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HOUSEHOLD PREFERENCES FOR IMPROVED WATER SERVICES IN KELANTAN, MALAYSIA: A CHOICE EXPERIMENT APPROACH

(PILIHAN ISIRUMAH TERHADAP PERUBAHAN PERKHIDMATAN AIR DI KELANTAN, MALAYSIA: SATU PENDEKATAN EKSPERIMEN PILIHAN)

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Abstract: The condition of water supply provided to consumers is an important element which influences their health and daily routine. Excellent water services will give consumer's confidence to consume the water but poor services may endanger the households in many aspects and may tarnish the water company's reputation. Low water price may limit the water services improvement and upgrading projects. The objective of this study is to estimate household's willingness to pay using stated preference technique, the Choice Experiment (CE). This technique is employed to assess consumer's preferences in water service attributes such as water quality (QUAL), water disruption (DIST), Non-Revenue Water (NRW) and water price (PRICE). The Mixed Logit (ML) was applied to derive the households' marginal value for different attributes of the water services. The findings show that households are willing to contribute more on "water quality" attribute which derives the highest marginal value. The outcomes of this study will form the basis of policy recommendations to improve and enhance current domestic water services to a better level in the future.

Keywords: Attribute, choice modelling, Mixed Logit Model, water service, willingness to pay.

Abstrak: *Keadaan bekalan air yang disalurkan kepada pengguna adalah elemen penting yang mempengaruhi rutin harian dan tahap kesihatan. Servis yang cemerlang akan memberikan keyakinan kepada pengguna untuk penggunaan yang berterusan namun servis yang lemah boleh membahayakan pengguna dalam pelbagai aspek dan boleh mencemarkan reputasi syarikat pembekal air. Harga air yang rendah boleh menghadkan peningkatan servis dan perlaksanaan projek. Objektif kajian ini adalah untuk mengetahui anggaran kesanggupan isi rumah dalam dalam membayar kualiti yang disediakan dengan menggunakan teknik yang dinyatakan iaitu Choice Experiment (CE). Teknik ini digunakan untuk menilai pilihan penguna dalam ciri-ciri servis seperti kualiti air (QUAL), ganguan air (DIST), kadar air tidak berhasil (NRW) dan harga air (PRICE). Mixed Logit (ML) diguna pakai dalam menjana nilai marginal isi rumah bagi ciri-ciri servis air yang berbeza. Keputusan kajian mendapati isi rumah sanggup menyumbang lebih kepada kualiti air yang mencatatkan nilai marginal tertinggi. Hasil dari kajian ini akan membentuk saranan polisi asas dalam memperbaiki dan meningkatkan keadaan servis air semasa ke tahap yang lebih baik di masa akan datang.*

Kata kunci: Sifat, Choice Modelling, Model Mixed Logit, servis air, kesanggupan membayar.

Introduction

Lack of access to good quality water is putting pressure on the public since it affects them in many ways especially their health. The significant function of water as a public need cannot be denied. Improvement in water services is an important aspect in designing and applying efficient strategies for the sake of people's wellbeing and economic growth of the country. Frequent water interruption traps people in poverty as they lack basic necessities in their life. Problems arise because of failure

of water utilities in having expertise that knows how valuable improvement in services would be to consumers. Thus, economic valuation on this issue will identify the problem and provide solutions on how to improve the non-market goods and services. Whittington *et al.,* (1990) claim that water utilities should be concerned about household's behaviour and their willingness to pay for improvement in water services based on the demand-oriented approach.

In Kelantan, problems in water services are considered as a long standing issue. Some places have experienced long duration of water disruption which is disrupting household's daily activities. This study presents the findings of a study on the value of households place on attributes of water services based on Choice Experiment (CE) method. Households choose the best alternative among the proposed water services for future interest. This study is based on an analysis of the CE which is comparable to previous studies used by Hensher *et al.* (2005), Mohd Rusli *et al.* (2011) and Nam & Son (2004) regarding the water sector. For instance, a study conducted by Mohd Rusli *et al.* (2011) used the same method to value consumer's willingness to pay for improvement in water services in Selangor, Malaysia. The attributes presented to respondents are water quality, consumer trust, water interruption and water price. The findings show that people are willing to pay more for improvement in water quality and reduction in water interruption, which increases consumer trust in tap water. Concisely, respondents will be presented with a selection of attribute levels for water services together with suggested water price in the CE. Then, they choose the best selection of attributes. Differences in attribute levels and water prices can be affirmed by the estimation of the Marginal Rate of Substitution (MRS). The households' preferences will expose the willingness to pay for positive changes in water services.

Willingness to pay (WTP) can be used to determine the potential for fulfilling sustainability, at least from a financial perspective (Kaliba *et al.,* 2003). Nonnegative WTP demonstrates that it is possible; people will contribute to improve management and for operational costs. This study is contradicted to Mohd Rusli *et al.,* (2011) in terms of selection of the model. The previous study used basic Conditional Logit model, however this study applied Mixed Logit model in order to determine the WTP. Mixed Logit (ML) model illustrates consisting of mixture of logit models. Researchers and practitioners use ML model in estimation with diverse degree of sophistication with combination of revealed preference and stated choice data growing (Hensher & Greene, 2003).

The objective of the study is to answer the question; are households willing to pay for higher service standards with the intention to improve the current domestic water service in the state? If they are willing to pay, how much could be added to the current water price in each attribute levels regarding estimation in Mixed Logit model? Implicit price in each attribute levels can be revealed according to the estimation of the Marginal Rate of Substitution. The sections below give the background of the study, research methodology and estimation procedure, results and finally discussion of the study.

Water Management Issues

The sole water provider in Kelantan is Air Kelantan Sdn. Bhd. (AKSB). In Kelantan, water sources are 60% from surface water and 40% from groundwater to meet their public needs (Zamri, 2009). Only 57% of the population has access to water supply supplied by water company in 2010 (Malaysian Water Association, 2011). About half of the population is taking advantage of rich groundwater alluvial basin particularly in the north of Kelantan. The Association of Water and Energy Research Malaysia (2011) states that continuous reliability on non-treated water supply imposes health risk to people in Kelantan, besides it denies basic human rights to water. People require water that are in

excellent condition since it functions as "public good" in life.

When water price is too low it is unable to generate enough revenue to cover the full cost of capital investment, operation and maintenance. Kelantan ranked 3rd in 2011 as a state with lowest water prices for domestic water services (RM0.55 applied for first 35m^3). A research by the Association of Water and Energy Research Malaysia (2011) highlighted some areas in Kelantan with dirty and smelly water supply, low coverage performance, and frequent unscheduled interruption. Water utilities solve these problems by increasing water production, however it still does not solve the crisis. Water utilities should not only concentrate on increasing water supply because of the profit motive, but also should concentrate on demand management. Water utilities cannot afford to carry out the Non-Revenue Water (NRW) reduction and on top of this, the households are paying relatively cheap water price. Thus, adequate funds have to be generated in order to cater for rising public's demand for water sources. Seeing that population is increasing, there will be conflict in the allocation of water sources among households, commercial, livestock, agriculture, recreation and many more. Besides, weak water policies, poor water management and low water price will limit development of efficient water services in the state. Government wants to keep prices low so it can be very affordable to households. Though low prices sound politically and economic inefficient, inexpensive water produces low revenues for water companies, then the investment opportunity for the private sector is very poor (Rietveld, Rouwendal & Zwart, 2000).

Research Methods

The format of Choice Experiment (CE) needs details in its attributes since the rule is to avoid correlation between attributes (Pearce & Ozdemiroglu, 2002). The attributes should be different in order to disclose respondent preferences based on choices for improvement in the program. This application has its advantages as it can assess welfare benefits of different programs by varying attribute levels in the choices. The common design in construction of the method involves five stages such as selection of attributes, determine levels, choice of experimental design, constructing choice sets and measurement of preferences (Bateman *et al.*, 2002).The process engages households to decide one alternative from other alternative services based on their expectations. Thus, it is important to develop a model that is consistent with economic theory. Normally, McFadden (1980) random utility hypothesis is used for standard procedure to estimate WTP. The hypothesis is based on consumer behaviour which demonstrates people make choices which maximize their perceived utility, subject to economic constraints on expenditures.

The rise of Mixed Logit (ML) model is because of some weakness and limitations in the standard logit model. The ML model solves three limitations of the standard logit model which are correlation in unobserved factors over time, taste variation, and unrestricted substitution patterns. The derivation of ML model can be expressed based on the following equation according to Train (2009):

$$U_{itc} = \beta_c x_{itc} + \varepsilon_{itc} \quad (1)$$

Equation 1 explains that consumer c chooses an alternative i which gives greatest utility in choice situation t. Whereas, x_{itc} denotes vector of independent variables that include attributes of the alternatives and other socio economic factors. β_c represents coefficient vector of taste parameters which is assumed as stochastic influences and ε_{itc} is not observed in the model. Each respondent has different taste which deviates from population mean b by vector η_c. Then, the utility can be presented as below:

$$U_{itc} = (b + \eta_c)\, x_{itc} + \varepsilon_{itc} \quad (2)$$

The model presumes that general distribution for η_c and an independently and identically distributed (IID) extreme value distribution for error term (Hensher, 2003).

The unobserved part of utility ($\eta_c x_{itc} + \varepsilon_{itc}$) is related among alternatives in choice sets which confront respondents, cause of the influence in η_c. According to Equation 1, β_c does not include t since it is believed that the respondent's c tastes vary among each other, but constant over choice sets. Train (2009) states that respondents have specific tastes which stay constant over a panel of repeated choices made by the same respondent. Probability of consumer c in choosing i alternative can be specified as follow, as error term is still presumed to be (IID) extreme value type 1 (Hensher & Greene, 2003):

$$Prob_{ic}(\beta) = \frac{\exp(\beta' V_{ict})}{\sum_j^J \exp(\beta' V_{jct})} \quad (3)$$

The indirect utility function in the Equation 3 portrays a ratio of any two coefficients and it presents the information of trade off or MRS. The substitution rate can be estimated by dividing the β coefficient with another β coefficient (monetary attribute) and multiply it by -1 in order to present the implicit price, the equation is as below:

$$\rho_k^c = \frac{\frac{\partial V}{\partial x_{c,s}}}{\frac{\partial v}{\partial P_{c,s}}} = \frac{-1\beta_{c,s}}{\beta_{c,s=p}} = - \frac{\beta_{attribute}}{\beta_{monetary}} \quad (4)$$

Survey Design and Implementation

Attributes are the significant product which respondents consider when making decision in selection of choices in CE. Selection of attributes and levels should be related to the policies implemented in water industry and their conditions in Kelantan. The attributes, levels of the attributes and the methods which explain the attributes are constructed through discussions with expertise and officers in Air Kelantan Sdn. Bhd. (AKSB). Respondents should not be provided with too long, difficult and complex options (Mohd *et al*., 2008). It takes time and tends to make respondents to discontinue answering the questionnaire. This study offers five choice sets and each choice set consists of three alternatives or service options including *status quo* option. Respondents choose *status quo* or current situation if they do not intend to have any improvement or change of the service options offered. If respondents decide not to have any option, they pay nothing; it means they do not improve the environment (Cooper & Crase, 2008).

The attributes also have their own levels and the conditions of levels are different from one another and they elicit preferences of consumers. The CE was used as trade-off that households make between water quality, water interruption, non-revenue water and water price. The selected attributes and their levels are shown in Table 1.

Theoretical expectations of independent variables which consist of the attributes in the CE model describe that three attributes (QUAL, DIST and NRW) are expected to have positive signs in their relationship. PRICE attribute has negative sign in their relation with the dependent variable. Increasing water prices is expected to have negative relationship with consumer's WTP as it brings negative impact on consumer's utility and reduces their monthly budget.

The first attribute is water quality (QUAL). Many previous studies mention that people are willing to pay higher price to get better water quality since it guarantees their survival besides it is an important basic need. There are three levels chosen for these attributes such as satisfactory, good and very good. The attribute levels illustrate whether the indicators meet World Health Organization (WHO) standard or not.

The second attribute is water disruption (DIST). Unscheduled interruption in water supply causes the loss of millions of Ringgit Malaysia (RM) to the industrial users and becomes an inconvenience for domestic users who have large household sizes. In Kelantan, the number of complaints from consumers regarding water supply interruption is very high and the statistics show the number goes up and down every year (Malaysian Water Association, 2011). The levels assigned for this attribute are frequent, sometimes and never.

Table 1: List of attributes and their levels

Attribute/ Variable	Attribute Levels	Descriptions	Expected Sign
QUAL	*QUAL1*	*Satisfactory in water quality*	
	QUAL2	Good level in water quality	+
	QUAL3	Very good level in water quality	
DIST	*DIST1*	*Frequently experienced with water supply interruption*	
	DIST2	Sometimes experienced with water supply interruption	+
	DIST3	Never experienced with water supply interruption	
NRW	*NRW1*	*High percentage level of Non-Revenue Water*	
	NRW2	Moderate percentage level of Non-Revenue Water	+
	NRW3	Low percentage level of Non-Revenue Water	
PRICE	*PRICE1*	*RM0.55; Maintain the current water price*	
	PRICE2	RM0.65; Increase by 18% from current water prices; national average water price	–
	PRICE3	RM0.80; Increase by 45% from current water prices	
	PRICE4	RM0.98; Increase by 78% from current water prices; maximum water price in Malaysia	

Note: *Italics* text illustrates the *status quo*/base level.

The attribute levels describe frequency of water supply interruption happening in their homes.

The third attribute is Non-revenue water (NRW). High percentage of NRW can be viewed as not a good sign and reflects poor performance of delivery services to consumers. It requires immediate and appropriate action to reduce pressure on precious water resources. The state of Kelantan demonstrates high rates of NRW in Malaysia since it comprises about 52% of water production (Air Kelantan Sdn. Bhd., 2011). The water company in the state targets about 35% for NRW percentage, and the 9th Malaysia Plan states that the expected national average for NRW in 2010 is 30%. Thus, the targeted and expected percentages of NRW are selected as the attribute levels and they can be considered as a benchmark of their performance.

The forth attribute is water price (PRICE). Water price is the most significant parameter which measures consumer's WTP and preferences since the adjustment in the prices brings a major impact on consumer's budget decisions. Water prices cover the cost of operation, maintenance, recovery aspects and many more. Kelantan is ranked at the 3rd place in ranking with lowest water rates in the country with the average RM 0.55 for domestic users applies on the first 35 cubic meters. For the attributes levels, this study chooses the national average water price which is RM0.65 on the first 35 cubic meters and maximum water price in the country which is domestic average water prices in Johor (RM0.98 on the first 35 cubic meters). However, in order to avoid the big gap between RM0.65 and RM0.98, then this study puts RM0.80 between the gaps to make it acceptable for domestic consumers. The water prices offer choices for future water price in the state to domestic consumers.

This study uses other sources from water company reports, government statistics, and brochures in order to construct the attributes and their levels in this study. During the survey, respondents were told that changes in water tariff will affect their budget allocation for other expenditure too. Thus, they need to choose the best option for changes in water services based on their budget and Table 2 shows an example of the CE in the questionnaire.

Suppose Service Option 1 and 2 below are the only possible alternatives to the Current Service Option for domestic consumers, which option do you prefer? (Please choose **ONE** and tick in the box).

Table 2: Example of CE question in questionnaire

	Service Option 1	Service Option 2	Current Service Option
Water Quality	Good	Good	Satisfactory
Water Disruption	Sometimes	Frequently	Frequently
Non-Revenue Water (NRW)	Low	High	High
Water Price	RM0.98	RM0.65	No Change
OPTION	X		

This study employed a pre-test as a trial run for 60 respondents in order to screen out any problems in the construction of questionnaire. It revealed that there was not consistent combination in attributes and their levels in CE questions. In new questionnaire survey, we did a new orthogonal process with new combination in attributes and their level. In final survey, this study uses stratified random sampling since the survey sample is from a broad population in the state which consists of 552 respondents. The respondents are domestic users which come from urban and rural areas of 10 districts in Kelantan. They were told that the study will help the water industry so that the water company will understand consumers' expectations on improvement. Table 3 portrays the total number of respondents who were selected according to the districts of the state.

Table 3: Total of respondents according to the districts (n=552)

District	No. of Respondents
Kota Bharu	168
Pasir Mas	70
Tumpat	55
Bachok	46
Pasir Puteh	44
Tanah Merah	45
Kuala Krai	38
Gua Musang	34
Machang	35
Jeli	17
Total	**552**

Results and Discussion

Socio Demographic Profile of Respondents

The response rate of this study is 100% (552) which consists of female respondent 277 (50.2%) and male respondent 275 (49.8%). The mean age of respondents is 38 years old and average size of household is 5 people. Table 4 below illustrates socio demographic profile of respondents.

Consumer's Perceptions on Water Services

The survey shows about 392 (71%) of the respondents report problems to the water company. It explains that consumers are alert about the interruption since it can limit consumer's activities. This study demonstrates that most consumers (80.8%) choose to boil the water first before consuming it. The consumers said that they are still unsure about quality and condition of the water supply. It reports that only 2.5% of respondents choose to drink from the tap directly and they do not have any doubt on its quality at all. Moreover, half of respondents (52.9%) report that they face water supply and quality problem regarding water services. The rest of respondents, 7.4% (41) say that they do not have any water services problems at homes.

Choice Experiment Analyses

Estimation procedures for CE were employed by using econometric software which is LIMDEP, NLogit Version 9. The model is regressed by including coefficients for each level of the discrete attributes in order to have

Table 4: Socio demographic profile of respondents

Characteristics	Frequency	Percentage (%)	Mean	Standard Deviation
Gender				
Male	275	49.8		
Female	277	50.2		
Age				
20 – 30 years	27.7	27.7		
31 – 40 years	30.8	30.8		
41 – 50 years	29.3	29.3	38.34	10.99
51 – 60 years	9.6	9.6		
61 – 70 years	1.8	1.8		
>71 years	0.7	0.7		
Size of Household				
1 – 5 people	271	49.1		
6 – 10 people	266	48.2	5.10	2.59
>10 people	15	2.7		
Education Level				
PhD/Master	19	3.4	3.10	1.095
Bachelor	137	4.8		
Diploma/Certificate	199	36		
Secondary level	135	24.5		
Primary level	48	8.7		
No Education	14	2.6		
Numbers of working family members				
0 – 3 members	481	87.1	2.13	1.18
4 – 7 members	65	11.8		
>8 members	6	1.1		
Household Income (monthly)				
Less than RM 2,000	162	29.3		
RM2,001 – RM4,000	154	27.9		
RM4,001 – RM6,000	127	23	4077.90	2720.711
RM6,001– RM8,000	51	9.2		
RM8,001– RM10,000	22	4		
>RM10,000	36	6.5		

the best model. Each main attribute is recorded with three columns (QUAL1, QUAL2, and QUAL3). For instance, one of QUAL attribute levels is coded as 1 if respondents prefer the option among others. It signifies that the particular QUAL attribute level is selected for changes in services. Level one or *status quo* is identified as a base level, level two and level three are medium and high level. The variables were regressed to reveal differences in probabilities of option between those in attribute levels and base levels.

Mixed Logit Model Result

This part presents the ML model attributes incorporating levels specification for improvement in domestic water services. The model is stated in Equation 5 below:

$$U = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon \quad (5)$$

Where β_1 till β_7 denote coefficient of main attributes and X_1 till X_7 entail the main attributes. The simple ML model includes seven variables such as QUAL2, QUAL3, DIST2, DIST3, NRW2, NRW3 and PRICE. The results of simple (ML) model are shown in Table 5.

Table 5: Results of ML simple model (Model 1)

Variables	Coefficient (β)	Std. Error	t-value
QUAL2	0.2059	0.1763	1.168
QUAL3	0.5759	0.2339	2.461**
DIST2	0.4577	0.1601	2.859***
DIST3	-0.1342	0.1127	-1.191
NRW2	0.0896	0.1010	0.887
NRW3	-0.3299	0.2574	-1.282**
PRICE	-3.112	0.6562	-4.742***
Marginal values of the attributes: - $\frac{\beta_{attribute}}{\beta_{monetary}}$			
QUAL2		0.0661	
QUAL3		0.1850	
DIST2		0.1470	
DIST3		-0.0431	
NRW2		0.0287	
NRW3		-0.1060	
Summary Statistics			
Number of observations		2760	
Log Likelihood		-2810.586	
Log Likelihood, No coefficients		-3032.170	
Pseudo R^2		0.0722	
Adjusted Pseudo R^2		0.0698	

Note: (*) 10% level, (**) 5% level, (***) 1% level.

The coefficient of QUAL 2 and QUAL3 are both positive in its relationship, but only QUAL3 is significant at 5% level. The variables with positive signs imply that respondents need good water quality rather than *status quo* (level 1) in water services. DIST2 is also positive and statistically significant at 1% level. Whereas, DIST3 demonstrates negative relation which indicates that people still decide on current water condition. The NRW2 variable has positive sign and NRW3 has negative sign in the relationship. However, the PRICE variable has negative sign and is statistically significant at 1% level. It confirms our prior expectation that as water price increases, people will contribute less because of decrease in their utility level.

This study illustrates ML model with interactions of socio-economic parameters such as age, household income, and household size. Hence, it demonstrates the strength of influence of respondent's socio economic characteristics on consumer preferences towards domestic water services in the state. The interactions of socio-economic parameters and attributes offer heterogeneity of preferences. The inclusion of socio-economic parameters can be an important step in obtaining an accurate model (Rolfe *et al.,* 2000).

ML Model with Interaction

The model fit improved with the insertion of socio-economic variables in the model. The log likelihood is improved compared to Model 1 (Table 5), since the value increases slightly from -2810.586 to -2785.609. By comparing with Model 1, it can be seen that the Pseudo R^2 increases (0.0722 to 0.08131), and adjusted R^2 increases from 0.0698 to 0.0783. It specifies that the model has improved and it has high explanatory power. Hence, the model specification has been achieved. The model specification for Model 2 is as stated below:

$$U = \beta_1 X_1 + \beta_2 X_2 + \ldots. + \beta_8 Y_1 X_4 + \beta_9 Y_2 X_1 + \beta_{10} Y_2 X_3 + \beta_{11} Y_3 X_6 + \varepsilon \quad (6)$$

Where X_1 is QUAL2, X_2 is QUAL3, X_3 is DIST2, X_4 is DIST3, X_5 is NRW2, X_6 is NRW3 and X_7 is PRICE. While, Y_1 is AGE, Y_2 is INC, and Y_3 is HHM that denotes socio-economic parameters which interacted with main attributes. The results of the ML model with interactions are shown in Table 6.

Table 6: Final ML model with interaction

Variable	Model 2	
	Coefficient	Std. Error
QUAL2	-0.2700	-1.403
QUAL3	0.6080	2.582***
DIST2	0.2409	1.341
DIST3	0.2752	1.005
NRW2	0.0925	0.913
NRW3	0.1667	0.536
PRICE	-3.3020	-4.991***
DIST3_Age	-0.0105	-1.608*
DIST2_Income	0.0933	2.844***
NRW3_Household size	-0.0763	-2.595***
Marginal values of the attributes: - $\frac{\beta_{attribute}}{\beta_{monetary}}$		
QUAL2	-0.0817	
QUAL3	0.1841	
DIST2	0.0729	
DIST3	0.0833	
NRW2	0.0280	
NRW3	0.0504	
DIST3_AGE	-0.0030	
QUAL2_INC	0.0626	
DIST2_INC	0.0282	
NRW3_HHM	-0.0231	
Summary Statistics		
Number of observations	2760	
Log Likelihood	-2785.609	
Pseudo R^2	0.08131	
Adjusted Pseudo R^2	0.07831	

Note: (*) 10% level, (**) 5% level, (***) 1% level.

The result demonstrates that most main attributes are following prior expectation correctly except the variable QUAL2 which has negative sign in its relation in the model. Based on Table 6, there are some specific features in the Model 2. It shows that QUAL3 is highly significant at 1% level compared to 5% level in ML simple model, but still with correct expected sign in the model. In addition, the variables of DIST2, DIST3, NRW2 and NRW3 have correct expected positive signs. PRICE which is the only monetary variable has negative sign and highly significant at 1% level.

The ML model with interactions proves that all interaction variables are significant at all levels. The variable of DIST3_Age has negative sign with 10% significance level, which shows that younger people are more concerned about water disturbance at home. However, when the INCOME variables interact with QUAL2 and DIST2 in the model, it gives positive relation and all are highly significant at 1% level. The variables prove that by interacting with NRW3, the NRW3_Household size results in a negative sign with 1% significance level in the relation. It indicates that respondent with large household size is not interested in paying high bill for reduction in non-revenue water (NRW) programs. It indicates that small number of households would not have any problem if high water prices are imposed to reduce NRW. Probably this is because it does not interfere with their household monthly budget.

The result explains calculated marginal values for each attributes and interactions are shown at the bottom in Table 6. The marginal value of QUAL2 is RM-0.08 lower than ML simple model (Model 1) which is at RM0.06. It can be seen that the values of QUAL3 and DIST2 are lower than in Model 1 with RM0.18 and RM0.07 correspondingly. However, the DIST3 and NRW3 values at RM0.08 and RM0.05 demonstrate great improvement in the values, compared to Model 1.

Marginal Values

Estimated coefficients in variables are used to measure the outcome of changes in attributes based on the price that consumers are willing to pay for changes in water services. Respondents are required to make a trade-off and show

how much they are willing to pay in terms of an increase in prices for numerous proposed water services attributes for better services. We calculate the marginal implicit price of the attributes by dividing estimated coefficient of non-monetary attributes with monetary attribute based on Equation 4. This section highlights the monetary trade-off between the two attribute levels, while other attribute levels remain constant. Table 7 exhibits two models which are ML simple and interaction models, for estimated marginal values of difference in attribute levels. Arrows in the table illustrate the directions of change in attribute levels.

Table 7: Marginal values for difference in attribute levels

Attribute Levels	ML Model	
	Simple (Model 1)	Interactions (Model 2)
	RM	
Water Quality (QUAL) QUAL1 → QUAL2 *Satisfactory to Good*	0.07	-0.08
QUAL2 → QUAL3 *Good to Very Good*	0.13	0.27
Water Disruption (DIST) DIST1 → DIST2 *Frequently to Sometimes*	0.15	0.07
DIST2 → DIST3 *Sometimes to Never*	-0.19	0.01
Non-Revenue Water (NRW) NRW1 → NRW2 *High to Moderate*	0.15	0.07
NRW2 → NRW3 *Moderate to Low*	-0.13	0.02

As shown in Table 7, the difference from '*satisfactory to good'* in water quality attribute is at RM0.07 in Model 1. In the same model, respondents place high value with marginal value at RM0.13 when they are confronted with '*good to very good'* water services particularly in water quality aspect. In Model 2, the marginal value is at RM–0.08 for improvement from '*satisfactory to good'*, increases to RM0.27 for improvement from '*good to very good'*. An improvement in water quality aspect in both models show that on average the changes from '*satisfactory to good'* is RM0.12, and changes from '*good to very good'* is at the value of RM0.17.

In water interruption attribute, the marginal value for ML model is RM0.15 in Model 1 and RM0.07 in Model 2 for improvement in '*frequently to sometimes'* level. The changes from *'sometimes to never'* level is decreasing in value as it shows at RM-0.19 in Model 1 and RM0.01 in Model 2. The results illustrate that respondents are satisfied when water disturbance is improved at the level of '*frequently to sometimes*' and they are not expecting more than that in services. A possible explanation for this might be that they choose to have frequency of water disturbance just from *base level* to *moderate level* since the current condition of water disturbance is very unacceptable in the state.

The values of differences in MRS at 'Non revenue water' attribute demonstrate relatively low values compared to other attributes (water quality and water disturbance). The marginal values are decreasing compared to previous attributes. Most respondents point out that they do not bother with the NRW problems particularly at the thought that it is the main problem in their water industry. It is apparent from the result that some NRW variables are insignificant in the models, indicating that the variable is not significant for consideration. Based on Table 7, it shows that 'water quality' attribute at moderate level to high level produces the highest marginal value at RM0.20 (RM0.12+RM0.27/2). Most respondents are willing to pay more to contribute in order to improve the standard of water quality. Worsening water quality threatens their household activities. This is proven by a previous study conducted by the Association of Water and Energy Research Malaysia (2011) which claims that people in Kelantan desired better water quality and increase water supply coverage in the state.

Conclusion

This study sets out to evaluate water service attributes by using CE method. The selected attributes in the study are water quality, water supply interruption, non-revenue water and water prices. Mixed Logit (ML) model is used to estimate the marginal values of the attributes. This study finds that the respondents agree to pay more in order to move away from the *status quo* for improvement in domestic water services. When the ML model was combined with socio economic characteristics, the model improved compared to the simple model, as both Pseudo R^2 and adjusted Pseudo R^2 increased. Nam (2004) states that the inclusions of socio economic characteristics to the main variables present heterogeneity in choices. The consumer's main concern is the 'water quality' attribute which shows that people are willing to contribute more in order to improve the condition of water supply. Respondents prefer to improve the water quality problems from moderate level (DIST2) to high level (DIST3) as it produces the highest marginal values (RM0.20) based on the ML model. The selected attributes clearly affect consumer's WTP and it is important to be considered further since every attribute's levels produce different consumer's willingness to pay for improved services.

Households need an improvement in the services and water companies should know what needs to be done differently in the future. Therefore, it requires major changes in planning management and investments from both sides. The government should facilitate the producer by giving subsidies to cover the high cost of production. Since water is considered as a 'public good', it should be allocated to the consumers in the best condition. By granting subsidies to the water company, the services provided by the company can be improved without effect of price increases. Households will be aware to conserve water and avoid water wastage if prices are increasing. Educating the users about the significance of water in our life is required to maintain the benefits for future uses. Moreover, households have the right to be informed about any water disruption in their area. The water program and strategies should be designed based on demand-driven in order to meet the needs of the consumers. By increasing water price, consumers will realize the significant functions of water and they do not take for granted. Consumers should use water properly and avoid water wastage in daily consumption. At least, water as natural capital should earn a return to reflect its scarcity and its rent.

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