



## What Determines Households' Willingness to Pay for Clean Water?

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### Abstract

This study aims to measure the households' Willingness to Pay (WTP) for clean water in Aceh Besar Regency and its determinants (i.e., income, education, family size, gender, and age). Of 16,164 households who have no access to clean water across seven sub-districts in the Aceh Besar region, 154 of them were selected as the sample of the study using a multi-stage random sampling technique. To measure the households' WTP for clean water and its determinants, this study uses the contingent valuation and multiple regression techniques. The study recorded that the average households' WTP for clean water was IDR444,123.38 per month. Based on multiple regression model, except for the variables of gender and age that have insignificant effect, the level of income, education, and family size were found to affect the households' WTP for clean water positively. These findings imply that to enhance households' WTP for clean water, the government should prioritize the rural-based economic, education, and family planning programs. Providing a more clean water distribution, followed by improving water and services quality at affordable prices would help the government to realize 100% access to clean water for all citizens in accordance with one of the SDGs' pillars.

## INTRODUCTION

Water is essential for the survival of all living things on earth. Water is a daily basic need, especially for consumption, personal hygiene, agricultural land waters, recreation, and various other purposes. For personal health, it is necessary to have quality water suitable for use or so-called clean water. Although the amount of water resources is abundant, the availability of clean water is still limited. In addition, the availability of water keeps decreasing over the years due to climate change, higher living standards, increasing population (Santikayasa, Babel, Shrestha, Jourdain, & Clemente, 2014), and forest destruction, thus it fails to meet people's demand for clean water. The clean water crisis is further exacerbated by advancing technological developments resulting in industries that use a lot of water, over-exploitation of springs for commercial purposes, and water pollution caused by industrial and household waste (Asim & Lohano, 2015).

The availability of clean water is a global challenge (Connor, 2015); Indonesia is no exception. With an estimated world population of 8.5 billion and an estimated 345 million of Indonesian by 2030 (World Bank Report, 2019), this will undoubtedly lead to an increase in demand for water resources in the future. The ongoing process of sustainable economic development puts pressure on the earth's limited resources (Connor, 2015). Over the past few centuries, economic growth has driven the desire to explore the possibility of utilizing all economic resources for maximum profit, including water. As a result, 2.2 billion global populations suffer from lack of access to the adequate water supply. Millions of people, especially children, die every year from consuming contaminated water and about 95% of deadly diseases are closely related to the low quality of water consumption (Raimi, Ayibatombira, Anu, Odipe, & Deinkuro, 2019). Water scarcity now affects more than 40% of worldwide populations, and by 2030, water demand is expected to grow by 50%. Maintaining current water use in South Africa is expected to

produce 17% of the water deficit by 2030 (Akinyemi, Mushunje, & Fashogbon, 2018).

Public complaints about the inadequate supply of clean water are one sign of declining community welfare. This is like the case in Florida, the United States of America where people often complain because of a lack of water supply provided by the federal government (Chatterjee, Triplett, Johnson, & Ahmed, 2017) and people continue to suffer from water shortages and air pollution in China (Mu, Wang, Xue, Wang, & Li, 2019). Simultaneously socio-economic developments, urbanization, and industrialization threaten the continued use of water resources (Mu et al., 2019). This condition has become a concern of the global world to provide a 100% clean water access and proper sanitation for all citizens globally in 2030, as outlined in one of the Sustainable Development Goals (SDGs).

According to Parkinson et al. (2019), the sixth SDGs target, namely providing universal and equitable access to clean, safe, sustainable, affordable, and adequate sanitation for all world citizens by 2030 is not easy to be realized, given 2.1 billion of the world population still experience lack of access to clean water sources. Likewise, with Indonesia, which targets the availability of 100% water access for all residents in 2019, but until now, there are still many people having no sufficient access to clean water.

Although Indonesia is known as a tropical country whose geographical location makes water available throughout the year, water distribution is still uneven because of the lacking government's unpreparedness to anticipate population dynamics and development and increasingly uncertain seasonal water cycles as a result of global climate change. The World Bank Report (2020) showed that Indonesia is still lagging behind other developing countries in providing good quality of water and sanitation services. Even compared to Vietnam and the Philippines, which have lower per capita income than Indonesia, these countries have better access to safe drinking water and higher sanitation. This fact makes Indonesia potentially faced with the

situation of water resources crisis in the future (Saputra, Iyan, & Mardiana, 2017).

Although the Indonesian government has a strong desire to provide access to clean water for all Indonesian citizens by providing better services in the management and service of drinking water, the provision of services, the achievement of increased efficiency and coverage of clean water services, as mandated in Article 4, the Republic of Indonesia Law No. 7 of 2004 and its application are listed in the Strategic Plan of the Ministry of Public Works and Housing, the Republic of Indonesia (2015-2019). However, there are still many people in Indonesia has no full access to clean water.

In the Indonesian context, the community generally uses water services provided by the Regional Water Supply Company (*Perusahaan Daerah Air Minum - PDAM*) for the fulfilment of clean water. The number of people who have access to clean water has continued to increase in the past four years. This achievement cannot be separated from the cooperation of development actors at the central and regional levels. In 2018, on average, 88.32% of Indonesian citizens had access to drinking water nationwide (Central Bureau Statistics, 2019). Even though the community's access to clean water continues to increase every year, there are still 32 million people who have no access to clean water.

Until the year 2019, no single province in Indonesia had 100% access to clean water, as targeted. Besides, inequality in access to clean water between rural and urban areas is also still high. Only 64.18% of people in rural areas in Indonesia have access to clean water. In comparison, only 81.55% of people in urban areas have access to clean water (Central Bureau Statistics, 2019). Of the 34 provinces in Indonesia, half of them (17 provinces) have lower access to drinking water below the national average, including the province of Aceh whose access to clean water only reached 58.04%.

To catch up with the lack of access to clean water, the Government of Aceh has formulated a strategic step to achieve the target of access to clean water that is evenly distributed to all citizens. The target of 100% clean water access in

2019 is in line with the policy outlined in the 2015-2019 National Medium-Term Development Plan (*Rencana Pembangunan Jangka Menengah Nasional - RPJMN*), and the follow-up from the Constitution No. 23 of 2014 concerning Regional Government and Law No. 11 of 2006 concerning Aceh Government. These rules emphasized that one of the obligations of the governments at the Regency/City level is to provide equitable access to clean water across 23 regencies/cities within the Aceh province, including Aceh Besar Regency.

Even though Aceh Besar Regency is a supporting area or satellite city of the capital of Aceh Province, Banda Aceh, but not all sub-districts in this regency has access to clean water. Of the 23 sub-districts in the Aceh Besar Regency, only 16 sub-districts have access to clean water. Meanwhile, seven other sub-districts including Simpang Tiga, Pulo Aceh, Blang Bintang, Cot Glie, Lembah Seulawah, Leupung, and Lhoong have no access to clean water provided by the Regional Water Supply Company (PDAM). Although households can obtain clean water from alternative sources, such as buying bottled water, installing water filtration devices, and other ways of purifying water rather than relying on clean water supply provided by the local government (Rodríguez-Tapia, Revollo-Fernández, & Morales-Novelo, 2017), only a few people can afford these alternative sources of clean water. This means that there are still many people have not been able to meet the needs of clean water in Aceh Besar Regency. This existing condition is interesting to study, whether the fulfilment of clean water through PDAMs has not yet been met because of the low Willingness to Pay (WTP) for clean water of the local community? If so, what is their level of WTP for clean water? And what are the factors influencing households' WTP for clean water in Aceh Besar Regency?

According to Kling, List, & Zhao (2013), Willingness to Pay (WTP) is the maximum amount a person is willing to pay, sacrifice, exchange, or consumer perceptions to accept the good or reject something undesirable such as pollution. In general, WTP for clean water is

defined as the amount that is willing to pay an individual or a group of people to access clean water, reflecting the value of clean water and sacrifice to get it. WTP for clean water certainly differs from one individual to another, depending on their characteristics and socio-economic factors.

In their research, Anteneh, Zeleke, & Gebremariam (2019) found that WTP for clean water is significantly influenced by water price, service quality, levels of income, education, and public awareness for healthy living. Burt et al. (2017), Chatterjee et al. (2017), and Akeju, Oladehinde, & Abu Bakar (2018) documented that gender, volume of water consumption, level of education, income, household size, water quality, and water installation costs are factors determining WTP for clean water in Nigeria. Maddison, Catala-Luque, & Pearce (2005) and Whittington (2010) found that WTP for clean water is determined mainly by investment costs and the number of clean water supply.

Furthermore, Ameriana, Majawisastra, & Basuki (2006) recorded that WTP is determined by the number of family members, consumers' concern and confidence in the product. Besides, consumers' WTP for clean water depends on monthly consumption (Lopez et al., 2018), water quality (Jessoe, 2013; Dey et al., 2018), and water sources (Jessoe, 2013). By using the Contingent Value Method (CVM) to find out the WTP for clean water, Akhtar, Dean, Anjum, & Javed (2018) found income as its primary determinant.

In a similar vein, Jiang & Rohendi (2018) found that the purpose of using water, whether for drinking or not, determines the community WTP for clean water. Meanwhile, Mu et al. (2019) found that factors such as trust in authority, awareness of healthy living, family structure, and education had a significant impact on the WTP for clean water. WTP for clean water is also affected by safe water supplies, residential risk zones, household income, water consumption volumes, and awareness of water source contamination (Khan, Brouwer, & Yang, 2014). Finally, Larson, Minten, & Razafindralambo (2006) found that educated and higher-income households tended to rely on

private water supplies and used them more than low-educated families that relied on public water sources and managed not to change water use patterns dramatically.

Previous researches on the WTP for clean water and their determinants generally focused their analyses in other countries, such as Africa, China, India, Pakistan, Bangladesh, the Philippines, Cambodia, etc. Similar studies in Indonesia have also been carried out in other provinces, such as Riau, Makassar, and none of the previous similar studies has been found for the case of Aceh Besar District. Satifa, Aliasuddin, & Jamal (2018) only estimated the value of community WTP for clean water in Siron Village, District of Ingin Jaya, Aceh Besar Regency, and they did not examine all sub-districts that having no access to clean water in across the regency. In addition, their study only examined the influence of per capita income factors, the number of family members, and the volume of water needs on people's WTP for clean water, and ignored other determinants of WTP for clean water, such gender, age, level of education, etc. To fill the gaps of previous researches, this study intends to measure and explore households' WTP for clean water and its determinants, including levels of income, education, family size, gender, and age in Aceh Besar District, Indonesia.

The results of this study are expected to provide the estimated figures for households' WTP for clean water and its determinants more comprehensively so that they can be used as a reference for the water policy formulation to provide 100% clean water access for people in Aceh Besar District, as targeted by the local government. More specifically, the results of this study are expected to become a benchmark for the government, especially the public works department and regional water supply companies in providing sufficient clean water at an affordable price in accordance the WTP for it.

## RESEARCH METHODS

This study aims to measure the households' WTP for clean water and its determinants in Aceh Besar District. This

research was carried out in seven sub-districts within the Aceh Besar region that have no access to clean water. These sub-districts include Simpang Tiga, Pulo Aceh, Blang Bintang, Kuta Cot Glie, Lembah Seulawah, Leupung, and Lhoong. Of the 16,164 households that do not have access to clean water in these seven sub-districts, 154 households have been selected as the sample of the study using a multi-stage random sampling technique. In the initial stage, villages were selected in each sub-district as the research sample using cluster sampling techniques, while in the second stage households from these villages were selected using a simple random sampling technique.

To gather the data, questionnaires were distributed to 154 selected households. This questionnaire contains the respondent's background and question items to measure the variable studied. Before distributing the questionnaire, three experts in the field are requested to validate the questionnaire. The experts' suggestion and comments have been used to improve the substance of the questionnaire. In the next stage, the revised questionnaire was pilot tested on ten households. The refinement of the questionnaire was then made based on the responses of selected households. Afterwards, the questionnaire was distributed thoroughly to 154 households that were sampled in this study. In the last stage, the questionnaire that had been filled by respondents was tabulated for further analysis.

To measure the households' WTP for clean water, as the dependent variable in this study, the mean value of WTP for clean water in Indonesian Rupiah (IDR) is calculated using the Contingent Valuation Method (CVM). Technically, CVM can be measured using experimental/simulation and survey techniques (Girisuta et al., 2008). This study uses survey techniques to determine the households' WTP for clean water. Meanwhile, the independent variable of the level of income is calculated from the total average monthly household income in IDR. The level of education is calculated based on the number of years of schooling of the respondent. The gender is measured using a

dummy variable (1 = male, and 0 = female), the family size is calculated based on the number of family members in each household, whereas the age is calculated based on the years of respondent's ages. In the regression analysis, the households' WTP for clean water and the level of income were transformed into the natural logarithm due to their large values.

The collected data is tabulated according to research needs and analyzed using multiple regression analysis. This method has some interesting statistical properties that make it one of the most potent and popular regression analysis methods (Asteriou & Hall, 2015). By applying the classical linear assumptions, this method provides an unbiased, linear, minimum variant estimator or so-called Best Linear Unexpected Estimator (BLUE).

To measure and analyze the influence of levels of income, education, gender, family size, and age on households' WTP for clean water in Aceh Besar District, this study uses a multiple regression model with the following equation:

$$WTP = \beta_0 + \beta_1 INC + \beta_2 EDU + \beta_3 GEN + \beta_4 FS + \beta_5 AGE + \varepsilon \dots \dots \dots (1)$$

Where WTP is the households' willingness to pay for clean water access, INC is the monthly income, EDU is the education level, GEN is the gender, FS is the family size, AGE is the age,  $\beta_0$  is a constant term,  $\beta_i$  are the estimated value of each regressor, and  $\varepsilon$  is the error term.

Prior to the data analysis, rigorous classical assumption tests of normality, multicollinearity, and heteroscedasticity were firstly performed. The Kolmogorov-Smirnov (K-S) is used to test the normality. If the Z-value of the K-S test is higher than the 5% significance level, then the data is found to be normally distributed. As for the multicollinearity test, the Tolerance Value (TV) and Variance Inflation Factor (VIF) are used. If the TV is greater than 0.1 or the VIF is smaller than 10; thus, the data are free from the multicollinearity problem. Finally, the Glejser Test (GT) is used to test for the heteroscedasticity of the data. If the value of the estimated coefficients regressed with the absolute residual value is higher than the

specified probability value, then the data is found to be homoscedastic (Gujarati, 2017).

This study hypothesizes that the monthly income, education level, gender, family size, and age have significant positive effects on the households' willingness to pay for clean water access.

## RESULTS AND DISCUSSION

The Aceh Besar Regency is one of 23 Regencies/cities in Aceh Province. The geographical location of Aceh Besar Regency is between the lines of 5.05'-5.75 'North Latitude and 94.99' -95.93 'East Longitude. Aceh Besar Regency borders the Malacca Strait and Banda Aceh City in the north, borders Aceh Jaya Regency in the south, Pidie Regency in the east, and the Indonesian Ocean in the west. The Regency has 604 villages with a total area of 2,903.50 km<sup>2</sup>, and most of its territory is on the mainland, while only a few others are on the islands. As the capital city of the Aceh Besar Regency, Jantho City is the largest area with a total of 593 km<sup>2</sup>, representing 20.42% of the regency area (Central Bureau of Statistics of Aceh Besar District, 2019).

In Aceh Besar District, the management of the clean water supply is under the authority of the Regional Water Supply Company (Perusahaan Daerah Air Minum - PDAM) PT. Tirta Mountala. The PDAM supplies water that meets health requirements following the mandate of Minister of Public Workers Regulation No. 18 of 2017, concerning the Development Policy for the Management of Regional Clean Water Supply Systems. Of the 23 sub-districts in the Aceh Besar Regency, only 16 sub-districts have access to clean water from the PDAM, while the remaining six sub-districts do not have access to clean water.

In 2018, there were 27,110 customers of the PDAM. Conversely, as many as 16,164 households in the sub-districts do not yet have access to PDAMs (PDAM PT. Tirta Mountala Report, 2019). The increase in the use of clean

water is following population growth and increase in the standard of living of the citizens.

This study selected 154 households from seven sub-districts having no clean water access from the PDAM using a multi-stage sampling technique. Table 1 illustrates the characteristics of respondents in the study.

As illustrated in Table 1, of 154 households having no access to clean water in seven sub-districts in Aceh Besar Regency, the majority of them having 32-48 years old (31.7%), while the minority of them having an age of fewer than 28 years old (1.9%). 70.1% of them are male, and the remaining 27.9% are female. The majority of them have an undergraduate degree (47.4%), and only 10% of them are Master's graduates. Most of them earned monthly income between IDR1-2 million (37.7%), and only 3.9% of them received a monthly income of less than IDR1 million. In terms of family size, the households generally have 2-4 family members (72.7%), followed by 5-7 family members (16.9%), more than seven family members (7.1%), and less than two family members (3.2%).

Furthermore, in view of the adequacy of clean water, most households confessed to having insufficient clean water (66.8%), and the remaining 33.2% stated that they had enough clean water access. They said that the quality of the water they consumed was in the quality categories of medium 63.7%, high (20.1%), and low (16.2%). The water they are consuming, generally, sourced from the wells (53.3%), bottled water (17.5%), rivers (16.9%), and other water sources (12.3%). If they are provided with clean water by the government, all of them (100%) said willing to pay for clean water at a price greater than IDR50,000 (25.9%), IDR40,000-IDR 50,000 (23.4%), IDR30,000-IDR40,000 (16.2%), IDR20,000-IDR30,000 (21.4%), IDR10,000-IDR20,000 (11.8%), and below the price of IDR10,000 (1.3%). Overall, this study found that the average households'

WTP for clean water in Aceh Besar Regency was IDR44,123.38 per month.

**Table 1.** Characteristics of the respondents

Characteristics	F	%	Characteristics	F	%	Characteristics	F	%
<i>Age (Years):</i>			<i>Willingness to pay (IDR):</i>			<i>Monthly income (IDR):</i>		
<28	3	1.9	<10,000	2	1.3	<1 million	6	3.9
25-38	29	18.8	10,000-20,000	18	11.8	1- 2 million	58	37.7
32-48	57	31.7	20,000-30,000	33	21.4	2-3 million	49	31.8
39-58	42	27.3	30,000-40,000	25	16.2	3-4 million	23	14.9
46-68	17	11	40,000-50,000	36	23.4	4-5 million	11	7.1
>69	6	3.9	>50,000	40	25.9	>5 million	7	4.5
Total	154	100	Total	154	100	Total	154	100
<i>Gender:</i>			<i>Water sufficiency:</i>			<i>Willingness to pay:</i>		
Male	108	70.1	Yes	86	33.2	Yes	154	100
Female	46	29.9	No	69	66.8	No	0	0
Total	154	100	Total	154	100	Total	154	100
<i>Education level:</i>			<i>Family size:</i>			<i>Water sources:</i>		
<Junior high school	26	16.9	<2 persons	5	3.2	Well	82	53.3
Senior high school	45	29.2	2-4 persons	112	72.7	River	26	16.9
Undergraduate	73	47.4	5-7 persons	26	16.9	Bottled water	27	17.5
Postgraduate	10	15.4	>7 persons	11	7.1	Others	19	12.3
Total	154	100	Total	154	100	Total	154	100

Note: F indicates frequency.

The above characteristics of the respondents show that the households in the seven sub-districts of Aceh Besar Regency have inadequate access to clean water and they have a willingness to pay for it –if provided by the government – at varying prices, depending on the source of water consumed, level of income, education, age, and gender. However, to ensure the extent to which age, sex, income, family size, and education level affect the households' WTP for clean water in Aceh Besar Regency, it would be tested using multiple regression models. The results of the multiple regression estimates are reported in Table 2.

Table 2 reports the estimated regression results of the effect of total income, education level, gender, household size, and age on the households' WTP for clean water in Aceh Besar Regency, Indonesia.

Before the estimation results are interpreted and analyzed, as mentioned earlier in the methodological section, the classical assumption tests of normality, multicollinearity, and heteroscedasticity are firstly tested. The Last Row of Table 2 shows the results of these

classical assumption tests. The insignificant Kolmogorov-Smirnov (K-S) p-value test indicated that the variables used in this study are normally distributed. Furthermore, all independent variables are found to be free from multicollinearity problems, as indicated by values of Variance Inflation Factor (VIF) that are smaller than 10 and Tolerance Values (TV) that are greater than 0.1. Finally, based on the Glejser Test (GT), the data used in this study are also free from heteroscedasticity problems, as indicated by insignificant values of estimated coefficients that were regressed on the absolute residual value (Gujarati, 2017).

Referring to Table 2, this study found that the level of income affected households' WTP for clean water positively with an estimated coefficient of 0.759 at a significance level of 1%. The results of this study indicate that a 100% increase in income has caused a rise in households' WTP for clean water by 75.9%. This is very natural, considering that clean water is a necessary household need. Then the increase in income causes the desire of households to consume clean water to increase.

If viewed from the size of the estimated coefficient, then the variable of the level of income is recorded to have the largest estimated coefficient value. This finding confirmed that income is the most critical factor affecting households' WTP for clean water (Akhtar et al., 2018). With an average monthly household income of IDR3,775,974.03, the households only have a WTP for clean water of IDR44,123.38. If their monthly income has doubled, their WTP for clean water will increase to IDR77,613.03 monthly. These results imply that to enhance households' WTP for clean water, the government must prioritize development

programs that can improve community income, especially rural communities. Optimizing the use of village funds to strengthen rural business units, especially the village-owned business entity (*Badan Usaha Milik Desa – BUMD*) must be prioritized. The BUMD assistance programs, such as professional management training series should be initiated and provided regularly and continuously to strengthen their business capacity. The village business unit is expected to be able to increase the income of rural communities, and in turn, enhance the rural households to afford to pay for access to clean water.

**Table 2.** Findings of determinants of Households' WTP for clean water

Variable	Estimated Coefficient	t-statistics	P-value
Constant	-0.883	-1.468	0.144
Income	0.759***	7.829	0.000
Education	0.026***	6.232	0.000
Gender	0.002	0.088	0.930
Family Size	0.048***	5.728	0.000
Age	-0.001	-1.257	0.211

TV = 0.534 – 0.979; VIF = 1.021 – 1.873; D-W = 1.488; K-S = 0.585;

K-S (p-value) = 0.880; GT (p-value) = 0.098 – 0.950; R<sup>2</sup> = 0.736;

Adj-R<sup>2</sup> = 0.728; F-stats = 82.698; F-stats (p-value) = 0.000

Note: \*\*\*, and \* indicate significances at the 1% and 5% levels, respectively. K-S is the Kolmogorov-Smirnov test for normality; VIF and TV are the Variance Inflation Factor and Tolerance Value for testing multicollinearity; and GT is the Glejser test for heteroscedasticity.

The results of this study are in line with previous studies. For example, previous research found that the level of income had a significant positive effect on the community WTP for clean water in Bangladesh (Khan et al., 2014), Tanzania (Burt et al., 2017), United States of America (Groothuis, Cockerill, & Mohr, 2015; Chatterjee et al., 2017), Nigeria (Akeju et al., 2018), Pakistan (Akhtar et al., 2018), and Ethiopia (Bogale & Urgessa, 2012; Anteneh et al., 2019). Without having sufficient income, the community prefers to buy food and drinks with low quality. Thus, an increase in income has a positive contribution to the households' WTP for clean water.

Furthermore, as reported in Table 2, the level of education also has a positive effect on the households' WTP for clean water with an

estimated coefficient of 0.026 at a significance level of 1%. The results of this study indicate that each additional one year of education has led to an increase in households' WTP for clean water by 0.026 units. This happens because the level of education reflects high awareness and knowledge of the importance of avoiding consuming water that contains unhealthy levels of chemicals and contaminants (Chatterjee et al., 2017). Water plays a vital role in ensuring the level of health of the body; thus, consuming clean water is one way of living a healthy lifestyle (Prüss-Üstün, Bos, Gore, & Bartram, 2008).

The results of the study imply that households' WTP for clean water is primarily determined by the level of education and public knowledge of the importance of consuming clean water. Therefore, to increase community

awareness for healthy living, the community must be educated about the importance of healthy life with clean water (Chowdhury, Zaman, & Mahmood, 2018). This can be done by introducing the topic of a healthy lifestyle with clean water in the education curricula at all levels. Besides, informally, education about the importance of healthy living with clean water can also be done through a healthy life socialization program conducted by the government through village health workers. Health education, distribution of pamphlets, writings on clean water on social media, and giving awards to rural communities who live healthy with clean water are believed to increase the level of public knowledge to consume clean water.

The positive significance of the effect of education level on households' WTP for clean water in Aceh Besar District is in accordance with previous researches. The level of education has a positive impact on households' WTP for clean water in Madagascar (Larson et al., 2006), Tanzania (Burt et al., 2017), the United States of America (Groothuis et al., 2015), and Nigeria (Akeju et al., 2018). Likewise, (Mu et al., 2019) found that households' WTP for clean water in China is influenced by the level of education of its citizens, people with higher education tend to use more clean water than less-educated households (Larson et al., 2006).

The next factor affecting households' WTP for clean water households in Aceh Besar District is family size. As illustrated in Table 2, the family size is found to have a positive effect on households' WTP for clean water with an estimated coefficient of 0.048 at a significance level of 1%. The result indicates that an addition of one family member has caused an increase in households' WTP for clean water by 0.048 units. The results of this research are very logical because the more family members grow, the more they need for clean water for consumption, bathing, washing cars, watering plants, etc..

The results of this study imply that to meet public demand for clean water, the government must control population growth through family programs and increase clean water supply in harmony with an increase in population. If the

government of Aceh Besar District aims to meet the 100% clean water access target for all residents, the amount of clean water supply must be increased proportionately in par with the population growth rate. Without an adequate supply of clean water, no matter how high the households' WTP clean water, then some of the demand for freshwater by the community would not be met (Genius et al., 2008), thus, the target of 100% clean water access would not be realized.

Our empirical evidence is supported by the previous studies of Burt et al. (2017), Chatterjee et al. (2017), and Akeju et al. (2018). Their studies found that the number of dependents or household size had a significant positive effect on households' WTP for clean water in Tanzania (Burt et al., 2017), the United States of America (Chatterjee et al., 2017), and Nigeria (Akeju et al., 2018). Likewise, Mu et al. (2019) found that family structure influences households' WTP for clean water in China, the high demand for fresh water due to the increase in family members (population) compared to the availability of the quantity of water supply would encourage competition among the community, thereby helping some of them to have a high WTP for clean water, which cannot be exploited by local water companies by raising prices without being followed by improvements in the quality of clean water and services.

Unlike the variables of the levels income, education, and family size that have a significant positive effect on households' WTP for clean water, this study found an insignificant effect of gender and age on households' WTP for clean water. The number of clean water consumption that does not differ between men and women has caused gender to have an insignificant effect on households' WTP for clean water. Likewise, the age difference did influence households' WTP for clean water to change significantly. The importance of increasing income strongly supports the results of this study as a significant factor, causing an increase in households' WTP for clean water. Without having sufficient income, a household filled with family members

of different sexes and ages would not be able to pay for clean water at a higher price.

The findings of our study are in harmony with previous studies that found gender has insignificant effect Households' WTP for clean water in China (Wang, He, Kim, & Kamata, 2013), Tanzania (Burt et al., 2017), United States of America (Chatterjee et al., 2017), Nigeria (Akeju et al., 2018), and Thailand (Vassanadumrongdee & Kittipongvises, 2018). Likewise, previous studies have also found the insignificant influence of age on households' WTP for clean water in Mexico (Vásquez, Mozumder, Hernandez-Arce, & Berrens, 2009), China (Wang et al., 2013), and Thailand (Vassanadumrongdee & Kittipongvises, 2018).

Overall, the results of our study suggest that to improve households' WTP for clean water access, the focus must be given to development programs that contribute to community incomes, increase levels of education and community knowledge, and control the population growth through family planning programs. Besides, increasing the supply of clean water must be ensured sufficient and accessible to all levels of society, especially in rural areas. The addition of clean water networking distribution by the regional water supply company, followed by an increase in water quality and services at an affordable price must be a priority for the government to provide 100% clean water access to all citizens in accordance with the government's aspires to realize one of the SDG pillars.

Finally, the estimated model in this study has been able to measure the determinants of households' WTP for clean water robustly. In addition to meeting all classical assumptions, the estimate research model is also free from misspecification problems. This is as indicated by the significance of the F-statistics value at the level of 1%, which suggests that, overall, the variables examined in this study were able to explain the variations in household's WTP for clean water at the estimated coefficient of determination (Adjusted-R<sup>2</sup>) of 0.728 (The Last Row of Table 2). More specifically, this signifies that the changes in households' WTP for clean

water could be predicted by 72.8% changes in factors of levels of income level, education, number of family members, gender, and age. Only the remaining 27.2% of the changes in the households' WTP for clean water was predicted by factors not incorporating in our model, such as the management of clean water services by local water companies, political, cultural, environmental, and technological factors.

## CONCLUSION

This study measured the households' Willingness to Pay (WTP) for clean water in Aceh Besar Regency and explored its determinants. These determinants comprise levels of income, education, family size, gender, and age. Of 16,164 households who have no access to clean water across seven sub-districts in the Aceh Besar region, 154 of them were selected as the sample of the study using a multi-stage random sampling technique. To measure the households' WTP for clean water and its determinants, this study, respectively, utilized the contingent valuation and multiple regression techniques.

This study is among the first attempts to measure the WTP for clean water and explore their determinants for the case of Aceh Besar District, Indonesia. Unlike the previous study that focused only on a single sub-district in the region and covered only limited WTP determinants. This study covered more sub-districts and incorporated not only the per capita income and the number of family members, but it also included the gender and age as the determinants of households' WTP for clean water into the proposed estimated model.

The study documented that the average households' WTP for clean water in the Aceh Besar Regency amounted to IDR444,123.38 per month. Based on multiple regression models, except for the variables of gender and age that have insignificant effect, the level of income, education, and family size were found to have a significant favourable influence the households' WTP for clean water. These findings imply that to enhance households' WTP for clean water, the government should prioritize the rural-based

economic, education, and family planning programs. Providing a more clean water distribution, followed by improving water and services quality at affordable prices would help the government to realize 100% access to clean water for all citizens in line with one of the SDGs' pillars.

To enrich our empirical findings of the households' WTP for clean water, future studies are suggested to incorporate more determinants, not only the socio-economic factors, but also the environmental, political, and technological factors. Besides, covering more areas in Indonesia into the analysis would also enhance the findings of future studies. Finally, a comparative study of the households' WTP for clean water across sub-districts and provinces nationwide would also provide extensive empirical evidence on the clean water access issue.

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