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Consumer Willingness to Pay for Domestic Water Services in Kelantan

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ABSTRACT

The importance of water to life cannot be denied as it is the most precious substance among all our natural resources. Rapid population growth and urbanization have increased the demand for water which is expected to undergo substantial changes in the future. Kelantan faces many problems in the water sector. The state lacks financial resources to improve its water supply coverage. In fact, there are numerous functions which are supported by the price of water itself such as the costs of water treatment, water storage, and delivery to its customers. Lowwater rates may lead to heavy losses to the water provider who is expected to provide various services to the community, including the delivery of clean and adequate water supply. This study utilizes Contingent Valuation Method (CVM) to derive consumers' willingness to pay (WTP) for improved water services, and based on the WTP value obtained, the aggregate monetary benefits of improving water services for the consumers of Kelantan are estimated. Logit model is used to analyze primary data gathered during the survey. The estimated mean WTP for improved domestic water services is RM0.5979 applicable on the first 35m^3 (i.e. 8.7% above the current price). The findings offer policy recommendations to address the numerous, serious water issues faced by the state. The appropriate water tariff may help the water provider to overcome the problems /challenges in providing better services in the state.

Keywords: Contingent Valuation Method, willingness to pay, water prices, Logit model, water demand

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INTRODUCTION

Water is a replenishable, but also depletable resource. Water is not only a resource of economic value, it is also a basic component of human's natural environment, making

it a necessity as well. About 70% of the earth's surface is covered by water which includes rivers, lakes, oceans and streams[1]. Consumption of water varies tremendously throughout the year especially for household purposes. There has always been a shortfall in water supply following increases in water demand every year. So new sources and alternatives must be found. The uses of water vary from top to toe such as for bathing, drinking, heating, cooling, cleansing and many more.

Nowadays, the water supply fails to meet demand as water suppliers are facing problems with non-revenue water (NRW), water quality, water services and water scarcity in some places. Furthermore, rapid economic and social developments are placing heavier demands on water resources. Sometimes, it is difficult for water companies to cater for the demand of large populations especially when they lack capital to manage efficiently as maintenance is too costly. Low water tariff puts too much pressure on the water industry as. it tends to create a wrong perception among consumers that water is cheap and this often leads to excessive water usage.

Most environmental goods, such as clean air and water, landscape, diverse flora and fauna, scenic towns and many more are not traded in the markets. These natural resources are precious and have significant functions in the ecosystems. It is difficult to value these environmental goods since they are unpriced, and the consumption of these goods has the characteristics of 'public goods'. Hence, an accurate economic valuation of natural resources, particularly non-marketable goods is needed. Non-market goods may include both direct and indirect values (Kahn, 2005). Their economic value is defined as the aggregate willingness to pay (WTP) or in other words, the amount that people are willing to pay for environmental goods since they are not subject to market prices.

In this study, if consumers are willing to pay a certain amount of money for the consumption of water, it signifies that water service is valued. Thus, it is possible to generate more income to maintain the operation and maintenance (O&M) costs, and even support the improved water services program . This study addresses the following objectives, namely to identify the factors that influence consumers' WTP for improved domestic water services in Kelantan, and determine appropriate water pricing in the state.

We have estimated consumers' willingness to pay (WTP) for improved domestic water services by using the discrete choice of Contingent Valuation Method (CVM). Previous studies have used WTP for water services to decide on the level of water prices. Sarala Devi (2009) points out that income is one of the factors that determines consumers' WTP. Public demand for water quality is needed to determine efficient water pricing. It seems that consumers are willing to pay a higher price if they derive a high social value from the water service. Many previous studies such as Vasquez *et al.* (2009), Farolfi,

[1]Water Science for Schools, 2011.

Mabugu and Ntshingila (2007), and Larson, Lew and Onozaka (2001) have used WTP approach toimprove water supply services in the United States. WTP studies revealed that if something is worth having, then it is worth paying for. If consumers get what they want, they are willing to give up some money for a good value of water supply, and this ultimately, means that they believe it is value for money. CVM has been extensively used in many previous WTP studies in the water sector such as Raje, Dhobe and Deshpande, (2002), (-McPhail, 1993), Shultz and Soliz (2007), and many more. A good CVM is intended to be realistic for respondents to capture the "hypothetical" choice seriously (Whittington, 1998). The CVM obtains values which are contingent on the level of information by the respondents, and the extent of information provided by the survey (Wang *et al.,* 2009). The vital part of CVM is when it creates a realistic contingent valuation scenario which precisely states the options of water supply price that will subsequently reveal the levels of prices the water supplier can charge to provide the service.

BACKGROUND OF THE STUDY AREA

The investigation on consumer WTP for domestic water services featured in this study focuses on the state of Kelantan, a relatively less developed state which is located on the East Coast of Malaysia. The state has high levels of poverty and a large population that is still living in rural areas. The sole provider of water services in Kelantan is Air Kelantan Sdn. Bhd. (AKSB). Kelantan has most of its population concentrated in one-third of the state area with the availability of water in its alluvial subsurface terrain (Zamri, 2009). It is estimated that about 80% of the population live in the northern region of the low alluvial plain and the remaining 20% live in the southern parts on higher ground. Kelantan's water sources are 60% from surface water and 40% from groundwater[2]. The districts of Kota Bharu, Tumpat and Bachok receive their water source from groundwater while the other districts use surface water. Currently, Kelantan is the largest groundwater operator in Malaysia.

Issues such as interruptions in services and other failures in the water industry are controversial in Kelantan. There are many water industry-related problems in Kelantan according to the 9th Malaysian Plan which indicates low water supply coverage, , production capacity, and quantity of water supply[3]. In fact, it is the state with the highest NRW rate in the country. For example, the state experienced a high rate of NRW (36%) in 2010 (National Economic Planning Unit, 2006). Unfortunately,Kelantan may not have adequate capital and financial resources to enhance water supply coverageIn addition, old and rusty water pipelines need to be replaced due to their worsening conditions. Consumer complaints include dirty water, coloured water, unreliable of water services and frequent unscheduled of water disturbance which disrupt their household

[2]See Water Malaysia Magazine (2009) for further discussions.

[3]Asian Development Bank and International Water Association, 2003.

activities (Association of Water and Energy Research Malaysia, 2011).

In the water industry, NRW is a major problem since it leads to water loss. The Ninth Malaysian Plan (2006) (states that the government has made a plan to reduce the rate of NRW year by year as it recognized the current situation to be very wasteful to the country. In Kelantan, the NRW rate was the highest in the country (36%) in 2010 which is why reducing the NRW has been the main focus for AKSB. However, reducing NRW leads to other problems since changing old and rusty pipes involves huge capital outlays. Through the low tariff and water price paid by consumers, water companies cannot afford to carry out the NRW reduction works, such as pipe replacement, leak repairs, leakage detection, and many more. Still, the reduction of NRW is pivotal in the efforts to improve water supply economically as water losses will be reduced in the distribution system.

Currently, since water tariffs are extremely low, water companies are unable to generate enough revenue to cover the full cost of capital investment, operation and maintenance. The present water rate is RM0.55 which is applied on the first $35m^3$. Therefore, it is not surprising that the water company is unable to maintain and sustain its operations. In addition, the low price of water sometimes tends to lead to water wastage among consumers. In other words, inexpensive water rates and its ample supply often lead to consumers taking water supply for granted.

METHODOLOGY

A single bounded CVM was designed to elicit consumer's WTP in this study. The selection of CVM in this study is due to its reliability in valuing non-market goods based in previous studies. This study also includes a hypothetical change in the water services in Kelantan from its current condition to improved conditions in which consumers believe it is at the acceptable standard for their daily use. In a conventional CVM, only a price or bid is offered to respondents. The method involves asking respondents a question such as *"Would you be willing to pay $X for an improvement in water services?"* When a hypothetical price is revealed, the respondents are required to decide whether to "take it" or "leave it".

A pre-test survey was conducted in selected areas in Kelantan with 25 respondents. Information was collected through pre-testing by presenting a realistic situation in order to have more reliable data and information for the valuation questions in the final survey. In the final questionnaire, the first section introduces information on water service conditions in Kelantan in order to give a clear picture to the respondents. The second section includes valuation and WTP for the program with a hypothetical market. The third section explores respondents' perceptions in water uses followed by the final section which covers the demographic profile of respondents.

Based on the results of the pre-test survey, 5 groups of bidding price were designated in the range of RM 0.61 (10%

increase from current price), RM 0.63 (15% increase from current price), RM 0.66 (20% increase from current price), RM0.69 (25% increase from current price), and RM0.72 (30% increase from current price). Stratified random sampling was assigned between urban and rural areas in order to avoid bias in sampling.

Model Specifications

Since improvement in water services is considered as an economic good, WTP is expected to be non-negative random variable (Larson *et al.,* 2001; Hanemann, 1989). WTP_i as a dependent (latent) variable is consumers' willingness to pay for a change in water services and it can be expressed in a linear regression model as.

$$WTP_i = x_i \beta + e_i \quad (1)$$

The x_i stands for an independent variable which indicates consumer income, bid price, household size, age, education, etc. which are observable. β is a parameter to be estimated with numerical values. Gujarati (1999) points out that *e* represents the random error term which signifies all the forces which affect WTP but are not clearly introduced in the model. In this study, *i* represents an individual who responds to any water services improvement.

When a respondent is asked to pay a specific amount of money or price bid due to an improvement in domestic water services, there is a probability to obtain "*yes*" or "*no*" answers. Thus, it can be presented by formulating a model which follows Hanemann *et al.* (1991) as:

$$\begin{aligned} &\text{Prob } \{ \text{ Yes } \} \\ &= \text{Prob } \{ \text{ WTP} > \text{BID } \} \\ &= 1 - G \text{ (BID; } \theta) \end{aligned}$$

$$\begin{aligned} &\text{Prob } \{ \text{ No } \} \\ &= \text{Prob } \{ \text{ WTP} < \text{BID } \} \\ &= G \text{ (BID; } \theta) \end{aligned} \quad (2)$$

Where BID is the proposed price bid, WTP_{max} is the true maximum willingness to pay (WTP), and G (BID, θ) is the cumulative distribution function of WTP. The above equations describe that if the proposed price bid (BID) amount is more than the consumers' true willingness to pay, then they are not willing to pay that amount. However, if the bid is below their true maximum willingness to pay the amount, the probability of obtaining a "Yes" answer to that amount is high, that means they will maximize utility, and pay that specific amount. These equations respond on random utility context based on consumers' decision on the program. This study follows Cameron (1988) with a modified "censored logistic regression". It can also be defined as the following equations (Flachaire and Hollard, 2005):

$$\begin{aligned} c_i &= 1; \text{ if WTP} > \text{BID} \\ c_i &= 0; \text{ if WTP} < \text{BID} \end{aligned} \quad (3)$$

$c_i = 1$ represents the consumer *i* saying "Yes" to the proposed price bid while a "No" response is indicated by $c_i = 0$. The dichotomous choice logit model is derived from random utility context in consumer decision-making. This signifies a choice

between two mutually exclusive options.

$$\begin{aligned} &P\,(c = 1) \\ &= P\,(WTP > BID) \\ &= P(x\beta + e > BID) \\ &= P\,(e/k > BID/k - x\beta/k) \end{aligned} \quad (4)$$

k is a scaling parameter of the logistic function. The log-likelihood function for single bounded CVM is:

$$\begin{aligned} &\log L^{SCVM} \\ &= \Sigma\,(1 - c)\,\{(BID - x\beta)/k\} \\ &- \log\{1 + exp\,[(BID - x\beta)/k]\} \end{aligned} \quad (5)$$

The estimation of mean WTP can be derived based on Cameron (1988) through the following equation:

$$WTP = \frac{\beta_0 + \sum_{i-2}^{n} \beta_i X}{-\beta_1} \quad (6)$$

Where β_0 is the estimated constant, β_1 is the coefficient for the price bid, and β_i is the coefficient for socio-economic characteristics of respondents.

RESULTS AND DISCUSSION

A total of 552 respondents were selected in the survey between August to November 2011. The survey was conducted on randomly selected domestic users who come from urban and rural areas in Kelantan. Respondents come from different districts in Kelantan. They were informed that the study would help the water industry by enabling the water company to understand consumers' expectations of water service improvement.

Characteristics of Respondents

The descriptive analyses for the explanatory variables are presented in Table 1. Majority of respondents are female (50.2%) since they are mostly available at home and they are in charge of house chores related to water consumption. The average age of the respondents is 38 years with educational levels on average at Diploma/Certificate level. Most of them are Malays (92.9%), and thisis not surprising since the majority of the population in Kelantan is Malay. In terms of the occupational aspect, most of the heads of household work in various sectors (31%), followed by government (27.2%), private (25.9%), and corporate (15.9%). The average size of household consists of 5 people with about 2 family members holding jobs. The mean monthly household income is estimated at RM 4077.90 during the time of the survey.

Consumer Perception on Domestic Water Services

Table 2 presents consumers' perception on the quality of water services which was provided by AKSB. Most respondents (80.8%) believe that they should boil the water before drinking it. It shows that they are still pondering about the quality of water for dailyconsumption.

Table 3 indicates consumer awareness on water supply in Kelantan. About half of the respondents (52.9%) responded that they were unsatisfied with the water supply and water quality in the state. The respondents believed that the service

TABLE 1
Characteristics of respondents (n = 552)

Characteristics	Frequency	Percent
Gender		
Male	275	49.8
Female	277	50.2
Age of respondents (years)		
Race		
Malay	513	92.9
Chinese	32	5.8
Indian	3	0.5
Others	4	0.7
Size of Household		
1 – 5 people	271	49.1
6 – 10 people	266	48.2
More than 10 people	15	2.7
Type of Residence		
Bungalow	121	21.9
Terrace	212	38.4
Apartment/Flat	21	3.8
Others	198	35.9
Occupation of Head of Household		
Government sector	150	27.2
Private sector	143	25.9
Businessman	88	5.9
Others	171	31.0
Education Level		
PhD/Master	22	4.0
Bachelor	139	25.2
Diploma/Certificate	200	36.2
Secondary level	134	24.3
Primary level	50	9.1
No education	7	1.3
Number of working family members		
0 – 3 members	481	87.1
4 – 7 members	65	11.8
More than 7 members	6	1.1
Household Income (monthly)		
Less than RM 2,000	162	29.3
RM2,001 – RM 4,000	154	27.9
RM4,001 – RM 6,000	127	23.0
RM6,001 – RM 8,000	51	9.2
RM8,001– RM 10,000	22	4.0
More than RM10,000	36	6.5

TABLE 2
Perception on quality of water supply

	Frequency	Percent (%)
Drinking from water tap directly	14	2.5
Drinking filtered water	92	16.7
Drinking boiled water	446	80.8
Total	552	100

TABLE 3
Awareness on Water Supply

	Frequency	Percent (%)
No water problems	41	7.4
Water supply interruptions	96	17.4
Water quality problems	123	22.3
Water supply and water quality problems	292	52.9
Total	552	100

problems interrupted their daily affairs since their water consumption was high.

The discrete choice of CVM offered respondents with "YES" and "NO" answers, where "Yes" = 1 and "No" = 0. Based on the previous studies, the most significant determinant in WTP studies is the offered price. This study proves that the bidding price is significant at 5% level. Thus, Fig.1 demonstrates that if the offered price increases, the probability of consumer saying "Yes" decreases and vice-versa in the program. It demonstrates that most respondents are willing to pay when the price bid offered is low. The Fig.1 corresponds with the demand theory in a typical situation: an individual purchases less of a good the higher is its cost (Tietenberg, 2000).

Results from Logistic Regression

The data is analysed using IBM SPSS Version 20. A value of 0 is given to respondents who rejected the idea or characteristics of interest in logistic regression. For instance, 0 is used to code the answer 'No' to the question of "Are you willing to pay $\$X$ for domestic water services improvement?" Then the value of 1 is for a 'Yes' answer. Table 5 demonstrates the determinants of full and reduced models to determine consumer's WTP in the study. Table 5 also shows the importance of each predictor variable in the model. In the full model, the WTP is regressed against all independent variables including the insignificant estimates ($p > 0.05$). There are many explanatory variables that are insignificant towards the WTP variable in the full model. Since there are insignificant variables in the model, the decision is made to drop the variables in the full model. Thus, in the reduced model which is the final model, the WTP is regressed against the remaining significant variables from the full model.

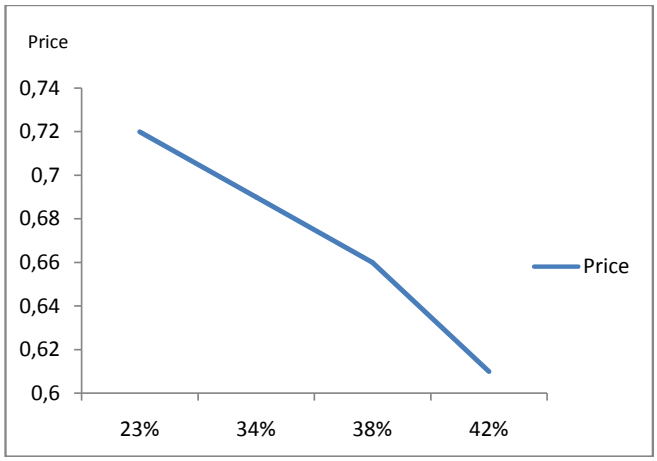

Fig.1: Offered price to consumers

In other words, the reduced model only has statistically significant variables in order to obtain the best estimate.

Direct logistic regression was performed to elicit consumer's WTP towards improvement in domestic water services in this study. The reduced model is restricted to three independent variables (price bid, household income and household size). The model includes all predictors that are statistically significant, x_2 (3, N = 552) = 31.03, $p<0.001$, specifying that the model is able to differentiate between respondents who rejected, and those who were unwilling to pay for improvement in this study. Overall, the model as a whole described correctly classified 62.3% of cases. According to Table 5, the independent variables make a unique statistically significant contribution to the model. The strongest determinant of willingness to pay for domestic water services improvement is 'household income', i.e. reports with an odds ratio of 1. It describes that respondents with high household income are more willing to pay for improvement in domestic water services, controlling for all other factors in the model.

Thus, the mean WTP computed from this study is RM0.5979 applied on the first 35 m^3. It is about a 8.7% increase from the current water rate (RM0.55). The β values in Table 5 show the direction of the relationship in the model which is either positive or negative. The BID variable is negative in sign and statistically significant at 5% level as predicted. It indicates that as offered bid price increases, the probability of saying "YES" decreases among consumers under hypothetical market. Respondents reject the offered price as it increases, and this is consistent with the demand theory.

Household income is a significant determinant in this study since it shows a positive sign and it is significant at 5% level too. The determinant is consistent with the economic theory which posits that WTP for goods increases with income, hence

TABLE 4
Consumers responses to offered price

Price Bid	WTP		Total
	No (0)	Yes (1)	
RM0.61	58%	42%	105
RM0.63	50%	50%	121
RM0.66	62%	38%	116
RM0.69	66%	34%	119
RM0.72	77%	23%	91
Total			552

TABLE 5
WTP Model Results using Logit Model

Variables	Full Model (i)		Reduced Model (ii)	
	Coefficient	Standard Error.	Coefficient	Standard Error.
Constant	5.997	1.742	6.169	1.631**
Price Bid	-9.874	2.467**	-9.721	2.439**
Household income	0.000014	0.000004**	0.000015	0.000004**
Household size	-.083	.038**	-.082	.037**
Gender (Female = 1, Male=0)	-.143	.188	-	-
Master/PhD	.530	.793	-	-
Degree	.577	.636	-	-
Diploma	.241	.630	-	-
Secondary school	.348	.636	-	-
Primary school	.276	.693	-	-
-2 Log likelihood	696.768		701.347	
Cox & Snell R Square	0.062		0.055	
Nagelkerke R Square	0.085		0.074	
Mean WTP			RM0.5979	

Significance at 0.05 confidence level (**).

household income should have a positive sign. It denotes that as household income increases, consumers' probability of saying "YES" increases too. People tend to spend more for improvement in water services. Households with high levels of income are willing to pay higher water bills if there is an increase in water prices. In addition, people with higher income canafford to use more water-using appliances to suit their high-end lifestyles such as dishwashers and washing machines.

The household size variable shows a negative relationship with WTP. It demonstrates that as a household size increases, the WTP decreases. The relationship between household size and WTP variables is as expected in this study. The more members there are in a household, the greater the reduction in WTP. They

consume more water but a higher water bill can be burdensome to them. Since most respondents are from rural households which are characterized by larger household size and lower income, they are less willing to pay towards improvement in water services.

CONCLUSION

Poor domestic water services in Kelantan are a long-standing issue, and consumers have no choice but to go through these problems in daily life. The importance of water cannot be denied since it is a basic need for human life. Thus, consumers demand good quality of water and they are willing to contribute towards the improvement in water services for future benefits. A hypothetical price was established in the Contingent Valuation Methods, and respondents were required to indicate either "Yes" or "No" responses based on their WTP towards improvement in water services. According to the CVM survey on 552 respondents in the state, it is observed that on average the consumers were willing to pay RM0.5979 (8.7% increase from the current price) for the first $35m^3$ of water to improve domestic water services. The explanatory variables such as BID price, income, and household size are statistically significant at 5% level, and their signs are as expected.

The information obtained from the survey is useful for the water company. The water company can make a better estimation of the amount to charge its customers for a higher quality of water, coupled with a newly upgraded service level that is satisfactory for the future. For that reason, the most significant result of this study is to provide a clear guideline for policy makers to achieve their economic targets without jeopardizing long term economic prospects. The results may influence public policy-making onthe water industry, and offer recommendations for policy makers to consider while they address the numerous water issues faced by the nation. They should be responsive to those particular socioeconomic factors which influenceconsumers' willingness to pay for improvement in services. The government must incorporate the appropriate balance between supply (water resources availability and delivery systems) and demand (adequate, quality and quantity of water) - in order to protect both interests. Water prices should reflect at least the cost of water production in order to promote market efficiency. On the consumers' side, while imposing higher prices will hurt them, t it can also encourage them to save water since there is no substitute for water in life. In addition, educating the young generation about the significance of water in our life is essential in order toensure there is sufficient water supply in the future. . For these reasons, it is important to see whether such policies will be able to improve the water industry in this country.

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