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Effective Demand for Water Supply Service: The Case of Johor Water Company in Malaysia

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This study assesses the residential customers' preferences for water services in Johor State. The Johor Water Company (SAJH) is a privatised company that provides water from the source to the household. Choice modelling (CM) was applied as a tool for the assessment of effective demand for improved water supplies, particularly by residential customers. The findings indicate that customers are willing to pay for water service improvements. Additionally, the significant variables affecting demand are pipe bursts, (BUR), water quality (QUA), disruption (DIS) and connection (CON), as well as price (PRI). The most important factors influencing the WTP of water services are gender, age, number of persons in the household, and income. These patterns of customer behaviour are important and useful to the water company for improving their services.

1. Introduction

In the 21st century, water is predicted to be the leading issue, because this vital resource might be a scarce commodity, and increasingly polluted (Chan, 2001). In developing countries, because of rising population and increased development, the escalation in demand for water doubles every twenty years, but the growth in supply is far lower and is currently trailing far behind demand. As a result, it is expected that development will be significantly checked due to water demand (Bouguerra, 1997). Currently, there is a water crisis caused by poor water management in developing countries such as Nigeria and India. As a result, one in five of the world population do not have access to safe and affordable drinking water. In fact, three to four million people die each year of diseases carried via water; this includes over two million young children dying of diarrhoea (Cosgrove et al., 2000).

According to the Global Water Supply and Sanitation Assessment, 1.1 billion people do not have the use of an appropriate water supply for domestic purposes, and about two-thirds of them – nearly 670 million people – are in Asia. This comes to about 18% of the population of the continent, according to the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF).

Due to the increasing population, industrialisation and urbanisation, the water demand is projected to increase at the rate of 12% per year throughout Malaysia. The current water demand of 12 billion m^3/year will increase to 20 billion m^3/year in 2020 (Ti et al., 2001).

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Although the total water availability exceeds the demand, water shortages do occur due to the variability and uneven distribution of rainfall, especially in a protracted drought period.

There has been a severely increased demand for water as consequence of the rise in population and GDP over the past few decades. Population growth has become a big issue in the urban areas; this is due to rural-urban migration and increasing urbanisation. The rapid growth of the urban population has placed heavy demands on the government's capabilities to deal with the population's needs for infrastructure and services and provide environmental conditions necessary for a better quality of life. Naturally, the per capita amount available for each person of water decreases with a rise in population.

In Malaysia, the responsibility for state water supply services is that of the Public Works Department, the Water Supply Department, the Water Supply Board and the Water Supply Corporation or Company in each state, but also of private companies. In order to achieve financial sustainability and an efficient service to customers, the Federal Government set up PAAB (Water Asset Management Company) under the Ministry of Finance to take over the responsibility to finance and develop new water infrastructure. Therefore, water operators lease the water infrastructure for operation and maintenance purposes.

SAJ Holdings is a fully integrated water supply company in Johor state. It is involved in the all the processes of drinking water supply; these range from raw water acquisition, treatment and purification, and the subsequent distribution of purified water to customers, plus billing and payment collection. Therefore, SAJH needs to meet customers' demands. They should all receive the same level of service; customer quality includes water quality compliance to Ministry of Health (MOH) standards, continuous supply, and pressure. Furthermore, the customer charter relates to pipe bursts, pipe leakage and connection. Residential customers have complained about leakages, pipe bursts, reservoir capacity, low water pressure, water quality, disruption to the water supply, and connection times. In order to deliver a better service to residential customers, SAJH has stated its targets through quality objectives and the customer charter.

The most crucial issue of the three sites selected is polluted water from the river, particularly at Johor Bahru, Batu Pahat and Kluang. Another problem is the critical water level at Sembrong Dam during the drought season. SAJH should take into account these highlighted problems in order to achieve efficiency and better delivery to the residential customer, particularly in the sample areas of this study, and Johor state as a whole.

There were also complaints from customers during the survey. These included: the impact of replacement of water meters causing increases in water bills, even though there was no leakage found at home; poor quality of water in terms of taste, colour and odour during the flood and drought seasons, because the water treatment plan does not function well; sometimes customers have to make a complaint more than once about a particular water problem; the "customer-friendly" roadshows (Mesra Pelanggan) are also limited in number and only rarely held in the customers' area; some staff are not friendly; and notice of water disruption does not cover the whole area affected, especially in rural areas.

Research has been dedicated to improving the water demand in developing countries in South Asia, Africa and Latin America as reported by the World Bank Water Demand Research Team (World Bank, 1993). This is a pioneer research on water resources in Malaysia. It focuses on the study of leakage, burst pipes, reservoir capacity, water quality standards, disruption to the water supply, pressure, and connection times which need to be improved in order to provide a better service to residential customers, particularly in Johor. Different socioeconomic factors influence the WTP. Therefore, this study examines customers' willingness to pay (WTP) for a particular water supply service level as well as the determinants of residential customers' willingness to pay (WTP). The primary socioeconomics factors are gender, age, number of persons in the household, and income.

As a result, this research has been carried out to determine the value of universal access to an improved water service using a willingness to pay approach (WTP) in the area of study; specifically, to examine the socioeconomic factors that influence residential customers' willingness to pay for an improved water supply. This study concentrates on the water supply service to residential customers. Aspects of this service which could be improved are leakage, burst pipes, reservoir capacity, water quality standards, disruption to the water supply, pressure, and connection times. The customers' preferences for improvements to these water service attributes will allow SAJH to ensure that customers receive a better service in the future.

The paper is organized as follows. The next section discusses the related literature on the topic. It followed by methodology and model are presented in section 3. Findings of this study are in section 4. The last section is summary and conclusions.

2. Literature Review

Factors Affecting WTP for Water Services

Financing is a necessity for a new project, and consumers are the main resource from which to obtain the capital via their monthly water bills. Therefore, the water provider management must make efforts to identify the factors which influence the WTP for improved water service conditions.

Numerous studies have attempted to examine the factors influencing WTP for water services. The factors affecting domestic demand for enhanced water services in particular parts of South Asia, Africa and Latin America were investigated by the World Bank Water Demand Research Team. This study demonstrated that households' willingness to pay (WTP) was influenced by socioeconomic characteristics. Highly educated households were willing to pay more than lower educated ones, as they were more concerned about improvements in health connected to a better quality of water service. Female respondents were willing to pay more for an improved water service than male respondents (World Bank, 1993).

Similar results concerning education levels were reported by Wittington et al. (1990), Kaliba et al. (2003), Farolfi et al. (2006), Mbata (2006), Alaba (2001) and Pattanayak et al. (2006). They found that the relationship between educated households, particularly women, and improvements to the water service, was positive.

In Haiti, respondents who worked in the farming sector were willing to pay less than non-farming families. Unfortunately, this was not applicable for households in Pakistan and Nigeria. But, in Brazil, respondents who work in the government sector were willing to pay more approximately 15% than those in the private sector. However, there was no statistically significant relationship between households' size and composition and their WTP for an improved water service. Similar findings showed that other socioeconomic factors, such as the number of people in the household, the number of adult women, the number of children, and the age of the respondent, did not influence the WTP for an improved water service.

Furthermore, households in rural areas were willing to pay very little for an improved water supply; the percentage of income which they were willing to pay varied widely. For instance, in Zimbabwe, households were willing to pay less than 0.5% of their income, whereas in Ukunda, Kenya people were willing to pay approximately 9% of income for improvements such as water vendors and kiosks (World Bank, 1993; Alaba et al., 2002). Similar results were obtained in a study conducted by Alaba (2001) in Nigeria. This study employed CVM to identify factors for the demand for water. Households' income level was significant, and also had a positive relationship with WTP.

Previous research findings claimed age and WTP were inconsistent and contradictory. For instance, some older households were not willing to pay for changing to a new water source, because they preferred to use the traditional one (Davis, 2004). Others were willing to pay because they had sufficient assets to do so, and had to travel long distances to collect water from public sources (Farolfi et al., 2006).

Based on consumer demand, households would pay more for improved water services (Raje et al., 2002; Yang et al., 2006; Snowball et al., 2007). Similarly, a study by Nam and Son (2005) applied CVM and CM to examine consumers' preferences and WTP to improve the water service level. There is a negative relationship between WTP and the monthly water bill. For instance, in Haiti, households were willing to pay an estimated 40% of their income for a private connection if the existing water source was far away from their home; whilst households in Kenya were willing to pay an increase of about 10% if they bought water from a vendor or found it time-consuming to collect water, and an increase of approximately 2% if they bought water from a kiosk (World Bank, 1993).

In conclusion, residential customers have to pay the water bill depending on monthly water consumption. Capital is needed for maintenance and to develop new projects. Hence, this study sought to examine the WTP as well as its determinants in order to reach the best solution for upgrading water services. To do this, it examined the socioeconomic influence of residential customers' WTP for improving the water services.

3. The Methodology and Model

The Johor Water Company is the first privatised water company in Malaysia. It has the highest water tariff among states in Peninsular Malaysia because the cost of water treatment is high due to polluted rivers, among others. At the same time, there were complaints from customers regarding the water service such as water pressure, water quality and leakages that need to be fixed immediately.

This study applied cluster sampling for collecting the data. A characteristic of cluster sampling is heterogeneity among the elements within each group. Hence, there are several groups with intragroup heterogeneity and intergroup homogeneity. It is possible to carry out random sampling of the clusters or groups and obtain information from each member (Sekaran, 2003). Additionally, the most important properties of cluster sampling include the fact that the population is divided into *N* groups called clusters and samples are randomly selected from *n* clusters by the researcher. Due to budget constraints, cluster sampling is the best method (Zelin et al., 2005)

Practically, the sample sizes for conjoint studies range between 150 and 1200 respondents. Additionally, if the quantitative research does not intend to compare analysis, the sample size should be 300 respondents (Orme, 2010). By using Sawtooth Software's CBC System, the sample size should be calculated in accordance with the formula below (Johnson and Orme, 2003). Therefore, the study has 392 usable respondents. It shows that the sample is representative to present the population of active water customers in Johor.

The choice experiment method derives from random utility theory (Luce, 1959; McFadden, 1974; Thurstone,1927) and the characteristics theory of value (Lancaster, 1966). Random utility theory (RUT) is an example of a discrete choice econometric model. It makes the assumption that the individual is perfectly able to make choices which are fully informed; but also assumes that the researcher does not have all the information and consequently must take uncertainty into consideration (Manski, 1977). In choice experiment, individuals choose between different sets of (environmental) goods; these are depicted in terms of their characteristics (or "attributes") and attribute levels.

The equation of the utility represents as $U_{nj} = V_{nj} + \varepsilon_{nj}$, where ε_{nj} is the random factor. The joint density of the random factors vector $\varepsilon_n = < \varepsilon_{ni} ... \varepsilon_{nj} >$ is denoted as $f(\varepsilon_n)$. Then the probability of decision-maker n choosing alternative i can be expressed as:

$$\begin{aligned} P_{ni} &= \text{Prob}\,(U_{ni} > U_{nj}) \\ &= \text{Prob}\ (V_{ni} + \varepsilon_{ni} > V_{nj} + \varepsilon_{nj}) \\ &= \text{Prob}\ (\varepsilon_{nj} - \varepsilon_{ni} < V_{ni} - V_{nj}) \qquad (3.1) \end{aligned}$$

It is complex to predict respondents' preferences because of the random component's influence. This component allows the modelling of the choice of options in a probabilistic form: the probability that individual n will choose option i from the choice set over the other options j may be expressed as:

$$\text{Prob } (i \mid C) = \text{Prob } \{V_{in} + \varepsilon_{in} > V_{jn} + \varepsilon_{jn}, \text{all } j \in C\} \quad (3.2)$$

where C = complete choice set

To estimate an equation (3.2), it is presumed that random elements are independent and identically distributed (McFadden, 1974) and Type 1 extreme value distribution or Gumbel-distribution (Weibull). Then, the probability of choosing i can be given by:

$$\text{Prob } (i) = \frac{\exp^{\mu vi}}{\sum_{j \in C} \exp^{\mu vj}} \quad (3.3)$$

where:

μ = scale parameter. This is inversely proportional to the standard deviation of the error distribution, and typically assumed to be one.

Equation (3.3) can be calculated by means of a multinomial logit or conditional logit model (CL) that has to obey the IIA property, which means the relative probabilities of two choices is unaffected when they are either introduced into or removed from the alternatives (Ben-Akiva and Lerman, 1985).

Then, to estimate the linear-in-parameters utility function for the j^{th} alternative as follows (Blamey et al., 1999);

$$V_j = ASC_j + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ... + \beta_k X_k + \gamma_1 (S_1 * ASC_j) + ... + \gamma_p (S_p * ASC_j) \quad (3.4)$$

where:

β = a vector of coefficients

X = a vector of observable characteristics of alternative i or j

p = socioeconomic characteristics

j = alternatives in the choice set

k = attributes or factors

γ = a vector of utility values associated with a vector of individual respondent differences

Moreover, ASCs (alternative-specific constants) capture the unexplainable factors which can explain choice mean effect in the error terms for each alternative (Ben-Akiva and Lerman, 1985). Socioeconomic characteristics can be included in the model interactively with ASCs (Swallow et al., 1994). ASCs also relieve inaccuracies caused by the assumption that IIA is violated (Train, 1986).

When the parameter estimates have been obtained, the estimation of welfare can be derived from WTP, according to Hurlimann and McKay (2007) Hanemann (1984), Parsons and Kealy (1992), Alvarez-Farizo and Hanley (2002), and van der Pol and Ryan's (1996) method, which can be derived as:

$$WTP = b_y^{-1} In \left\{ \frac{\sum_i \exp(V_i^1}{\sum_i \exp(V_i^0} \right\} \qquad (3.5)$$

Equation (3.5) can be simplified as follows:

$$WTP = \frac{-b_c}{b_y}$$

where:

b_c = a coefficient of any of the attributes in the model

b_y = coefficient on price

However, if the IIA is not violated, the standard random utility model can no longer be employed. There are more complex statistical models, including the random parameters logit (Train, 1998), the nested logit (McFadden, 1981) and also the multinomial probit (Hausman and Wise, 1978). IIA may be tested via Hausman and McFadden's method (1984).

4. The Findings

Socioeconomics Characteristics

The results of the socioeconomic characteristics included gender, ethnic, age, number of children, number of persons in the household, type of house, education, current work, and income, as reported in Table 1. Male respondents comprised 59.95% of the sample and female ones 40.05%. The majority of respondents were Malay (83.93%).

Table 1: Socioeconomics Profile of Respondents (n=392)

Items	Frequency	Percentage (%)
Gender		
Male	235	59.95
Female	157	40.05
Ethnic group		
Malay	329	83.93
Chinese	48	12.24
Indian	11	2.81
Other	4	1.02
Age		
20-30 years	151	38.52
31-40 years	75	19.13
41-50 years	83	21.17
More than 51 years	83	21.17
Children		
2 children or fewer	214	55.15
3-5 children	122	31.44
6-8 children	41	10.57
More than 9 children	11	2.84
Persons in household		
2 persons or fewer	67	17.14
3-5 persons	180	46.04
6-8 persons	113	28.90
More than 8 persons	31	7.93
Type of house		
Terraced	145	36.99
Double-storey	107	27.30
Semi-detached	29	7.40
Bungalow	31	7.91
Other	80	20.41
Education		
Primary school	39	9.97
Secondary school	122	31.20
College	112	28.64
University	118	30.18
Current work		
Support staff group	106	27.11
Professional group	106	27.11
Others	179	45.78
Income per month		
RM500 or less	42	10.71
RM501-1,500	105	26.79
MR1,501-2,500	133	33.93
More than RM2,501	112	28.57

Most respondents were aged between 20 and 30 years (38.52%) followed by those 30 to 40 years old (19.13%), and the rest were above 40 years old. Most respondents had 2 children or fewer (55.15%), and the percentages of households with 3 to 5 persons and 2 persons and below were 46.04% and 17.14%, respectively. The majority of respondents lived in terraced and double-storey houses (36.99% and 27.30%, respectively). Most respondents had college or university degrees (28.64% and 30.14%, respectively); this was followed by 31.20% of respondents with secondary school education only. The majority of respondents had an income of RM1,501 to RM2,500 per month (33.93%) or more than RM2,501 per month (28.57%).

Willingness to Pay of Residential Customers

The result of main attributes and socioeconomic characteristics are presented. However, the significant variables only reported.

Table 2: CL Interaction Model, Choice 1 (WI)

	Model 1		
Parameter	*Estimate*	Approx *Pr* > ItI	*Marginal WTP*
LEA	-0.7085	0.0033*	
LEA2	0.0150	0.0020	
BUR	0.0970	0.7647	
RES	-0.0821	<0.0001*	
PRI	-0.0968	<0.0001*	
ipc5	0.7044	0.0025*	0.071
ipc6	0.4541	0.0543**	0.045
ipc7	0.6563	0.0104**	0.066
iph11	0.3024	0.0053*	0.031
iph12	0.3630	0.0039*	0.037
Number of observations	1568		
Log likelihood	-1245		
McFadden's LRI	**0.2771 R/U**		

Notes: *significant at 1%; **significant at 5%
ipc5; interaction between BUR and customers with 2 children or fewer, ipc6; interaction between BUR and customers with 3 to 5 children, ipc7; interaction between BUR and customers with 6 to 8 children, iph11; interaction between BUR and customers living in terraced houses, iph12; interaction between BUR and customers living in two-storey houses.

In Table 2, Model 1 describes the interaction between BUR and SE. Both LEA and PRI remain with their correct signs and are significant at the 1% level. Additionally, BUR has the correct sign as well, but it is not statistically significant. RES remains unchanged with a negative rather than positive sign as expected. The results reveal that BUR has an interaction with number of children and type of house (ipc5, ipc6, ipc7, iph11, iph12). However, the coefficients are higher and have significant values which are also similar between the 1% and 5% levels as well.

Table 3: CL Interaction Model, Choice 2 (RC)

	Model 2			Model 3		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
QUA	-2.3027	0.7040		-2.0931	0.0608**	
DIS	-10.9807	0.1531		-7.3509	0.3401	
DIS2	3.1035	0.1415		1.5516	0.4659	
CON	-0.6496	<0.0001*		-0.6711	<0.0001*	
PRE	0.0330	0.2549		0.0342	0.2455	
PRI	-0.1095	<0.0001*		-0.1065	<0.0001*	
iqg	2.1798	0.0718**	0.195			
iqa4	8.5358	<0.0001*	0.764			
id2g				-0.0726	0.0393**	0.006
id2a4				-0.2802	<0.0001*	0.026
Number of observations	1568			1568		
Log likelihood	-1342			-1285		
McFadden's LRI	**0.221 R/U**			**0.256 R/U**		

	Model 4			Model 5		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
QUA	-1.0993	0.3354		-1.8201	0.0945	
DIS	-7.3755	0.3477		-7.0115	0.3580	
DIS2	2.1005	0.3301		2.0106	0.3371	
CON	-2.2784	<0.0001*		-0.6676	<0.0001*	
PRE	0.0459	0.1248		0.2793	0.1862	
PRI	-0.1173	<0.0001*		-0.1091	<0.0001*	
icg	-0.2585	0.0125***	0.056			
ica4	-0.6662	<0.0001*	0.021			
ipg				0.1280	0.0024*	0.021
ipa4				0.2310	<0.0001*	0.011
Number of observations	1568			1568		
Log likelihood	-1288			-1279		
McFadden's LRI	**0.2522 R/U**			**0.2573 R/U**		

	Model 6		
Parameter	*Estimate*	*Approx Pr > |t|*	*Marginal WTP*
QUA	-1.4581	0.1866	
DIS	-6.7877	0.3773	
DIS2	1.9161	0.3643	
CON	-0.4906	<0.0001*	
PRE	0.0202	0.4943	
PRI	-0.1590	0.0349**	
irp8	-0.1871	0.0006*	0.012
irp9	-0.2017	0.0003*	0.012
irp10	-0.2265	0.0063*	0.014
iri21	-0.1282	0.0102**	0.007
iri22	-0.1514	0.0352**	0.009
Number of observations	1568		
Log likelihood	-1338		
McFadden's LRI	**0.2231 R/U**		

Notes: *significant at 1%; **significant at 5%; ***significant at 10%
iqg; interaction between QUA and customers' gender, iqa4; interaction between QUA and customers' age, ica4; interaction between CON and customers' age, icg; interaction between CON and customers' gender, id2g; interaction between DIS2 and customers' gender, iqa4; interaction between QUA and customers' age, id2a4; ipa4; interaction between PRE and customers' age, id2a4 Interaction between DIS2 and customers' age, interaction between DIS2 and customers' age, irp8; interaction between PRI and customers with 2 persons or fewer in the household, irp9; interaction between PRI and customers with 3 to 5 persons in the household, irp10; interaction between PRI and customers with 6 to 8 persons in the household, iri21; interaction between PRI and customers with a monthly income between MYR500 and MYR1500, iri22; interaction between PRI and customers with a monthly income between MYR1501 and MYR2500.

The MWTP is between RM0.031 to RM0.071 for each percentage point increase of improvement in repairing pipe bursts within 24 hours. The highest WTP is RM0.071 by customer with 2 children or fewer (ipc5), followed by the groups with 6 to 8 children (ipc6), and 3 to 5 children (ipc5), with MWTP estimated at RM0.066 and RM0.045 respectively. Moreover, the MWTP of customers who live in terraced houses (iph11) and two-storey houses (iph12) are RM0.031 and RM0.037 respectively. These trends show that WTP definitely depends on the purchasing power of customers, whether with a lower or higher monthly expenditure.

Table 3 describes the linear term interaction between Residential Customers (RC) and socioeconomics (SE). Model 2 shows the interaction between QUA and SE. The results demonstrate that DIS, CON, PRE and PRI have the correct sign according to expectations and that CON and PRI are highly significant at the 1% level, whilst DIS and PRE are not statistically significant. QUA remains unchanged with a negative rather than positive sign. However, QUA has a relationship with gender and age (iqg, iqa4). These variables are significant at the 5% and 1% levels respectively. The MWTP of female respondents (iqg) and customers aged 41 to 50 years old (iqa4) are RM0.19 and RM0.76 for each percentage point of improvement to water quality and compliance with the MOH

Standards. These values are the highest MWTP amongst all the models. The results also indicate that their concern about water quality is a top priority of these customers' perception of a better service provision.

Model 3 includes a non-linear term for DIS in the RC choice experiment. The inclusion of a non-linear term for DIS, i.e. DIS2, results in DIS having the correct sign, but it is not statistically significant. Three variables, namely CON, PRE and PRI, have the correct sign as expected *a priori*. Variables CON and PRI are significant at the 1% level, whilst variable PRE is insignificant. The results show that DIS2 has interaction between gender and age (id2g, id2a4). These groups are highly statistically significant at the 5% and 1% levels respectively. The MWTP for gender (id2g) and the age group between 41 to 50 years old (id2a4) are RM0.0066 and RM0.026 for each percentage point in reducing disruption to the water supply. The results reveal that customers' WTP is at a certain amount in order to avoid disruption and to ensure the daily routine runs properly.

Furthermore, Model 4 reports the interaction between CON and SE. The results reveal that DIS, CON, PRE, and PRI have a correct sign as expected *a priori*. However, DIS and PRE are not statistically significant as in the previous model. CON and PRI remain constant, highly significant at the 1% level. There are interactions with the gender and age variables (icg, ica4) as well and these are significant at the 1% and 10% levels respectively. The MWTP of gender (icg) and the age group between 41 to 50 years old (ica4) is approximately RM0.056 and RM0.021 respectively. This means that the time taken for the connection of the water supply is an important criterion for good service by SAJH. Customers are willing to pay a certain amount for each percentage point of reduction of the time taken for connection, either for a reconnection following an overdue payment or for a connection to new premises. This is because a long period taken to connect the water supply will affect daily activities.

Model 5 shows the interaction between PRI and SE. All variables except QUA have the correct sign as expected *a priori*. However, DIS and PRE are not statistically significant. CON and PRI are highly significant at the 1% level. In interaction terms, PRI shows a relationship with the number of persons in the household, and income (irp8, irp9, irp10, iri21, iri22). Both groups – number of persons in the household (irp8, irp9 and irp10) and income (iri21, iri22) – are significant at the 1% and 5% levels respectively. The results reveal that the MWTP of customers where the number of persons in the household (irp8, irp9, irp10) range from RM0.012 to RM0.014 for each percentage point increase in the water tariff or monthly water bill. Moreover, the MWTP of those with an income of between RM501 and RM1500 (iri21) and between RM1501 and RM2500 (iri22) are RM0.0079 and RM0.0093 respectively. These values indicate that customers with a higher income are willing to pay more than those with a lower one.

In conclusion, under the WI, customers' WTP is higher for repairs to pipe bursts within 24 hours rather than leakage (LEA) and reservoir capacity (RES). This means that BUR is the priority attribute of Water Infrastructure (WI) and this should be taken into consideration when upgrading residential customers' service.

The second choice model (RC) has interaction with gender, age, number of persons in the household, and income. The interaction between the main variables and SE indicates that QUA, DIS, CON, PRE have a relationship with gender (iqg, id2g, icg, ipg) and age (iqa4, id2a4, ica4, ipa4). PRI has interaction with the number of persons in the household (irp8, irp9, irp10) and income (iri21, iri22).

Furthermore, the amount of MWTP varies, depending on the main attributes and socioeconomic (SE) characteristics. These demonstrate that customers' WTP is influenced directly by purchasing power. For instance, the more educated group is willing to pay more than the lower educated group. Probably the most important factor is customers' income level: the group with a higher income has a greater WTP compared to those with lower income levels. These groups of customers are also more concerned about the water service and environment. The MWTP for each attribute illustrates that customers' WTP is high in order to improve the water service and enjoy safe and clean water, particularly for repairs to pipe bursts (BUR). As a result, in order to achieve an excellent water supply service, SAJH need to concentrate on these attributes when implementing relevant policy to upgrade or improve the service. The findings support the hypothesis that socioeconomic characteristics influenced the WTP of residential customers.

5. Summary and Conclusions

This research employs CM for estimation of water resource attributes. The two groups of attributes are Water Infrastructure (WI) and Residential Customers (RC). WI comprises leakage (LEA), pipe bursts (BUR), and reservoir capacity (RES). RC consists of water quality (QUA), service disruptions (DIS), service connections (CON), and water pressure (PRE). The important factors were identified that influenced the demand; BUR, QUA, DIS, CON, and PRICE.

Furthermore, socioeconomics namely, gender, age, number of persons in households and income are important factors affecting WTP for improving the water supply. This result is similar with the previous study conducted by Wold Bank in 1993. Surprisingly, male respondents have more concern about water quality, disruption, connection and pressure, due to being the head of the family and therefore responsible to pay the water bill each month. Also, the older age group are concerned about the achievement of better delivery of service to customers, particularly about water quality, disruption, connection, and pressure, because they have experienced the history of SAJH and its transformation from state water company to privatized company. Furthermore, attitudes to increases in price have been influenced by the number of persons in the household and income level. These findings indicated the determinants of WTP for improving water service which was the pioneer study in developing country, particularly in Malaysia. It is so meaningful result for researchers to develop a comparison study between developing country and developed country.

The findings of this study have several implications for improving the cost recovery of SAJH. Specifically, in terms of strategy, SAJH needs to upgrade its strategy intensively in the areas of water quality (QUA) and price (PRI). Furthermore, water management could use such information to refine and segment the market in order to deliver differentiated service levels at different prices, with benefit to all customers (Sansom et al., 2000). In other words, customers might be offered different levels of water tariff based on the quality of water service. The segmentation of the market is also important to develop promotions and strategies that focus on customers' preferences and needs. By means of this strategy, the water operator can be customer-focused and achieve success in water service (Slater and Narver, 1994).

Interestingly, CM presents detailed information about customers' preferences and their WTP for different water attributes. This data is crucial for water providers to deliver water service at a reasonable price based on the customer's demand. As a result, the assessment of customers' preferences towards the SAJH water attributes is very important to the policymaker to ensure that water resources are managed efficiently and sustainably.

Due to the time constraint and limited budget, this study focused on the residential customer in three districts in Johor, namely Batu Pahat, Kluang and Johor Bharu. However, the selection of sample fulfilled the issue that experienced by the residential customers. The results are representative for the Johor state. This study also the pioneer in the water service which to determine the attributes of water service employed the Choice Modelling (CM) in order to improve the performance of water operators.

In the future, studies that involve different water providers will present a different attributes and levels. Therefore, a suitable focus group between water operators as well as stakeholders should determine appropriate attributes and levels. By using this method, detailed information can be provided to achieve better results, which will be more statistically significant. The knowledge of WTP and the its determinant for better services can be enhanced in water supply sectors.

In Malaysia, water providers are controlled by SPAN as a technical and economic regulator. Therefore, water providers must follow the rules and regulations in order to performance the operation of water supply. For instance, the most important example in this study is the price or monthly bill; water operators could not make a decision to change the price immediately without getting approval from SPAN. Therefore, in the future, SPAN should cooperate in management and make effective decisions in a shorter timeframe.

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