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Willingness to Pay for Improvements in Water Services in Terengganu, Malaysia: from Domestic Consumers' Perspectives

(Kesanggupan Membayar Penambahbaikan Taraf Perkhidmatan Air di Terengganu, Malaysia: Dari Sudut Pengguna Domestik)

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ABSTRACT

Water supply is an expensive investment and it is inevitable that the people have to prepare themselves for a universal hike in water prices in order to secure uninterrupted supply in the future. Inexpensive water prices cause the consumers to take water supply for granted and hence, lack of water conservation initiatives prevail. Sufficient funding is needed to implement various programs to improve water services. The costs of these programs should not be incurred by the water companies which are already burdened by the small revenue resulting from low water price. As the collection of revenue is inadequate to cover operating costs, the services rendered to the consumers are often unsatisfactory and the operational efficiency is below par. The last review of water tariff in Terengganu was done in the last two decades. Hence, with the increase in income within the last two decades, a study is needed to assess consumers' willingness to pay for improved water services. This study employs Double Bounded Contingent Valuation Method (CVM) to estimate households' willingness to pay (WTP) for improvements in water services in Terengganu. Monetary benefits of improved water services for the consumers in Terengganu were determined based on the value of WTP. The findings of this study will be used in identifying the frequent problems and issues faced by the government owned water supplier in Terengganu. Efficient water prices will facilitate efforts in delivering better water services and promoting greater efficiency in the financial and operational management of operators to attain financial sustainability.

Keywords: Contingent Valuation Method (CVM); log-logistic model; water price; water demand; willingness to pay.

ABSTRAK

Pembekalan air adalah pelaburan yang mahal dan rakyat tidak dapat mengelak daripada bersedia bagi sebarang kenaikan harga air sejagat untuk memastikan bekalan tidak terganggu pada masa akan datang. Air yang murah membuatkan pengguna mengambil kesempatan dalam penggunaan dan tidak ada inisiatif untuk pemuliharaan air. Pembiayaan yang mencukupi diperlukan untuk melaksanakan pelbagai program untuk memperbaiki perkhidmatan air. Kos untuk program-program ini tidak seharusnya ditampung oleh syarikat-syarikat air yang sudah dibebani oleh pendapatan yang kecil akibat daripada harga air yang murah.Kutipan pendapatan ini tidak mencukupi untuk menampung kos operasi lalu menyebabkan perkhidmatan yang ditawarkan kepada pelanggan tidak memuaskan serta mengurangkan kecekapan operasi. Tinjauan semula tarif air di Terengganu yang terakhir telah dilaksanakan dua dekad yang lalu. Oleh itu, dengan peningkatan pendapatan dalam tempoh dua dekad yang lalu, tinjauan semula diperlukan untuk menilai kesediaan pengguna untuk membayar perkhidmatan air yang lebih baik. Kajian ini menggunakan kaedah penilaian kontinjen (CVM) "Double-Bounded" untuk menilai kesanggupan membayar isi rumah (WTP) bagi peningkatan perkhidmatan air di Terengganu. Manfaat kewangan untuk perkhidmatan air yang lebih baik bagi pengguna di Terengganu ditentukan berdasarkan nilai WTP. Penemuan kajian ini akan digunakan untuk mengenal pasti masalah dan isu yang sering dihadapi oleh pembekal air milik kerajaan di Terengganu. Harga air yang berkesan akan memudahkan usaha menyediakan perkhidmatan air yang lebih baik dan mempromosikan kecekapan yang lebih hebat dalam pengurusan kewangan dan operasi pengurusan untuk mencapai kemampanan kewangan.

Kata Kunci: Kaedah penilaian kontinjen (CVM); model log-logistik; harga air; permintaan air; kesanggupan untuk membayar

INTRODUCTION

Water is fundamental to life; however safe and clean drinking water is scarce nowadays. Almost 1 billion people in the developing countries still do not have access to water. According to World Health of Organization (2015), about 1 in 10 or about 630 million people all over the globe do not have access to safe and clean water. Water shortage is among the main problems experienced in this century. Water consumption has been rising at more than twice the rate of population increase. Moreover, a lot of the water systems that are essential for the ecosystems and to ensure the availability of food for the human population have become strained. There is sufficient water on this planet Earth for all but water is distributed unevenly and too much of it is wasted, polluted, and inefficiently used. In many parts of the world, the water resource is also unsustainably managed.

At the global level, water providers and related authorities are facing pressure in water management. Population increases, changes in urbanisation, and climate change force the providers to re-evaluate their policies and guidelines in water management. Basically good water management is tied to poverty reduction and improvement in health. Previous research has indicated that investment in basic water and sanitation offers the same benefit as those in medicine, which is about 7 to 15 times higher (British Medical Journal 2007). It is expected that the current problems in the water industry will worsen in the future unless strategies that increase efficiency in water services can be identified. Application of effective technologies and upgrading of services are the key components in any strategy aimed at improving water services especially those in developing countries. It is important that the water systems that used are able to minimize the use of this scarce water resource, improve health condition; increase urban comfort, and improve resilience to climate change. Evidently, the water industry is a vital area that needs to be handled effectively and efficiently. Large amount of investment is required to ensure steady water security and water supply.

Inexpensive tariff for water provision leads to unsustainable financial condition for the water services industry. Those tariffs are utilised by the water provider to collect the revenue needed to sustain and develop the water system. However, a number of tariff incentives indirectly lead to weaker financial sustainability. Oftentimes, water providers implement tariffs for a substantial quantity of water at rates that are lower than the cost of providing the water supply. If the number of small users is dominant, such practice would ultimately cause the service to be not feasible from the financial viewpoint (John 2011). As a result, water operators would face difficulty to expand their firm and to improve the services that they offer.

The state of Terengganu is located in the East Coast of Peninsular Malaysia and lies 400 kilometres east of Kuala Lumpur. Similar to numerous other states, population growth is just one of the many challenges in water supply and resource management in Terengganu. Increasing population has resulted in an increase in demand for water, thus accelerating the depletion of water resources in the state. Apart from that, the state is faced with increasing consumer demand; approximately 283,000 water users are recorded but only14 water treatment plants are operational throughout the state. The water industry is confronting increasing costs and it is becoming more costly to provide the best services to its consumers. A lot of money is required to implement various programs and these improvement programs should not be borne by the water providers only. Furthermore, the cheap water tariffs have lessened the revenue generated by the water companies and consequently, hindering their development. Generally, the revision of water prices has to be performed every three to five years. Yet, the review of water prices in Terengganu was done in 1997, almost twenty years ago. The inexpensive water prices have resulted in high level of wastage among the users. At present, the usage of the first metre cubic is charged at RM0.52 in comparison to the actual production cost which is approximately RM0.59. Water pricing is an important and effective mechanism to depict the scarcity value of water. Revising new prices is important as water is priced not only to recover the full costs of its supply and production, but it is also to include the higher cost of producing water from unconventional sources as well. A study by Mahirah et al. (2013) in Kelantan has estimated that on average the consumers are willing to pay RM0.5979 (an increase of 8.7% from the current price) for the first 35m^3 of water to improve domestic water services. Then in 2013 after many decades, for the sake of higher cost in production, sustainability and survival of its water resource Air Kelantan Sdn Bhd (AKSB) has revised to a new water rate. Zuraini (2013) has identified and estimated half of the respondents in Johor (44.64%) use a water filter at home because of the colour and taste of the water. Although water quality treatment in the state has achieved 98% compliance with the Ministry of Health (MOH) Standards, the situation is similar to Terengganu, where at least half of the people are found to have install water filters in their home. Mohd Rusli et al. (2011) has pointed out that the people in Selangor are willing to pay more in order to be supplied with good quality of water as the current condition is declining. The study has also exposed how a questionnaire-based model of consumer preferences improves the public involvement in assisting decision makers or the domestic water supplier to improve water supply services.

The water wastage issue is worsened by the aging infrastructure; a majority of the water pipes are outdated and no repair has been done for decades. The projection showed that more than 36 % of water wastage

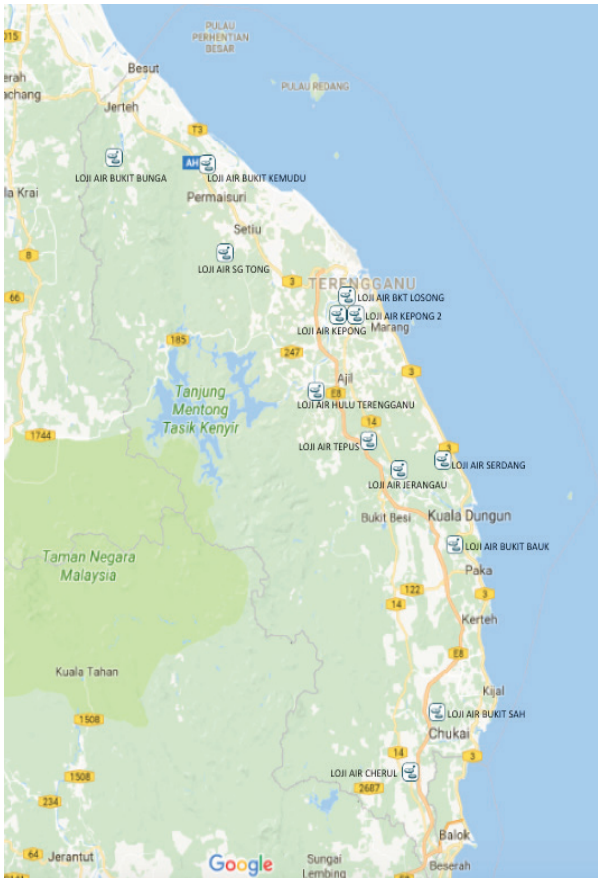

FIGURE 1. Water treatment plants in Terengganu

happened due to leakages. Based on the Malaysian Water Association (2015), the Malaysia average domestic consumption is 211 per capita per day, but the domestic consumption in Terengganu is 216 per capita per day compare to the standard average consumption of World Health Organization (WHO) which is 160 litre per capita per day. Figure 1 shows water treatment plants in Terengganu which is provided by solely water provider in the state, SATU.

Water provider in Terengganu is Syarikat Air Terengganu Sdn. Bhd (SATU) and it operates in all the eight districts. According to SATU, they suffered losses worth millions of ringgit annually due to burst pipes and water leakages. The production cost for supplying clean water is increasing every year, thus, the cheap water prices are pressuring their resources. The mission of SATU is to supply sufficient, high quality and clean water to consumers. SATU also wants to improve the quality of services provided in order to fulfil consumer satisfaction. The company is accountable in ensuring that their services respond to demand of consumers. In 2014, the state supplied water to about 96% of the state's population (Malaysian Water Association 2015). The two groups of consumers are the domestic users and non-domestic users. In 2014, the main consumers were the domestic users (57.7 %), while the remaining supply was consumed by non-domestic users (42.3 %). According to statistics from Malaysian Water Association (2015), about 99.1% of urban areas and 92.9% of rural areas are connected to water supply. In some remote and rural areas households are still using alternative sources such as wells.

Clean drinking water is a fundamental need in our daily life. The International Water Association (IWA) reported that about 4 billion people in the world still live without reliable access to safe water supply. Water is desirable for survival, used for a variety of purposes, such as for industry, domestic, recreation, and many more. Malaysia has ample water resources from both surface and groundwater sources. However, in the future, problems will arise due to water supply shortage as a result of rapid urbanization. Increasing population, urbanization and climate change have already affected the water supply in Malaysia. At the domestic level, the water provider in Terengganu has twelve water plants across the state. As of July 2015, SATU has 236, 420 active accounts of domestic users. The disruption in water services affects households, business and commercial activities in several ways and would result in huge losses. In Terengganu, salt water intrusion is one of the problems faced by consumers as freshwater extraction stations are located in the estuary. From the river mouth, the maximum salinity intrusion was recorded at 9.97 kilometres inland. Meanwhile, higher tidal during the spring tide typically penetrates the saline water further inland (Lee et al. 2016). On rare occasions, consumers use bottled water for daily consumption. Those who cannot afford to buy bottled water would continue to use saline water.

Currently, water prices in Terengganu seem to be inexpensive. The issue here is that the water company has not been able to raise sufficient revenue to cover the full cost of capital investment, maintenance and operation. In 2015 the state ranked the second lowest in terms of domestic water prices in Malaysia with RM0.50 for the first 30m^3 of usage. Cheaper water prices will of course bring less revenue to SATU and upgrading of water service projects require huge investments. It is difficult to impose an 'efficient' water price since it is impossible to implement it. The difficulty in pricing water is that water is a public good and this highly valuable resource does not have a well-defined market. In addition, surface water presents challenges with differences in many dimensions – the consumer demand curves, categories of users, different needs and rights to water. Issues of property right are complicated due to historical underpinnings such as prior rights; politics; and open access and common property rights. Besides, over extraction of water would lead to environmental degradation.

The objective of this study is to determine the domestic users' willingness to pay (WTP) for improvement in water services in Terengganu through new proposed water prices. Accordingly, this paper is organised into several parts. The introduction section discussed about the significant functions of water to people, as well as

the water management and water industry situation in Terengganu. Consecutively, the literature review part demonstrates the non-market valuation method – Contingent Valuation Method (CVM) – and the concept of WTP. Furthermore, the methodology section portrays the utility theory and how it relates to the WTP concept to be applied in this study. The section on results and discussions show the survey results based on (i) the domestic users' WTP for positive improvements in water services, (ii) the consumers' perceptions towards the services, and (iii) the calculation of mean and median WTP for new water prices in the state. Lastly, the conclusion section summarises the outcomes and recommendations of this study.

LITERATURE REVIEW

Non-market valuation methods have been applied to determine willingness to pay for various environmental goods and services over the past years. Welfare changes resulting from improvement of the goods and services have been regularly determined through the application of revealed preference and stated preference valuation methods (Whitehead et al. 2000). Cummings et al. (1995) and Mitchell and Carson (1989) explained that the CVM is commonly adopted because the method enables the estimation of a Hicksian measure for consumer surplus (CS) under circumstances where the change of environmental quality is being planned or envisioned (Hanemann 1984; Hanemann et al. 1991; Mitchell & Carson 1989). Notably, non-market valuation methods serve to measure the demand for and value of goods and services when no formal market that can establish any signal of value, such as price, exist. Contingent Valuation Method (CVM) is a widely applied as a non-market valuation mostly in the field of environmental cost benefit analysis and environmental impact assessment (Venkatachalam 2004).

CONTINGENT VALUATION METHOD (CVM)

In March 1989, an oil tanker belonging to Exxon Valdez crashed into Bligh Reef and spilled 11 million gallons of crude oil at Prince William Sound. The damage caused by the oil spill extended 470 miles to the southwest, contaminated hundreds of miles of coastline and destroyed the ecosystem. Prior to the incident, the estimation of passive use value, non-use or existence value, was an area of economic research not well known to many economists working outside the area of benefit cost analysis (Carson et al. 2003). The incident was a turning point in CV studies as the National Oceanic and Atmospheric Administration (NOAA) panels evaluated the validity of CV measures of non-use value because of the damage by the oil spill. The panels concluded that the CV survey is unreliable if it contains a high non response rate to the survey or to the valuation question and inadequate responsiveness to the scope of the environmental insult (Arrow et al. 1993).

Many earlier WTP studies have been conducted in the water industry such as Suleiman et al. (2014), Nabsiah and Chew (2015), Raje et al. (2002) and others. Whittington (1998) suggested that a good CVM is anticipated to be accurate for respondents to understand the "hypothetical" choice situation. The CVM attains the values which are contingent on the level of information by the respondents, and the extent of information presented in the survey (Wang et al. 2009). The significance of CVM is when it designs a realistic contingent valuation scenario which accurately states the options of water supply price that will consequently reveal the levels of prices that the water provider can charge. Economists use CVM which depends on hypothetical conditions when data are unavailable or unreliable (Callan & Thomas 1996).

CONSUMERS' WILLINGNESS TO PAY (WTP)

Willingness to pay (WTP) is an approach to estimate the price of goods when a market does not exist and then the price is unidentified. Most environmental goods, such as clean air and water, landscape, and diverse flora and fauna are not traded in the markets. These natural resources are precious and perform important functions in the ecosystems. It is challenging to value these environmental goods as they are unpriced and consumption of the goods has 'public goods' features. Therefore, a complete and precise economic valuation of natural resources, particularly non marketable goods are required. The WTP defines the highest amount that the consumers are willing to give up for certain benefits in exchange for others, sooner than without having it. The WTP usually refers to the value of a good to an individual as what they are willing to pay, sacrifice or exchange for it.

Based on the law of demand as discussed by Browning and Zupan (2004), the lower the price of a good, the higher the quantity consumers wish to pay. The basis of the demand curve is that lower price leads to more people willing to pay for and acquire the good. Most studies demonstrate that individual's WTP differs based on their profile such as income, age, household size, and demographic characteristics. Vasquez et al. (2009) reported that household with high income are willing to pay higher water bill, compared to low income households. With respect to age, Casey et al. (2006) found that younger respondents are responsible towards payment of water bill. Thus age affects the ability to pay water bills. A previous study by Hensher (2005) calculated the households' WTP for water service attributes by implementing the choice experiment method in Canberra, Australia. The study found that the households were willing to pay to reduce the frequency and the duration of water service interruptions and

waste water overflows. The respondents also mentioned that their main priority in daily water consumption is hygiene. Apart from that, Willis et al. (2005) identified consumer preferences and their WTP for service level changes in water services by a major water and sewerage service provider in the UK. The estimation of WTP allowed Yorkshire water provider to recognise the areas of water service that were most vital to the consumers. Moreover, the identification of WTP and economic optimisation towards the whole investment program in water services increased the transparency of the implications for the decisions made by the regulatory body and water provider. In addition, Behailu (2012) found that the WTP estimation in Shebedino District, Southern Ethiopia, was 10 cents for 25 litres of water. Summarily, the WTP for basic water services is higher if the services are guaranteed to be affordable and relevant. In Malaysia, few studies have been conducted on the willingness to pay for improvements in water services. To determine the selection of consumers' willingness to pay in Selangor, Mohd Rusli et al. (2011) has presented respondents with several attributes to determine their levels of choice. The respondents' preference when it comes to 'Water quality' with the highest margin is their willingness to pay, among other attributes. Accordingly, in Johor, Zuraini (2013) has conducted choice modelling to assess the consumers' willingness to pay. Here, water attributes are divided into two categories- Water Infrastructure (WI) and Residential Customers (RC). WI attributes are leakage, pipe bursts, and reservoirs while RC attributes are water quality, pressure, connections, and disruptions. The study found that different attributes yielded different value of marginal willingness to pay. Generally, the results on willingness to pay are also affected by the socio demographic background of the respondents. For instance, as the income increases so is the tendency for the consumers' willingness to pay. Correspondingly, in Kelantan, Mahirah et al. (2013) has demonstrated that as household size increases, the willingness to pay for improvements in domestic water services also decreases.

METHODOLOGY

Value is explained as what an individual set on something in terms of the amount of some other things that the individual would be willing to give up. By measuring the individual's willingness to pay is the appropriate thing to do. We can aggregate together all the individuals' WTP and measure the total benefits of the project or suggested policy. This study assumes a plan that will reduce water disruptions in the state. Equation 1 demonstrates an individual in an initial state of wellbeing (W_0) attains with an income (Y_0) and a level of water disruption (D_0);

$$W_0\,(Y_0, D_0) \tag{1}$$

Now consider a policy which would reduce water disruptions to D_1. This reduction in water disruptions would increase the individual's wellbeing to W_1;

$$W_1\,(Y_0, D_1) \tag{2}$$

Since this individual's wellbeing would improve with the policy, this study assumes that;

$$W_1\,(Y_0, D_1) > W_0\,(Y_0, D_0) \tag{3}$$

In effect, an individual is asked (or is hypothesized) to consider two combinations of income and water disruptions that both yield the same level of well-being. First, a combination in which their income is reduced and water disruptions is reduced. Second, a combination in which income is not reduced and water disruptions stay as it is (no change).

$$W_0\,(Y_0, D_0) = W_1\,(Y_0 - \text{WTP}, D_1) \tag{4}$$

WTP can be defined as the amount of money that makes these two combinations of income and water disruptions yield the same level of well-being. This is the maximum that people would be willing to pay for the positive change in welfare resulting from less water disruptions. The maximum WTP is defined as the economic value of the change in well-being resulting from the reduction in water disruptions from D_0 to D_1.

This study uses double-bounded CVM approach in order to determine consumers' WTP. The purpose of CVM is to produce valuations that are as close as possible to what would be exposed if a market actually occurred. Calia and Strazzera (1999) concluded that double bounded CVM generates more accurate point estimates of variables and central tendency measures of willingness to pay, along with narrower confidence intervals mean or median of willingness to pay. This paper uses CVM approach with closed-ended format to determine WTP. The method increases efficiency of the estimated parameters of WTP (Hanemann et al. 1991). Individuals can be proposed again and followed up by second round of bidding with additional proposed bids. This approach was first proposed by Hanemann (1985) and it is known as "double-bounded" CVM. This method involves respondents to response the first bid and follow to the second bid with a new proposed price bid amount which relies on "yes" or "no" responses in the first round. Flachaire and Hollard (2005) suggested that this method comprises of starting point bias because of respondent responses on second round will likely be persuaded by the first proposed bid in first round. This method generates discrepancy between answers on second and first bids. The bias may occur because the subject's value is weakly defined and the respondents did not notice the information clearly.

A question begins with "*If your household was asked to pay approximately RM 0.52 for the first 30m^3 of water usage in the monthly bill, would you vote for a new water price in order to secure better water services' quality in*

the state?" If respondents respond "yes" on the first bid, the second proposed bid will be reviewed upward and higher. If respondents respond "no" on the first round, the second proposed price bid will be reviewed to a lower amount. Subsequently, double-bounded CVM produces four possible responses; "yes/yes", "yes/no", "no/yes" and "no/no".

Kanninen and Khawaja (1995) stated that the mathematical equation of the double bounded CVM (DCVM) is a direct extension from the conventional CVM model. Model formulation for double bounded CVM thoroughly followed Hanemann et al., (1991). The second bids create responses which are $Probability_i^{YY}$, $Probability_i^{NN}$, $Probability_i^{YN}$ and $Probability_i^{NY}$. The probabilities of answers to both on first and the second round of WTP questions are as follows;

$$Probability_i^{YesYes} = \text{Probability}\{1^{st}\text{ BID} \leq \text{WTP}_{max} \text{ and High BID} \leq \text{WTP}_{max}\} \quad (1^{st}\text{ BID, High BID}) \tag{5}$$

$$Probability_i^{NoNo} = \text{Probability}\{1^{st}\text{ BID} \leq \text{WTP}_{max} \text{ and Low BID} \leq \text{WTP}_{max}\} \quad (1^{st}\text{ BID, Low BID}) \tag{6}$$

$$Probability_i^{YesYes} = \text{Probability}\{1^{st}\text{ BID} \leq \text{WTP}_{max} \leq \text{High BID}\} \quad (1^{st}\text{ BID, High BID}) \tag{7}$$

$$Probability_i^{NoNo} = \text{Probability}\{1^{st}\text{ BID} \geq \text{WTP}_{max} \geq \text{Low BID}\} \quad (1^{st}\text{ BID, Low BID}) \tag{8}$$

The equations clarify that if respondent responds "yes" to the first bid (1st BID) and the second price bid indicates a higher bid (HBID) than the first bid is 1st BID < HBID. If the respondent responses "no" to the first bid, then the second bid is lower (LBID) than the first bid, 1st BID > LBID. Hence, the probabilities for the dichotomous choice double bounded CVM for log-logistic model in this study is as follows;

$$Probability_i^{YesYes} = [1 + e^{-(\alpha + \beta \text{ High BID})}]^{-1} \tag{9}$$

$$Probability_i^{NoNo} = 1 - [1 + e^{-(\alpha + \beta \text{Low BID})}]^{-1} \tag{10}$$

$$Probability_i^{YesYes} = [1 + e^{-(\alpha + \beta \text{ High BID})}]^{-1} - [1 + e^{-(\alpha + \beta 1\text{stBID})}]^{-1} \tag{11}$$

$$Probability_i^{NoNo} = [1 + e^{-(\alpha + \beta \text{ 1stBID})}]^{-1} - [1 + e^{-(\alpha + \beta \text{Low BID})}]^{-1} \tag{12}$$

This paper employs the log-likelihood function for double-bounded CVM that has four outcomes as shown below:

$$\ln L^{DCVM} = \sum_{i=1}^{N} \{c_i^{yy} \ln Pr_i^{YY} + c_i^{nn} \ln Pr_i^{NN} + c_i^{yn} \ln Pr_i^{YN} + c_i^{ny} \ln Pr_i^{NY}\} \tag{13}$$

where $c_i yy$, c_i^{nn}, c_i^{yn} and c_i^{ny} are binary valued indicator parameters which are demonstrated by consumers stating yes/yes, no/no, yes/no, and no/yes. The mean WTP of application DCVM is estimated according to the area under the probability function of taking the price bid with an integration technique as shown below;

$$\text{Mean (WTP)} = \int (1 + e^{a+bWTP})^{-1} db_L^U \tag{14}$$

In equation 14 $(1 + e^{a+bWTP})^{-1}$ presents the probability of accepting price bid and upper (U) and lower (L) limits of the integration. While, the median WTP is determined as below;

$$\text{Median (WTP} \mid \bar{x}, \beta) = \bar{x}' \left[-\frac{\hat{a}}{\hat{\delta}} \right] \tag{15}$$

This paper also comprises covariates, α is a linear function of the covariates, instead of the intercept, where $\alpha = \bar{x}, \hat{\beta}$. $\bar{x}$ demonstrates the vector of interest for explanatory variable and $\hat{\beta}$ is the vector of Maximum Likelihood determines of the variables (Calian & Strazzera 1999).

SAMPLE SIZE AND SAMPLING

The sampling consisted of domestic users of water in Terengganu, who have registered active accounts with SATU. Most of the respondents are head of households since they are accountable for monthly water bill and we would like to find out their contribution and their willingness to pay (WTP) regarding the water services provided. The sample size consisted of 1175 respondents and the calculation of mean WTP was based on Mitchell and Carson (1989) as illustrated below:

$$N = [(z_{\alpha/2} V)/\Delta] \tag{16}$$

where N is desired sample size; z presents 95 % confidence interval statistic (1.96) at significance level (α) of 5 %; the coefficient of variation (V), portrays the value of 2; and Δ of 10 % is adopted as an acceptable difference among the actual populations of the mean WTP. Mitchell and Carson (1989) recommended a simple statistical formula for sample size in conducting CVM: any number between 200 and 2500 is suitable to be applied in the method. Thus, a sample of 1175 respondents is sufficient to portray the domestic users of water services which covered every district in Terengganu. Most of the time, this approach towards sample size for CVM is sufficient, but the classical method fails to separate the circumstances under which it is safer to take a small CV survey sample rather than large sample (Vaughan & Darling 2000). The data in this study was collected from domestic consumers in a survey conducted between April to June 2016. The assistance of enumerators has been engaged to collect the data as well as to implement the survey, where questionnaires have been conducted by interviewing respondents. The domestic users involved in the study were informed that the study will benefit the water industry and ultimately, the water provider will be able to recognise the consumers' expectations towards improvements in water services. Table 1 demonstrates the total of respondents who have been selected according to the districts in the final survey.

The distributions of the respondents are not equivalent in each district since the districts do not

TABLE 1. Total of respondents according to districts (n=1175)

District	No. of Respondents	Percentage (%)
Besut	148	13
Setiu	59	5
Kuala Terengganu	232	20
Kuala Nerus	163	14
Marang	146	12
Dungun	160	14
Kemaman	185	16
Hulu Terengganu	82	7
Total	1175	100

have the same total numbers of population. The number of respondents in each district is based on population share in Terengganu (Unit Perancang Ekonomi Negeri Terengganu 2016). The respondents have been selected randomly in each stratum. The sample is concentrated on consumers who use tapped water provided by SATU.

QUESTIONNAIRE DESIGN

The purpose of the survey is to estimate the respondent's willingness to pay, besides accumulating explanatory variables which are believed to affect respondent's WTP. The questionnaire for this study is developed in Bahasa Melayu since most respondents were unfamiliar with the English Language. The purpose of the questionnaire is to gather information on the socio-economic background domestic users of water supply in Terengganu and to gather information on how they value water supply in the state. The information obtained from the survey is strictly confidential and will be used for the purpose of the study.

The CVM comprises an organized questionnaire of consumer's WTP at stated prices in a hypothetical situation. Respondents received a set of questionnaire with situations that ask how much they are willing to pay for new water prices and contribute for improvements in the domestic water services. The amount that consumers would be willing to pay depends on how strong they feel about the improvement in that program.

Under the CVM method, this study applied the closed-ended questions involving "yes" or "no" answers. The survey required three types of information from the respondents. First, information about consumers' preferences and perceptions regarding the water services in the state. Second, information about consumers' probability of saying "yes" or "no" to hypothetical water prices. This information was used in the CVM to gauge their WTP for better water services in the future. The third part enquired information on consumers' sociodemographic characteristics.

As discussed above, Section 2 focuses on contingent valuation questions regarding WTP for improvements in domestic water services in Terengganu. The study outlined the implications of better water services, costs of action, implementation of plan, and WTP questions. Few examples of the flow in the questions are stated in Table 2 below:

TABLE 2. Examples of contingent valuation question in Section 2 of the questionnaire

Implications of Improvements in Water Services

We would like to know how strongly you may support an increase in water price for improvements in water services which may introduce additional cost to your household. Let's focus on the possible actions targeted to reduce water disruptions and leakages, in addition to increase water pressure for home consumption.

Costs of the Implementation Plan

Inevitably, the public in Terengganu has to bear the cost to implement the plan for upgrading water services to a better level. The current inexpensive water price which had never been revised for approximately two decades does not reflect the actual production cost nor promote financial sustainability. The low water price promotes negative behaviour among consumers, especially in terms of their consumption. On the other hand, in reality, the water industry business incurs a lot of costs and requires a huge investment.

Implementation of Plan

In order to implement such plan, SATU would request the domestic water users to pay a new proposed water price in their monthly water bill. The new price's sole purpose would be to finance the efforts for positive actions to improve water services in Terengganu.

WTP Questions

Considering your current income, as well as your expenses for housing, food, utilities, clothing, entertainment, saving, and etcetera, please think about how much you would be willing to pay to support the plan. Kindly assume that your monthly payment would be collected by SATU.

In this scenario, the public in Terengganu has the opportunity to vote for such plan but they need to bear the associated costs. If the majority of people vote for the plan, the plan would go into effect and every household would have to pay for the new increment in water price. If the majority of people vote against the plan, no one would have to pay the new price but the current situation for water services would continue to deteriorate. Remember that the sum collected would be used entirely for implementing the plan.

If your household was asked to pay a water price of approximately RM 0.52, applicable for the usage of the first 30m^3 in the monthly water bill, would you vote for new water prices in order to secure better water services in the state?

Yes/No

Variation of price bids is an approach to omit "starting point bias" problems that can arise when the initial bid introduced by the interviewer affects the level of WTP of the respondents. Alberini (1995) stated that no accepted viewpoint exists among earlier studies and in the literature on the number of proposed bids under the CVM. Table 3 presents five sets of proposed bidding water prices, which consist of an increase and decrease of 4% from the current water price (RM0.50 applies for first 30m^{3}of usage). Thus, each respondent received different water bids in their respective questionnaire.

TABLE 3. Hypothetical water price bid offers in Ringgit Malaysia (RM)

Initial Bid (RM)	Higher Price Bid (RM)	Lower Price Bid (RM)
RM0.52	RM0.54	RM0.51
RM0.54	RM0.56	RM0.52
RM0.56	RM0.58	RM0.54
RM0.58	RM0.60	RM0.56
RM0.60	RM0.62	RM0.58

A trial run was performed on a group of respondents in order to detect any problem in the construction of the questionnaire. The pre-test was conducted two times because the first pre-test had identified several issues with the CVM questions, namely the biased to answer "yes" and a starting-point bias. Additionally, in the first pre-test, most of the respondents were trying to please the interviewer in terms of the proposed water price. A total of 29 respondents from two districts – Kuala Terengganu and Besut were involved in the pre-tests. It was reliable and convenient to show that the respondents were from rural (Besut) and urban (Kuala Terengganu) areas. Table 4 exhibits the total number of respondents in the final pre-test.

TABLE 4. Total of Respondents in Pre-test

District	No. of Respondents
Besut	11
Kuala Terengganu	18
Total	29

The selections of 29 respondents were convenient because they were not too divergent from the actual respondent. The statistical sample for pretesting was not necessary since the focus of the pretesting process was to determine if the respondent had any difficulty in understanding the questionnaire (Zikmund 2000). The pre-test was applied to avoid any unclear and biased questions in the questionnaire.

RESULTS AND DISCUSSIONS

SAMPLE DESCRIPTIONS

This part demonstrates the outcomes of the double bounded CVM using descriptive and econometric analysis. Table 5 outlines the demographic and socioeconomic characteristics of the 1175 domestic consumers involved in our study.

TABLE 5. Respondents' profile (n = 1175)

Descriptions	Frequency	Percentage
Gender		
Male	579	49.28
Female	596	50.72
Education		
Primary	49	4.17
Secondary	370	31.49
Diploma	285	24.26
Bachelor	316	26.89
Master/PhD	126	10.72
No formal education	29	2.47
Occupation		
Civil servants	421	35.83
Private	238	20.26
Business	149	12.68
Others	367	31.23
Age		
21-30	182	15.49
31-40	336	28.6
41-50	413	35.14
51-60	185	15.74
61-70	42	3.58
71-80	12	1.03
81-90	5	0.42
Type of house		
Bungalow	232	19.74
Terrace	267	22.73
Apartment	69	5.87
Others	607	51.66

The profile analysis of the respondents in Table 5 shows the distribution of the respondents based on gender. A slight majority of the respondents (50.72%) are female. Educational achievement level of respondents is rather low with 31.49% of the respondents having secondary education. Respondents were requested to state their profession. About 35.83% of the respondents are civil servants. The percentage of respondents in private sector, business sector and others are 20.26%, 12.68% and 31.23%, respectively. The respondents who selected

"Others" (31.23%) indicated the group of retirees and housewives. They were groups who have part time job, small scale business at home, and retiree with monthly pension payments and thus were still capable to pay an average monthly water bill for 22.5m^3 i.e. about RM10 in Terengganu. The biggest proportion (35.14%) of the respondents involved in the study belongs to the 41-50 years age group. Plus, the respondents were asked about their type of house and a majority of them chose "Others" (51.66%); these respondents explained that they live in houses around the villages and remote areas.

CONSUMERS' PERCEPTIONS AND PREFERENCES

Table 6 presents consumers' perceptions on clean water connections at their homes. It shows that most consumers (52.17%) choose to boil the water before consuming it. The consumers said that they are unsure about the quality and condition of the water supplied. Only 8.85% of respondents drink directly from the tap since they are not doubtful of its quality. In a few parts of Terengganu, there are still issues of changes in colour, taste and smelly tap water that worry the consumers. Sea salt water intrusion is also triggering the water issue in the state as the freshwater extraction station is located near the estuary (Lee et al. 2016). The salinity level at Pulau Musang's freshwater pump house was found to be very high, and this is affecting the residents in Kuala Terengganu; exacerbated by the rise in sea level at certain time.

TABLE 6. Perceptions on clean water supply

Description	Frequency	Percentage (%)
Drinking from water tap directly	104	8.85
After filtered the water	431	36.68
After boiled the water	613	52.17
Others	27	2.30
Total	1175	100

In the survey, the respondents stated the reasons as to why they vote for the proposed program. Based on Table 7, of the 1175 respondents who completed the questionnaire, about 44.2% indicated that they hope the new prices will improve current water supply services. Meanwhile, 30.9% of respondents said the new increment in price would ensure a better water supply services in the future. About 4.8% of respondents stated that a rise in prices can be assumed as a contribution to the water service provider after all the hard work.

TABLE 7. Reasons why households are willing to pay for improvements in water services

Description	Percentage (%)
Improving current water supply services	44.2
Conserving and preserving the valuable value of water resources	15.9
As a contribution to water service provider	4.8
Securing a better water supply services in the future	30.9
Others	4.2

CONSUMERS' WILLINGNESS TO PAY

At the beginning of the survey the respondents were asked regarding an increment on current water prices. About 55.91% of consumers stated that they are willing to pay for any rise in prices, while 44.09% of consumers reject the idea of the program (Table 8). Those who reject the idea were reluctant to have a new water price in the state since they were comfortable with the current tariff. However, they are still interested to join the survey as they believe their opinions would be counted in the study.

TABLE 8. Consumers' response for proposing new increments on current water price

		Frequency	Percentage (%)
Willingness to Pay	No	518	44.09
	Yes	657	55.91
	Total	1175	100

The main aspect in the CVM is that respondents should be sensible to the proposed bid value. As the price bid rises, the probability of saying yes reduces. This shows that the respondents are observant of the amount that they are asked to pay for improvements in the program. Table 9 depicts that as the proportion of positive answers decreases, the bid amount increases. In the survey, the respondents stated the reasons why they are voting for the program. Table 10 demonstrates the percentages of those who accepted or rejected the first bid, and the proportion of the sample proceeding to either accept or reject the second bid based on the 1175 respondents stating a preference to vote for an increment in water price. Almost 55.91% of the respondents responded "Yes" to the first bid, but only 68.81% of these respondents accepted the second price bid with higher

TABLE 9. Distribution of the amount of the initial bid in Ringgit Malaysia (RM)

Response on First Bid	RM0.52	RM0.54	RM0.56	RM0.58	RM0.60	RM0.62	Total
Yes	72.99%	66.67%	52.38%	45.61%	46.19%	22.22%	55.91%
No	27.01%	33.33%	47.62%	54.39%	53.81%	77.78%	44.09%

TABLE 10. Respondents' responses to two rounds of price bids

		Second Price Bid		
		Yes	No	Total
First Price Bid	Yes	809 (68.81%)	503 (42.81%)	657 (55.91%)
	No	366 (31.19%)	672 (57.19%)	518 (44.09%)
Total				1175 (100%)

bid. Apart from that, 44.09% respondents rejected the first bid, while 57.19% of the whole sample responded "No/No" to both binary questions.

This study starts with regression of logit model for single-bounded CVM in first round with no control variables as in Table 11.

The logit model regression demonstrated that the first price bid variable was statistically significant and in line with the bid price increase which also decreased the probability of a positive response, suggesting a negative relationship. Equation 15 shows the variables included in the model. They are believed to be important variables of WTP.

$$\text{Willingness to Pay (WTP)} = \alpha + \beta_1\text{Price Bid} + \beta_2\text{Income} + \beta_3\text{Education} + \beta_4\text{Job} + \beta_5\text{Household size} + \beta_6\text{Experience} + \beta_7\text{Awareness} + \varepsilon \quad (15)$$

Table 12 portrays the description, mean and standard deviation of explanatory variables.

The estimated results for log-logistic analysis of WTP for improvements in water services in Terengganu state are presented in Table 13. The WTP equation is estimated using NLogit Version 4 software to resolve the relationship between WTP and each of the parameters as discussed earlier.

The results for the logistic model indicate that price bid presents negative relationship towards respondents' WTP, as proposed price bid increases with a parameter of –20.453, their WTP decrease, as it is in line with economic theory, as demand increases, quantity demanded will decrease, demonstrating a negative relationship. Based on Gunatilake and Tachiri (2013), households in Khulna city, Bangladesh are not expected to expand water connection if water charge increases, it relates to law of demand. Income has a positive relationship towards WTP with statistically significant results at the 1% level. It demonstrates that as consumers' income increase, the probability of deciding "yes" increases. This result is in agreement with previous studies by Alias and Shazali (2005) and Mamat et. al. (2013) which demonstrate a positive sign towards consumers' WTP. Households with higher level of income have better chances of maximising the utility and welfare from consuming and having access to good water services at homes. However, education and household size exhibit a negative relationship, as education in terms of the respondents' years of schooling does not show a contribution on respondent's WTP. This study is in line with a study by Moffat (2011) who also found a negative relationship between education and the respondent's WTP. The study revealed that higher number of years for schooling among the respondents would contribute to decreasing WTP. This situation may portray the group of respondents who deem water services as a provision that should be regulated and monitored by the government. In the case of household size, as the household size increases, WTP decreases. Most respondents stated that they are not willing to contribute for new increment in water prices if they have a bigger household size in the future. Water is used for a number of household purposes, for instance, for cooking, bathing,

TABLE 11. Logit Model Regression on first bid

Response 1	Coefficient	Std. Err	P > |z|	[95% Conf. Interval]	
First Bid	–16.1330	2.1453	0.002	–20.3378	–11.9282
Constant	9.3129	1.2099	0.003	6.9415	11.6843

TABLE 12. Summary of explanatory variables

Variables	Descriptions	Mean	Standard Deviation
Income	Monthly household income in Ringgit Malaysia (RM)	4182.512	4242.83
Education	Years of schooling, number of years devoted for education by the respondent	14.35	11.23
Job	Head of household's job		1.26
Household size	Respondents' household size	5.02	2.39
Experience	Experience with pipe leakage and water disruptions (1 = experience, 0 = no experience)	0.43	0.49
Awareness	Awareness of high expenditure to reduce water disruptions(1 = yes, 0 = no)	0.33	0.47

TABLE 13. Estimated parameters of the model for improvements of water services in Terengganu

Variables	Coefficient	Standard Error	t	P[|Z|>z
Constant	–19.489	1.049	–18.652	.0000
Price Bid	–20.453	0.811	–25.192	.0000
Income	1.056	0.098	10.672	.0000
Education	–0.228	0.138	–1.657	.0974
Job	0.222	0.120	1.856	.0635
Household size	–0.520	0.105	–4.921	.0000
Experience	–0.238	0.165	–1.442	.1492
Awareness	0.544	0.178	3.053	.0023
Log Likelihood	–733.403			
Restricted log likelihood	–824.721			
Chi Squared	182.635			
McFadden R-squared	0.110			

Notes: ***, ** and * demonstrate significance at the 1%, 5% and 10% significance levels, respectively. Tab r1 r2

and outside the house for gardening, lawn sprinkling and others. At higher prices, consumers will limit their unessential water uses significantly, but their water consumption for essential purposes will not reduce as much in relative terms. Consumers who have awareness on high expenditure to lessen water disruptions are willing to pay more as it portrays a positive relationship in the model. Respondents believe that those problems can be settled if the new increments in water price can help water provider to improve water services in the future. The estimated mean of WTP according to the integration technique in Equation 14 shows the water price is stated at RM0.70 applies for first 30m^3. However the median WTP stated at RM0.56 applies for first 30m^3. According to these results, the mean WTP is higher than current water price (RM0.50applies for first 30m^3) and the result shows respondents are willing to pay about 40% from the current price for better transformation in services in the future.

CONCLUSION

It is significant to estimate domestic consumer's willingness to pay and how much increase in price that they are willing to pay in order to secure better water services. Over the years, their water consumption keeps increasing as there is no incentive for them to conserve the resource. A study on economic valuation on water service is important in order to improve the management of water resource in Terengganu state. The result shows that domestic consumers' willingness to pay for water price is at RM0.70 applies for first 30m^3. This is the maximum that respondents would be willing to pay for the positive change in welfare resulting from improvements in water services. The maximum WTP can be defined as the economic value of the change in wellbeing resulting from the transformation in water services. In this case, a number of determinants influence their WTP such as (i) price bid, (ii) income, (iii) years of schooling, (iv) job, (v) household size, (vi) experience of water disruptions at home, and (vii) their awareness regarding high expenses needed to address water disruption problems. The recommended policies will benefit those involved in the industry which includes policy makers, water providers and consumers. From policy maker's perspectives, new suggested equitable water prices would benefit the consumers as well as the water providers. Therefore, both sides (producer and consumer) would appreciate the positive changes. By reviewing the water tariff, the water operator will subsequently be able to finance their operations to ensure sustainable water management.

Water is a resource that must be carefully managed and a source of services that comes at a cost. Even in countries that charge for water, tariffs are not always revised. Increasing the price of water will lead to economic effectiveness of water utilization among consumers. Generally, cost recovery principles will determine the pricing structure of water utilities. Most water regulators believe that the price should be set at revenues equal to cost. Hence, if revenue is too low to cover the cost, the losses must be subsidized from other sources, for instance, taxes or other revenues that would cover the costs. If revenue is larger than the cost, it demonstrates profit in business. This is unacceptable for a public utility with a monopoly status. Water market does not attain economic efficiency if water rights are not transferable. As a consequence of transferable condition, it creates a market for water and attains efficient allocation of water based on consumer's demand and willingness to pay. Transferability allows water scarce supplies to cater increasing population, changing values and growing demands. Hence, consumers are able to adjust their changing consumption needs, and rights can be permanently transferred through the market to meet the changing patterns of daily consumption, commercial, industries, and the environment. The consumers must also be knowledgeable about the explicit value and benefits that they would enjoy if the services are improved. The money that the consumers allocate to improve the water services will benefit

their daily activities, health and overall economic development. By increasing water price, consumers will appreciate the significant functions of water and they would no longer take it for granted. With higher water price, consumers would be inclined to use water carefully and avoid wastage in daily consumption. Under such a scenario, water as a natural capital would earn a return to reflect its scarcity and its rent.

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