*** (0.0356)
ENV	0.1676*** (0.0241)	0.1679*** (0.0242)
ADPYM	- 0.5626*** (0.0206)	- 0.5638*** (0.0207)
Log-likelihood	- 2925.74	- 2893.67
R^2Adj	0.06	0.07
Interaction Completed	5	5
Number of Observations	3000	3000

* the standard errors of the respective coefficients significant at 10% level, ** the standard errors of the respective coefficients significant at 5% level, and *** the standard errors of the respective coefficients significant at 1% level.

MNL Extended Model

This model assumes that a few environmental, attitudinal variables and socioeconomic affect

Volume: 8, No: 2, pp. 634-648
ISSN: 2059-6588 (Print) | ISSN 2059-6596 (Online)

respondents' preferences and behaviour. The socioeconomic and behavioural variables in this second model are represented by the Interactions between the variables and the alternative constant, C_0. Since $C_0 = 1$, these interactions capture the impact of those variables on the possibility of a respondent choosing the status quo. This model is specified by the equation below:

$$V_i = ASC_0 + \alpha_1 ASC_0*AGE + \alpha_2 ASC_0*RACE + \alpha_3 ASC_0*RESD + \alpha_4 ASC_0*OWNHSE + \alpha_5 ASC_0*TYPHSE + \alpha_6 ASC_0*AKAD + \alpha_7 ASC_0*HHICM + \beta_1*TIME + \beta_2*DIST + \beta_3*EFFL + \beta_4*ENV + \beta_5*ADPY$$

where i = 0, 1 and $ASC_0 = 0$ for $V_i = 1$.

ASC_0AGE	**Respondents' age (ratio data)**
ASC_0RACE	If the respondent is Malay, the dummy variable (DV) is one (1)
ASC_0RESD	Number of people living in the respondents' homes (ratio data)
ASC_0OWNHSE	DV = 1 for respondents who live in their own homes
ASC_0TYPHSE	DV = 1 for respondents who live in a two-story home
ASC_0AKAD	DV = 1 for respondents with qualifications higher than a diploma
ASC_0HHICM	DV = 1 for respondents with a monthly household income of less than MYR 4,000.00
TIME	The standard time for repair (Response time)
ADPY	Additional charges for WWT service improvement
ENV	Environmental Improvement (Sludge treatment)
EFFL	River water quality (Effluent)
DIST	Distance of treatment plant (Odour impact)

All the attributes, such as additional charges for WWT service improvement, environmental improvement (sludge treatment), river water quality (effluent), distance (odour impact), and the standard time for repair (response time), are vital and show both positive and negative signs. This finding demonstrates that respondents strongly support the option for improvement. On the other hand, for the monetary payment attributes, the negative coefficient signs indicate that the household's utility decreased with additional charges for WWT service improvement.

The socioeconomic attributes are substantial except for race and household income. A positive interaction coefficient between a variable and ASC implies that the former increases respondents' likelihood of choosing the improved WWT service options. In contrast, a negative coefficient indicates that respondents will choose the baseline option.

The models' explanatory powers (adjusted R^2) are satisfactory at 6% and 7% for the primary and extended models, respectively. Pek and Jamal (2011) reported that an adjusted R^2 of 0.2 - 0.4 is excellent. The extended model passes the Hausman-McFadden tests, like the baseline model, implying that at the 1% level, its estimates do not violate the IID assumptions.

As a result, the CpS estimates derived from these findings are unbiased.

Volume: 8, No: 2, pp. 634-648
ISSN: 2059-6588 (Print) | ISSN 2059-6596 (Online)

Estimation of Implicit Prices

Table 4 shows the implicit prices computed using the attribute coefficients from the MNL models. According to Pek and Jamal (2011), the marginal rate of substitution (MRS) between the monetary and non-monetary attributes is reflected in the implicit price. These implicit prices were calculated by dividing each attribute's coefficients by the monetary attribute's coefficients.

The implicit price of an attribute reflects the WTP for an additional unit of that attribute, ceteris paribus. The implicit prices of the attributes estimated by the two econometric models did not differ significantly. Jamal et al. (2004) previously noted that the heterogeneity of respondents' preferences had an insignificant impact on implicit price estimation, which was consistent with these indifferent estimates.

The lower implicit price values (MYR 0.01 - MYR 1.14) were comparable to a study by Jamal et al. (2004) (MYR 0.05 – MYR 1.36).

They used Malaysian mangrove valuations to demonstrate that low implicit pricing is also present in local values.

The higher implicit price values (MYR 2.12 - MYR 4.91) are consistent with the findings of Jamal (2006) (MYR 1.57 - MYR 3.51), which estimates the country's solid waste management value.

Table 4: Implicit price estimates (MYR)

Attributes	**Implicit Prices**							
	Developed District		**Moderately Developed District**		**Less Developed District**		**Overall Study Area**	
	M 1	M 2	M 1	M 2	M 1	M 2	M 1	M 2
TIME	0.27	0.80	0.21	0.21	0.50	0.57	0.12	0.12
DIST	0.01	0.02	0.29	0.30	0.31	0.38	0.22	0.23
EFFL	0.96	0.97	1.14	1.14	0.79	0.78	1.03	1.03
ENV	0.37	0.37	0.30	0.30	0.14	0.14	0.30	0.30

Note: M 1 = MNL basic model; M 2 = MNL extended model

Compensating Surpluses

Table 5 shows the compensating surplus (CpS) estimates for this research based on the model parameters chosen for the MNL model for various policy scenarios to describe the general WTP for upgraded WWT services over the current status quo.

The significant attribute's coefficients and the sample means of the socioeconomic characteristics were implemented in this study to identify the respondents' indirect utilities for five scenarios.

Table 5: Status quo and improved WWT planning scenarios

Attributes	Status quo	Improvement				
		Scenario A	Scenario B	Scenario C	Scenario D	Scenario E
TIME	48 Hours	12 Hours	12 Hours	12 Hours	12 Hours	24 Hours
DIST	30 - 40 Meter	100 - 150 Meter	50 - 100 Meter	100 - 150 Meter	50 - 100 Meter	50 - 100 Meter
EFFL	Polluted	Clean	Slightly Polluted	Clean	Slightly Polluted	Clean
ENV	No changes	60 % Improvement	60% Improvement	80% Improvement	90% Improvement	90% Improvement

The calculated CpS values for various scenarios of status quo change are plausible over the policy options chosen. Table 6 displays the CpS estimates for each policy-relevant and possible scenario (A, B, C, D, and E). The WTP describes the pattern, which rises as policy options shift toward improved environmental status (Ndunda et al., 2013). According to the CpS values for Scenario C, households seemed willing to spend an additional MYR 53.63 per month for Scenario C compared to the status quo. This result clearly shows that when the river water quality and environmental condition are improved further in Scenarios C and E, the mean WTP increases by MYR 53.63 and MYR 52.88, respectively, when compared to service improvement in Scenarios A, B, and D. Furthermore, households are willing to pay a higher monthly sewerage bill to ensure that treated effluent is of higher quality due to improved WWT technology.

Table 6: Household CpS estimates for extended models

Alternative scenarios	WTP (MYR per month)
Scenario A	49.88
Scenario B	34.13
Scenario C	53.63
Scenario D	41.50
Scenario E	52.88

Note: MYR stands for Malaysian Ringgit. At the time of the study, the exchange rate was MYR 1 = USD 0.24.

Conclusion

Malaysia's government is considering ways to improve household WWT service quality. The study's findings could benefit policymakers and relevant authorities in providing more public-friendly WWT services. Furthermore, the respondent is willing to pay for WWT service improvements if they benefit them. This finding is critical because it identifies a need in the country for better WWT service options. This data may assist the government in developing WWT technology and service policies that are more easily implemented and accepted by relevant authorities. Moreover, the public voted river water quality as an essential attribute. This finding calls for enhanced implementation with treatment technology advancements that can consistently meet the Department of Environment's effluent standards.

Furthermore, the existing treatment methods produced massive quantities of sludge in the environment. In this case, the public is willing to pay additional charges to improve sludge quality before disposing of the environment. This study also demonstrated the importance of WWT services. The attributes have been quantified and can thus be used to justify WWT in Malaysia. This research is also notable for demonstrating how the non-market value of WWT services can be estimated using the choice experiment method. Thus, choice experiment may contribute to policy formulation processes for sustainable natural resource conservation.

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