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Estimating Willingness-to-Pay Values to Improve the PDAM Clean Water in Surabaya

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Abstract. Clean water plays an important role in every activity of mankind—in household, commercial, industrial, as well as public and social sectors. As the second biggest city after Jakarta, Surabaya faces a fundamental issue of basic needs, which is the poor quality of clean water for domestic use. Polluted water due to contaminants has been a daily issue in Surabaya. Therefore, the aim of this research is to estimate the economic value of clean water accrued to households in Surabaya city, the capital of East Java Province in Indonesia. The economic valuation was carried out by determining households' willingness to pay for improved water quality and reliability of supply through the Contingent Valuation technique. The valuation is limited to urban households in this context is PDAM customer. This paper results the aggregate value of water quality and reliability improvements have been substantial such that it warrants PDAM to improve the quality of pertinent services. However, such provision will be contingent on a further cost-benefit valuation based on its affordability of supply relative to demand.

Keywords: Demand for clean water, economic valuation, contingent valuation method

I. Introduction

Background of the study

Clean water plays an important role in every activity of mankind—in household, commercial, industrial, as well as public and social sectors. According to Lange and Hassan (2006) [1], household sectors use clean water as a final good to fulfill physiological needs such as drinking, washing, bathing, etc. Meanwhile, commercial and industrial sectors treat clean water as an intermediate input to perform business activities and to produce outputs. In addition to the use of clean water for the purposes of cultural services, including recreational, social, and religious activities. Considering the importance of clean water, it is valued highly by all mankind.

Households heavily depend on clean water, particularly due to the risks imposed by its inferiority and scarcity. Lack of water in human body or dehydration will lead to many illnesses—including kidney and bladder stone, or urolithiasis—even worse, losing body fluids as much as 15% of body weight will cause mortality [2]. Based on its degree of importance, water comes as the second most important thing for human beings after the oxygen we breathe. We can only last for several minutes without oxygen, and for several days without water. From the aspect of water quality, various studies concluded that contaminated water will lead to various diseases, specifically waterborne diseases such as diarrhea. Hence, the obtain ability of clean water remains a crucial indicator for the level of public health and sanitation [3].

The sources of clean water for most households in Indonesia include groundwater wells and tap water provided by Perusahaan Daerah Air Minum or PDAM (State Company for Water Utilities). The result of 2010's Riset Kesehatan Dasar or RISKESDAS (Basic Health Research) suggested that Indonesian households utilized water from: groundwater wells (27.9%); artesian wells (22.2%); PDAM tap water (19.5%); and other sources [4]. On national scale, households access to clean water has reached 80% in 2009 [4], which has exceeded the aim of MDGs (Millenium Development Goals) 68.87% that was needed to be reached by 2015 [4].

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Surabaya is the second-largest city after the state capital Jakarta. The population of the city has reached 2.8 million people according to th 2010's census [5]. Almost 73% of total demand for clean water in the city is supplied by PDAM tap water (subscribed) which is managed by PDAM Surya Sembada of Surabaya. Although the city has accomplished MDGs' target, PDAM Surabaya is targeting service coverage of 80% by 2015 [6].

Similar to the phenomena in other major cities in developing countries, PDAM tap water provision in Surabaya also faces challenges such as water quality and reliability. Based on her sampling on Surabaya's households, Hidayati (2002) [7] found that: (1) nearly 41% of sampled households did not use PDAM tap water as their drinking water because 80% refer to the quality (it has taste, color, and odor) and eight percent refer to the reliability (intermittent water supply/pressure); (2) around 33% from 59% households use PDAM tap water as their drinking water after they purify it first; and (3) almost 80% households buy bottled mineral water for drinking.

The primary challenge faced by PDAM for expanding its service coverage and to improve its water quality and reliability are limited funding. Currently, PDAM Surabaya must spend a massive operational cost, particularly for acquiring bulk water, 96% of which come from Kali Surabaya that is heavily polluted. On the other hand, PDAM is responsible for the production of water with drinkable quality as regulated by the Regulation of Minister of Health Number 492 in 2010 [8]. Regarding the Requirements of Drinking Water. The circumstance becomes a dilemma as PDAM serves two purposes that is to improve public welfare by providing standardized drinking water and to seek profit as any other business establishments [9].

A research on the estimated economic value of clean water from the demand aspect of the foundation for the improvement of clean water provision in Indonesia is still rarely conducted, one of which was the research conducted by Hidayati (2002) [7] regarding the economic value of clean water in Surabaya, and the objective of the study was to estimate Willingness to Pay (WTP) in order to improve the quality of PDAM tap water. The study, however, had several limitations. First, the estimation was only based on quality aspect and excluding reliability. Second, the method being used was only a direct approach, hence unable to validate the estimation.

The objective of the study

Hence, the problems to be discussed in this research about households' willingness to pay for better clean water quality and reliability include:

a. Will households be willing to pay for improvements on the quality and reliability of clean water?

b. How much would the willingness to pay for improvements on the quality and reliability of clean water be worth?

c. Which factors that affect the willingness to pay for improvements on the quality and reliability of clean water?

Contribution of the study

The results of the study required as supporting any policy or strategy to improve public welfare in terms of water quality and reliability, as well as improvement on coverage within the limitation funding. For PDAM Surabaya, the result will benefit them in conducting cost – benefit analysis regarding their expansion plan in tap water provision as suggested by Millennium Development Goals (MDGs).

So that this condition needs to be followed by good management, and a set of policies based on the willingness to pay in order to have better improvement. The lack of proper planning or policy will make the Regulation of Minister of Health regarding the requirements of PDAM water is just only a regulation without enforcement.

II. Literature Review

Economic Valuation

Nowadays, various methods of valuation for natural and environmental resources have been developed and experts have classified them into different categories according to their purposes and observed problems [10]. The Asian Development Bank (1996) [11] placed them into two major categories, namely: (1) primary methods, which is conducted by collecting and analyzing field data; and (2) secondary method, using results from previous studies by adjusting parameters to capture characteristic differences of research locations and social-economy.

Primary economic valuation methods are more recommended than secondary for several reasons, including: (1) primary methods can provide better result with the lower uncertainty level; (2) primary methods are the foundation for implementing secondary methods; (3) previous studies on the basis of secondary methods are not always available. Secondary methods consist of benefit transfer and cost transfer, which usually are used to circumvent limited resources, particularly data, time, and funding.

Basically, primary economic valuation methods can be categorized into three groups, namely (1) market price methods; (2) revealed preference approach – RP; (3) stated preference approach – SP or expressed preference – EP [12]. The market price methods are used to measure marketed environmental goods or services. Should the market be in a state of perfect competition without any distortion, then the market price is an efficient price that reflects true the economic value. However in the real world, such a market never exists, which means market price is actually a distorted price. In a given condition, economic value can be approximated using a shadow price as a proxy, of which can be measured using RP or SP approach.

Should the market price is unavailable, then economic valuation can be performed through two approaches. First, by observing individual behaviors on the market of goods or services which has direct proxy – actual market, or indirectly – surrogate market, with the environment. Second, should there be no proxy, then the economic valuation can be achieved through direct questions to individuals regarding WTP for such environmental goods or services. As the economic value (WTP) is directly expressed, then the second approach is commonly known as a stated preferential approach – stated preference (SP) or direct approach. In contrast to the first approach which is called revealed preference (RP) or indirect approach.

The RP approach has several optional methods whether cost-based methods or benefit-based methods [13]. Furthermore, the SP approach consists of two methods that are contingent valuation (CV) and choice modeling (CM). The choice of deployed valuation method is based on many factors, particularly the availability of data, time, funding, and research expertise [14]. Estimated value is very sensitive toward different assumptions and approaches, which frequently lead to different values [1]. Moreover, environmental issues tend to be site specific, which means they differ from site to site due to differences in natural characteristics and social economic conditions.

1.1. Economic Valuation Methods for Clean Water with CVM

Clean water is a unique commodity with two characteristics that inhibit perfectly competitive market. First, clean water is a necessity for survival, hence it is invaluable. Second, the characteristic of clean water supply is a natural monopoly due to massive cost of clean water provision that hinders economic scale. Another hindrance to clean water market is market distortion caused by interventions from the government, especially subsidies for underprivileged people.

Contingent valuation (CV) is the most popular method from SP approach and consequently the most used method to measure non-traded environmental goods. These types of goods or services incorporate public goods such as clean air and historical sites, and non-market goods such as recreation, air quality, and acoustic biodiversity [11; 1; 15] Experts and several studies concluded that CV method is a reliable tool to estimate use value and the only method for the economic valuation of non-use value [11]. The application of CV method, to a greater extent, has been spreading to non-environmental studies, including health studies, marketing, and so on [15].

How CV method works is through creating a hypothetical market scenario for certain goods or services, prior to requesting individuals to mention the amount, they are willing to pay for such goods or services. Ergo, it is titled contingent (uncertain/provisional) valuation due to its estimated economic values depends on given hypothetical circumstances/scenarios [15; 16]. This method is also frequently named as hypothetical valuation [17]. Additionally, since this CV method always makes direct inquiry regarding WTP, it earns its status as the WTP study. Actually, both terms differ from one another because WTP is a concept referring to the economic value of certain goods or services, while CV is a survey-based method for estimating a WTP value [18].

The implementation of CV method was first conducted in early 1960s by Davis (1963) for measuring the benefit of recreational activities [19]. In 1960 to 1970, researchers applied CV method on cases of air pollution and water quality improvement. Whittington (1988) is a pioneer in implementing CV method in a case of clean water provision in developing countries and followed by a manual for implementing CV method which was written by Mitchell and Carson in 1989 [18].

Hypothetical bias is a basic nature or characteristic of CV study and reducible by developing survey instruments, careful implementation at the field, and meticulous application of econometric analysis. On the other hand, measurement bias usually occurs on non-use value estimation; while use value estimation, for instance, in a case of clean water provision and sanitation, is relatively unobservable. Its development in the last fifty years suggested that the CV method has been significantly progressing in providing better explanation regarding consumer preference. This fact is correlated with the advancement in econometric analysis, survey research method, designs of experiments and samplings, and policy implementation [18].

New evidences that have been found proved that the predictions of CV scenario and actual behaviours are relatively similar for the cases of clean water provision and sanitation [18]. Dixon, et al. (1988) [17] argued that despite the fact that CV has many limitations, but this method is still the best tool to measure the impact of environmental changes to social welfare. Although there were inaccurate estimations on several cases, but the CV method was able to estimate the order of magnitude that can be used for decision making [17].

In CV method, there are several formats to obtain WTP value (elicitation methods), including open-ended, bidding game, payment card, and dichotomous choice. Tiltness (1988) [20] opted for naming the first method as a continuous method, while the other three are collectively called as discrete methods. Other researchers usually grouped the last three methods as closed-ended or referendum, as respondents should choose value options, not express values as in an open-ended format. NOAA panel recommended referendum format as a suitable technique to obtain WTP value in a CV study [21].

First, open-ended. Respondents are requested to mention their WTPs for certain hypothetical conditions/scenarios. This format is very simple and does not require any econometric model to analyse the results because the average WTP can be descriptively estimated through a simple arithmetic equation. This format is intended to prevent starting point bias, but may potentially cause a lot of problems, including: low responses particularly for less known goods or services, zero or protest answers, outlier outcomes, and possibly lower WTP than the actual WTP due to strategic bias. For those reasons, this open-ended format is rarely being used in a CV study [11, 12, 14].

Second, bidding game. This oldest and most-used format works similar to an auction, in which respondents are inquired regarding WTP and the inquiry then is being repeated by altering WTP value until they refuse to pay. The initial bid can be started at a minimum value and then escalated to a maximum. Alternatively, the bidding process can be reversed, by starting with the highest value and progressing to the lowest [15]. In practice, an open-ended question is frequently used after the refusal of the last WTP offer [12, 14]. The advantage of bidding game is the availability of thinking time for respondents, but its disadvantage is the obtained WTP value is very sensitive to the initial bidding which may give rise to starting point bias [18].

Third, payment card or ladder approach. This format requires respondents to express their WTP values using a visual aid of payment cards. These payment cards usually display a benchmark that links a value with an actual household or tax-related expenditure. The payment card format can solve problems outlier and starting-point bias that usually occur in open-ended and bidding game techniques, but may be embedded with value-cue bias in setting the value range and benchmark reference for the payment cards [22]. Open-ended questions are frequently asked when respondents do not provide answers within the given range [14].

Fourth, dichotomous choice, or commonly known as take it or leave it [17, 11, 12, and 14]. Respondents are given binary choices, that are a status quo and an alternative condition with a consequence of the certain amount of payment. Generally, respondents are divided into sub-groups with similar questions but different set of payments. Possible answers for all respondents are "yes" or "no" for alternative conditions. These answers do not directly reflect WTP value and to estimate the average value of WTP, it takes an econometric model under the assumption of strict statistical distribution. Regardless of lack of gathered information, this format can prevent starting-point and strategic biases that happen on open-ended and bidding game [14]. Additionally, the hypothetical situation/scenarios being given are constructed to be closely similar to tha actual market, enabling respondents to understand it quickly.

A multivariate regression model is an analytical tool that is commonly utilized to estimate WTP value under CV method. The selection of relevant models depends on the estimation technique of WTP, while the referendum format that produces binary data (yes/no) utilizes probit or logit model. The formation and analysis of regression mode are based on the theories of economy and hypotheses of researchers regarding the correlation between WTP with social-economic characteristics, water consumption patterns, and preferences.

Gunatilake, et al., (2007) [18] inventoried several independent variables that can be used to estimate WTP on the provision of clean water and sanitation, namely: (1) price rate (monthly bill); (2) characteristics in CV scenarios such as piping cost, service level, dummy variables for privileged and underprivileged people, geographical area, etc.; (3) water source characteristics such as the number of accessible and usable source of water, water price, the proximity of water source from users' houses, perceptions of water quality; (4) household characteristics such as income or wealth, educational background, medical history, occupation, family size, ethnicity, religion, gender, age, etc.; and (5) locally-specific variables. Several researchers considered other variables to be relevant, including: the presence of small children in the family [23]; wealth (measurable through indexes of house ownership statuses, house structures, monthly expenses, and house facilities) and household awareness (measurable through indicators of educational background, mass media access, and diarrhea-contraction experience) [24]; as well as house ownership status and sanitation facilities [25].

III. Methodology

The type of this research is a survey on the field (field research). The approach being used is quantitative, emphasizing on the analysis of numerical data or quantified facts. These data take shape in the form of operational variables under certain scales of measurements. For the quantitative approach, the use of statistical method is very dominant in describing the research results, figuring out the connections between variables, testing the validity of the theories being referred to, as well as estimating and forecasting based on the parameters on the research results.

Data Source

A quantitative approach uses deductive reasoning, that is a research is preceded by referring to established theories, followed by observational results of empirical data are being used to confirm or test the theories. This approach also uses positivistic paradigm that emphasizes on the combination of numerical data and deductive reasoning and the use of quantitative tools in "objectively" interpreting a phenomenon [26].

The sampling size of this research is decided using the following formula [27]:

$$n = \frac{NZ^2PQ}{d^2(N-1)+Z^2PQ} \tag{1}$$

where: n is the sample size; N is the population; Z is the statistical value of the level of significance; P is the variation of population; Q is (1-P); and d is tolerable error. On this research, the level of significance (α) is 5%; while Z is 1.96, P is 0.5, and d is 5%. Based on the formula (3), the sampling size for a population of 806,794 people is at least 401 PDAM subscribing households.

Contingent Valuation Estimation

In a closed-end format or a 'referendum,' WTP value cannot be obtained directly, but through an estimation using a multivariate statistical method. A suitable statistical method for the binary choice ("yes"/"no") data is logistic regression. The WTP estimation using logistic regression model is formulated into the following equation [28]:

$$Y_i = ln\left(\frac{P_i}{1-P_i}\right) = \beta_o + \beta_1 X_{1i} + \mu_i \tag{2}$$

where: Y is the log natural of odd ration; Pi is the probability of household's willingness to pay; (1-Pi) is the probability of household's unwillingness to pay; Xi is the bidding price; βo is a constant, β_1 is a coefficientof the bidding price; and u is the *error term*.

Arithmetically, the mean of WTP value is directly uncountable, and it must be estimated through the formula below [18, 29]:

$$MeanWTP = \left(\frac{\beta_0}{\beta_1}\right) \tag{3}$$

The WTP value is stated in Rupiah per month. The valuation of aggregate WTP is performed through the multiplication of mean WTP value from the equation (3) with the number of households who are willing to pay. Households' willingness to pay is influenced by many factors that can be classified into: (1) clean water characteristics (W); and (2) household characteristics which include economic (E) and demographic (D) aspects. The correlation between WTP with these factors is examined through a multivariate regression model as follows [29, 3, 30]

$$WTP_i = \beta_0 + \beta_1(W_i) + \beta_2(E_i) + \beta_3(D_i) + \mu_i \quad (4)$$

Table 1. CVM Variables and Operational Definitions

Characteristics	Variables	Operational Definitions and Measurements
A. Clean Water (W)	1. Clean water source (X_1)	Household ownership toward other sources of clean water for daily use. The variable measurement is done qualitatively using a dummy, that is "1: if they have other sources and "0" if not
	2. Perception toward water quality (X_2)	Household assessment toward water quality, measured with a rating scale from 0 to 10, where 0 is the worst and 10 is the best.
	3. Water Reliability (X_3)	Household assessment toward water reliability. The variable measurement is done qualitatively using a dummy, that is "1: if PDAM Water can flow into the house 24 hours and "0" if not
	4. Perception toward clean water services (X_4)	Household assessment toward clean water services, measured using a 0-to-10 rating scale, where 0 is the worst and 10 is the best
	5. Clean water application (X_5)	Household application of clean water from its primary source. The variable measurement is done qualitatively using a dummy, that is "1: if they use it for drinking and "0" if others
B. Household		
1. Economy (E)	1. Income (X_6)	The amount of total income from all household members in a month, stated in Rupiah

	2. Wealth (X_7)	The ownership of household welfare, which is measured by a proxy of house ownership status. The variable measurement is done qualitatively using a dummy, that is "1" if the house is owned, and "0" if others.
	3. Clean water consumption (X_8)	The amount of household expenditures for clean water consumption each month, stated in Rupiah. For PDAM customers, the amount is measured from the mean of monthly bills.
2. Demography (D)	1. Age (X_9)	The length of time spent living, stated in years which refer to respondents' dates of birth.
	2. Gender (X_{10})	Respondents' gender according to their ID cards (KTP), which is measured is qualitatively using a dummy, that is "1: for male and "0" for female.
	3. Education (X_{11})	The most recent formal education, which is measured is qualitatively using a dummy, that is "1: for graduate or post-graduate degree and "0" for others
	4. Family members (X_{12})	The number of people living in the house with the respondent, stated in person
	5. Children underfive years old (X_{13})	The number of family members who has children under five years old, stated in person.

According to Gunatilake, et al., (2006) [18], the validity of CV method can be achieved using two methods, namely: convergent validity and construct validity. In general, the convergent validity refers to temporal stability or consistency of WTP estimation. One of the testing methods is by comparing WTP estimation with the estimation value resulted from revealed preference. In this research, the WTP estimation will be compared using the coping cost method. Alternatively, the construct validity refers to how well WTP can be explained by theoretically-established factors. If in a regression model the statistically-clarifying variables are significantly related to WTP, then CV method is considered valid. The correlations include (1) positive for income, water consumption, and education; and (2) negative for bid price an age. While for other variables, the correlation is specific [18].

IV. Results and Findings

Socio-economic profile of the PDAM Customers

The profile of respondents is shown in Table 2. The majority of respondents are female (71.82 percent). PDAM customers have a high level of education. About 17.96 percent only has a basic education level or elementary school while the other around 18.20 percent have completed the junior high or secondary education level and 48.38 percent have completed senior high education. Only 12.47 percent of respondents have completed college level (Diploma, Bachelor and Postgraduate). In terms of job profile, the majority of respondents interviewed were housewives or homemaker (44.39 percent) while 32.17 percent worked as entrepreneurs and self-employed. Based on interviews with respondents, 90 percent said they were married.

In terms of income, the average monthly income is approximately IDR 2,450,150, - per month, where 68.08 percent earn between IDR 1million-Rp3million. Households that earn under IDR 1 million are 6.73 percent and above IDR 3 million is 25.19 percent. Surabaya PDAM's water payments are around 49.38 percent between IDR 10,000, - per month up to IDR 50,000 per month, while payments between IDR 50,001 – IDR 200,000, - per month around 45.14 percent, while those who pay above IDR 200,000 as much as 5.23 percent. The PDAM tariff group for household consumers is divided into 6 groups, namely II, IV, VI, VII and VIII. Based on interviews, the majority of tariff groups fall in group IV, followed by group tariff of VII and VIII. The last two groups are group II and VI tariffs.

Table 2. Socio-Economic Characteristics of PDAM Customer

Characteristics		Frequency	Percentage
Gender			
1)	Female	228	71,82
2)	Male	113	28,18
Educational Background			
1)	Not Attending	12	2,99
2)	Elementary	72	17,96
3)	Junior High	73	18,20
4)	Senior High	194	48,38
5)	Diploma	12	2,99
6)	Bachelor	37	9,23
7)	Post-Graduate	1	0,25
Occupation			
1)	Civil Servant	6	1,5
2)	Employee	35	8,73
3)	State Owned Enterprise	0	0
4)	Army/Police	1	0,25
5)	Self-Employed	129	32,17
6)	Labour	13	3,24
7)	Retiree	18	4,49
8)	Homemaker	178	44,39

9)	Other	21	5,24
Income			
1)	Under Rp1million	27	6,73
2)	Rp1million-Rp3million	273	68,08
3)	Above Rp3million	101	25,19
Expenditure of PDAM per month			
1)	Under Rp10thousand	1	0,25
2)	Rp10thousand-Rp 50thousand	198	49,38
3)	Rp50thousand-Rp. 200thousand	181	45,14
4)	Above Rp200thousand	21	5,23
PDAM Tariff			
	II	51	12,72
	IV	175	43,64
	VI	15	3,74
	VII	98	24,44
	VIII	62	15,46

Source: Field Survey.

The willingness to pay of PDAM customers can be summarized under two conditions, that is: (a) water quality improvement (clarity, odorless, tasteless, and colorless); (b) improvement on reliability (strong and steady flow for 24 hours). The survey revealed that the respondents who were willing to pay more than current rate in correlation with water quality improvement is 63.34%, while the other 36.66% were unwilling to pay more. Respondents who were willing to pay more than current rate for improvement on reliability reached 57.86%, while the other 42.14% were unwilling to pay more.

Table 3. The Classification of Willingness to Pay for Better Quality and Reliability

Willingness to pay	Better Quality	Better Reliability
Yes	63.34	57.86
No	36.66	42.14

Source: Field Survey.

These are the reasons given by PDAM customer respondents for their unwillingness to pay better water quality for more than current rate, including: (1) current rate is high; (2) unable to pay more; (3) familiarity with current condition; and (4) current water provision is sufficient. On the other hand, the reasons given by those who were willing to pay more for better water quality include: (1) expectation for better provision of clean water; (2) concerns over possible health issues caused by current water condition; and (3) current rate is still lower than it should. For water reliability improvement, those who were unwillingness to pay more than current rate reasoned that: (1) they are already familiar with current condition; (2) current clean water provision is sufficient; (3) unable to afford higher rate; and (4) current rate is already steep.

Economic Valuation: CVM Estimation for Better Quality and Reliability

Based on equation (2) and (3), in which logistic regression analysis, then the mean of WTP for better quality is IDR 114,023.97, - per month. Estimated values are shown on Table 3. the aggregate WTP is obtained through multiplying the mean of WTP with the number of households who were willing to pay more for better water quality, that is 63.43% of 806,794 households or 511,749 households, then the aggregate WTP approximately IDR 58,351,702,132.74.- (It is considered as the Total Economic Value (TEV) of clean water in regard to PDAM water quality based on non-parametric approach. Meanwhile, the mean of WTP for better reliability is IDR 204,738.13, - per month and TEV clean water in regard to PDAM improvement water reliability approximately IDR 95,574,012,923.23, -.

Table 4. Logistic Regression for WTP

Willingness to Pay More for Better Quality				
Variable	Coefficient	Std. Error	z stat	p-value
Constant	0.137969	0.1379691	1.19	0.002
WTP	0.00000121	1.21e-06	3.16	0.235
Number of obs		401		
LR chi2(1)		1.49		
Prob > chi2		0.2216		
Pseudo R2		0.0028		
Willingness to Pay More for Better Reliability				
Variable	Coefficient	Std. Error	z stat	p-value
Constant	0.2293067	0.1321608	1.74	0.083
WTP	0.00000112	1.10e-06	1.01	0.311
Number of obs		401		
LR chi2(1)		1.08		
Prob > chi2		0.2998		
Pseudo R2		0.0020		

The willingness of households to pay is greatly affected by these factors: (1) clean water characteristics (W); (2) characteristics of households in terms of economic aspects (E) and demographic aspects (D). Clean water characteristics comprise of four indicators, namely: sources of clean water, perception on PDAM water quality, perception on PDAM water reliability, perception on PDAM clean water services, and PDAM water consumption for drinking and cooking purposes.

The economic characteristics of households include household income, house ownership, and monthly expenditure or cost for consuming PDAM water. Lastly, the demographic characteristics of households cover age, gender, educational backgrounds, the number of family members, and the number children under five years old. There seems to be no close correlation between factors that will be analysed using multivariate regression.

Partially, significant factors that affect willingness to pay for better quality are the perception of PDAM water quality, clean water application, age, and family members. We can look at the p-value of those variables. This condition is rather contrast to the model of willingness to pay for reliability improvement, which is affected by water quality perception, water reliability, PDAM services, wealth, and family members.

In the model of willingness to pay for quality and reliability improvement, significant variables include perception toward PDAM water quality and household expenditure for water consumption (significant at one percent level of confidence), PDAM services and drinking PDAM water (at a level of confidence of five percent). Simultaneously, all independent variables affected dependent variables in a significant level on all models being analysed, both of quality and reliability improvement; where the value of Chi Squared probability is below one percent.

Table 5. Determinants of WTP for Better Quality and Reliability

Variables	**Willingness To Pay for Better Quality**		**Willingness To Pay for Better Reliability**	
	Coefficients	p-value	Coefficients	p-value
Constant	3.59390100	0.003***	2.777939	0.025**
Other Sources of Water	0.263938	0.251	.01212907	0.601
Water Quality Perception	-0.2384864	0.024**	-0.2291745	0.030**
Water Reliability	0.1183421	0.642	1.037161	0.000***
PDAM Services	-0.0425997	0.676	-0.2154647	0.042**
Clean water application	-0.4135884	0.078*	-.0192974	0.425
Income	-6.14e-08	0.505	-2.67e-08	0.779
Wealth	0.4924915	0.108	0.544905	0.085*
Cost of PDAM Water	-2.52e-06	0.125	-3.51e-06	0.045**
Age	-.0154212	0.099*	-0.007344	0.431
Gender	0.3324864	0.193	0.3355147	0.187
Education	-0.1128805	0.766	-0.2747734	0.468
Family Members	-0.1340741	0.053*	-0.0769374	0.276
Children of underfive years old	0.0177166	0.927	-0.2097825	0.296
Number of obs	401		401	
LR chi2(13)	34.19		60.40	
Prob > chi2	0.0011		0.0000	
Pseudo R2	0.0649		0.1106	

Significant partial p-value test where *p<0.1, **p<0.05, ***p<0.01

Apparently, the determination coefficient using Pseudo R-Squared is 0.0649 for better quality y model and 0.1106 for reliability model. This means that the independent variables can explain the dependent variable of 6.49 percent for quality model and 11.06 percent for reliability model. According to Gujarati (2010) [28], the main things to consider are the model significance indicators, the significance of the independent variables, and the direction of the coefficients of these variables, so that, although the Pseudo R-Squared value in the logit model is low, it still makes a model considered good.

V. Conclusion

This study uses CVM method to estimate WTP for better quality and reliability for PDAM customer in Surabaya, East Java, Indonesia. More than 50% of PDAM customer respondents expected improvements both on quality and reliability for PDAM clean water provision. Furthermore, the majority of respondents being interviewed agreed on the necessity of better water quality and reliability from PDAM. Respondents' responses on the bidding method also relatively varied. From PDAM-subscribing respondents, the means of WTP for better water quality is IDR 114,023.97, - per month, and for better water reliability is IDR 204,738.13, - per month. In order to improve the quality and reliability, PDAM needs to focus on the solutions to its main obstacles, including: increasing clean water provision, suppressing health risks from current water conditions, and providing more efficient production processes which then lowering current rates to more affordable level for consumers or communities.

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