Consumption Patterns, Perception, And Economic Value of Drinking Water to the Households in Pulogelis, City of Bogor

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Abstract The high population and economic activities in Bogor City have caused pressures on natural resources and the environment, and resulted in soil and water pollution. Community in the PuloGeulis Village is one of the areas in the city of Bogor whose face the problems of ground water and poor sanitation conditions. As a result, people must allocate a portion of their incomes to consume piped water (PDAM water), bottled drinking water (AMDK), and refilled water. The purpose of this study is to identify sources of drinking water in meeting the needs of clean water for the people of Kampung PuloGeulis, to estimate the amount of expenditure for clean water consumption, and to estimate willingness to pay (WTP) of the community in the provision of improved clean water from the PDAM. Data analysis methods include descriptive analysis, income and expenditure analysis, and contingent valuation method. The results showed that the PuloGeulis community had four main water sources and produced five patterns of combined use of water. Total expenditure for clean water consumption is still relatively low i.e., about 4% of the average household income. People consume bottled water and refilled water because, it is perceived, that the quality of PDAM water is lower than alternative water sources. This has resulted in higher willingness to pay when there is an improvement in the water supply system through the PDAM. The estimated value of household WTP is quite high, around Rp 4,573/m3 for household in category R3. The community has felt the impact of waste pollution in the forms of smell and contamination of the surrounding land and water, so they proposed several environmental improvement programs in the Pulo Geulis area. Keywords: clean water provision, expenditure for water, groundwater pollution, public perception, willingness to pay

1. Introduction
Piped water is generally becoming the most important and significant sources of clean water for the people in modern society. In Indonesia, piped water is provided by the PDAM (Perusahaan Daerah Air Minum or regional sate-owned water company). Unfortunately, service coverage of PDAM in Indonesia is still limited. Nationally, only 20 percent of 260 million Indonesians have been connected to this piped water service. Due to difficulties and limited access to piped water, large number of people using the alternative water sources for drinking water, bathing, and washing. The alternative water sources commonly used by the people of Indonesia are well water, springs, rainwater, and others. BPS data (2018) shows that the percentage of drinking water service coverage by piped water companies (PDAMs) has decreased by 8.42% in 16 years i.e., from 19.08% in 2000 to 10.66% in 2016. This condition indicates that the growth of PDAMs water services is not as fast as its population
growth. Similar conditions also occurred in West Java, one of the most populous provinces in Indonesia, where percentage of drinking water service coverage has decreased from 12.38% to 7.04% in the same period. On the other hand, there have been massive changes in drinking water sources in Indonesia and West Java, from conventional drinking water sources (piped water, ground water, springs, etc.) to bottled water and refilled gallon water. Consumption of these two water sources has increased significantly during the same period. Its proportion has reached more than 30% of the total drinking water consumption in 2016, both in Indonesia and West Java.

Population increase in Bogor City, in the province of West Java, has led to an increase in the need for clean water. For the people of Bogor City, the actual use of PDAM water is actually still increasing. This can be seen from the increase in the number of household customers of PDAM TirtaPakuan—the PDAM of the Bogor City that supplies drinking water to the people of Bogor City. Based on BPS data from the City of Bogor (2017), the highest increase in the number of customers of PDAM TirtaPakuan is in the category of household customers with an increase of 35,940 customers in three years, namely from 2013 to 2016. However, the availability of alternative clean water in the city tends to decrease due to environmental pollution that is resulted from human-generated waste, both from consumption and production activities. The high level of water pollution usually occurs because of high population density and high economic activities. These two factors have caused environmental pollution, including both land and water pollution, which ultimately leads to poor water and sanitation conditions.

Kampung (village) PuloGeulis is one area in the city of Bogor that has difficult access to ground water and has poor sanitation. The high population density in KampungPuloGeulis (547 persons per hectare in year 2017) causes no space that can be used to develop septic tanks, so that the sewage system of the population directly empties into the nearest river, the Ciliwung River. Difficult access to ground water and contamination of surface water in PuloGeulis causes people to be unable to enjoy cheap sources of ground water. To meet the need for clean water, people must consume water from sources that have relatively high prices, such as piped water, bottled drinking water (air minum dalam kemasan or AMDK), and refilled water. This resulted in the community having to allocate a portion of their income to be able to use the water.

Community of PuloGeulis’s assessment on the performance or service of clean water providers, the price of clean water, and the quality of clean water could affect their behavior in choosing which clean water to be consumed. The use of bottled water and refilled water to meet drinking water needs was chosen by some people because of their perceived assumption that the quality of PDAM water was not as good as bottled or refilled water, though their prices are much higher compared to PDAM water. This has caused the community to have willingness to pay to the improvement in the conditions of PDAM water quality and services. The improvement in the quality and service of PDAM water certainly will imply greater expenditure for piped water consumption, but they do not need to pay to buy bottled water and refilled water that costs much more than PDAM water.

Environmental and sanitation conditions have becoming a significant problem in Kampung PuloGeulis. This sanitation problem arose due to limited land in Kampung PuloGeulis and it has become one of the factors that lead to the decline of water quality in the area. The density of settlements in KampungPuloGeulis has resulted in the absence of space that can be used to build septic tanks which are, in fact, included in the important needs of the community. This resulted in the disposal of household waste leading to the Ciliwung River flow, which caused a decrease in river water quality and disruption of the sustainability of water resources and environmental quality in KampungPuloGeulis. Therefore, the level of public perception of the impact of domestic waste pollution and the improvement of environmental quality in KampungPuloGeulis is important to analyze.

Based on the above problems, this research is directed to find the answers to four research questions, namely: (1) How do the people of KampungPuloGeulis meet the needs of clean water from various existing water sources?; (2) How is the allocation of water consumption expenditure to the total income of the people of KampungPuloGeulis?; (3) How are the public perceptions on clean
water and willingness to pay (WTP) for the community to improve the water supply system from the PDAM?; and (4) How are the public perceptions on the impact of waste pollution and environmental quality improvement in Kampung Pulo Geulis?

2. Research Method

2.1 Location and Time of Research
This research was conducted in KampungPuloGeulis, BabakanPasar Village (kelurahan), Bogor Tengah District (kecamatan), Bogor City. Location selection is done purposively with the consideration that KampungPuloGeulis is one of the residential areas that has contaminated groundwater (well water) and surface water (river water) so that the local community must meet the needs of clean water from other sources that have relatively higher prices in meeting their clean water needs. Data collection is carried out in April - May 2018.

2.2 Types and Sources of Data
The data used in this study are both primary and secondary data. Primary data obtained from observations and direct interviews using a prepared questionnaire. Interviews were conducted with the PuloGeulis community representing households using clean water facilities from the PDAM and other water sources. Secondary data was obtained from literature studies of various books, journals, articles, the Central Statistics Agency, PDAM TirtaPakuan, and the local village office.

2.3 Sampling Method
Non-probability sampling method is used in this study, specifically the convenience sampling method. Convenience sampling method is a sampling technique based on coincidence, meaning that members of a population with a certain criterion encountered and willing to become respondents can be sampled (Newman 2000). In this study, the criteria chosen were the people of KampungPuloGeulis RW 04, BabakanPasar Village. That is, every head of household of KampungPuloGeulis who was met by researchers and considered to be aware of information related to meeting their household water needs could be sampled. Determination of the number of samples is calculated using the Slovin formula:

\[ n = \frac{N}{1+N \cdot e^2} \]

where \( n \) =number of samples, \( N \) =total population and \( e \) =standard error (=0.1). Thus, the total amount of respondent is 88 households.

2.4 Data analysis method
There are three methods used in the analysis of this research data, namely descriptive analysis, analysis of expenditure and income, and contingent valuation method (CVM). The quantitative and qualitative descriptive analysis method is used to analyze the fulfillment of the community's clean water needs from various existing sources and analyze the community's perception on clean water, the impact of waste pollution, and the improvement of environmental quality in KampungPuloGeulis. The proportion of expenditure analysis was carried out to analyze the allocation of expenditure on water consumption relative to the total income of the people of KampungPuloGeulis; while the willingness to pay for the community to improve the water supply system and improve environmental quality in KampungPuloGeulis was analyzed using CVM.

Community perception of clean water was analyzed using descriptive analysis method. Community perceptions include community perception on the performance of clean water providers, clean water prices, and the quality of clean water. The WTP analysis of the improvement of the water supply system from the PDAM is analyzed using CVM with bidding game techniques. Bidding game method is done by asking questions to the respondent regarding his willingness to pay a certain amount of money which is submitted as the starting point. If the respondent is willing, then the value of money is raised to the agreed level. The steps taken to estimate the value of WTP using CVM are making market hypotheses, obtaining auction values (bids), calculating the WTP average value (EWTP), and estimating the bid curve (bid curve). Mathematically, the average value of WTP can be
calculated using the following formula (Fauzi 2006 and Syaukat et al. 2014): \[ \text{EWTP} = \frac{\sum WTP_i X_i}{n} \]

where \( \text{EWTP} \) = estimated average WTP value (Rp/household); \( WTP_i \) = value of WTP at category \( i \) (Rp), \( X_i \) = number of households who want to pay at WTP at category \( i \), and \( i (=1, 2, \ldots, n) \) = number of WTP categories.

Community perceptions on the impact of waste pollution and the improvement of environmental quality in KampungPuloGeulis were analyzed using descriptive analysis methods. Community perceptions that are evaluated include community behavior on disposing of household waste, community knowledge, and environmental quality improvement programs. The data that has been obtained during the research is processed qualitatively and quantitatively and expressed as a percentage.

3. Result and Discussion

3.1. Pattern of Community Clean Water Consumption in KampungPuloGeulis

The fulfillment of clean water needs used by the community of KampungPuloGeulis generally comes from three main sources, namely piped water from PDAM, bottled drinking water (AMDK), and refilled drinking water. In addition to the three main sources of clean water, some people still use river water to fulfill some of their non-consumption water needs, such as bathing or washing. The results of the analysis show that there are five patterns of consumption of clean water used by the community. Based on those patterns, the household respondents in this analysis were classified into five groups. Household groups based on clean water consumption patterns are presented in Table 1.

| Group of households | Sources of water consumption | Frequency | Percentage |
|---------------------|------------------------------|-----------|------------|
| 1                   | PDAM water                   | 46        | 52.27      |
| 2                   | PDAM water and AMDK          | 10        | 11.36      |
| 3                   | PDAM water and refilled water| 23        | 26.14      |
| 4                   | PDAM and river water         | 7         | 7.96       |
| 5                   | PDAM water, refilled water, and river water | 2 | 2.27 |
| **Total**           |                              | **88**    | **100.00** |

The first household group is the largest household group whose consume only PDAM water (52%) and is the only group that consumes a single water source. Four other household groups are water users from various sources, with various consumption patterns. The other dominant consumption pattern is the conjunctive use of water from PDAM and AMDK or PDAM and refill water. Household groups whose consume clean water sources and also river water has the smallest percentage (2%). The average volume of clean water use in each household group can be seen in Table 2.

| Group of households | Average water consumption (liter/month) | Average total water consumption (liter/month) |
|---------------------|----------------------------------------|---------------------------------------------|
|                     | PDAM water    | AMDK  | Refilled water   | PDAM water    | AMDK  | Refilled water |
| 1                   | 25,587        | -     | -               | 25,587        | -     | -              |
| 2                   | 26,000        | 108   | -               | 26,108        | 108   | -              |
| 3                   | 21,478        | -     | 164             | 21,642        | -     | 164            |
| 4                   | 18,714        | -     | -               | 18,714        | -     | -              |
| 5                   | 29,500        | -     | 76              | 29,576        | -     | 76             |
Table 2 shows that the fifth household group is the one that consumes the highest volume of clean water, 29,576 liters/household/month. The volume is calculated based on the average use of PDAM water and refill water only, because the volume of river water used cannot be calculated. The lowest volume of water use is in the fourth group (18,714 liters), that consumes PDAM water in addition to river water. The use of bottled water and refilled water is actually relatively small, because its use is limited only for drinking purpose.

Based on several research results, the standard volume for clean water needs per person is quite varied. The standard set by the Directorate General of Human Settlements, Ministry of Public Works is the standard used in the preparation of spatial plans regarding the needs of infrastructure including clean water needs. The standard for clean water requirements set by the Department of Public Works (2007) is 120 liters/capita/day. This standard is the same as the standard for water use for domestic needs set by Badan Standaridasi Nasional or BSN (2002). Based on the results presented at Table 2, it was found that the average consumption of clean water from the Kampung PuloGeulis community was 181 liters/capita/day, which originating from various sources of clean water. This figure shows that the volume of water consumed by the people of Kampung PuloGeulis has exceeded the standard of clean water requirements set by the government.

3.2. Household Expenditures for Water Consumption

Household expenditure for water consumption and share of that expenditure relative to total household income is one of the objectives of this study. The analysis of household expenditure for water consumption aims to see how much the proportion of household expenditure to consume clean water relative to the average household income per month. The household expenditure for water consumption includes expenditures for PDAM, AMDK, and refilled water consumption in each household group, while the volume and its economic value (if any) of river water consumption are not analyzed. There are three groups of water tariffs of PDAM TirtaPakuan which are applicable to the household respondents in PuloGeulis Village, namely groups R2, R3, and R4 (R stands for rumah tangga or household). The majority of households are included in R2 household group, while the smallest group of customers is in the R4 household group. This shows that PDAM water rates paid by households in Kampung PuloGeulis range from Rp 1,900 per m³ to Rp 4,100 per m³. PDAM applies an increasing block tariff, with three blocks of consumption i.e., \( x \leq 10 \) m³, \( 10 < x \leq 20 \) m³ and \( > 20 \) m³. However, the second and third blocks have the same tariff, thus there are actually only two effective block tariffs applicable to the customers (Table 3).

### Table 3. Effective Water Tariffs to R2, R3 and R4 Groups of Household Customers

| Category of customer | Water tariff (Rp/m³) | Percentage of customer |
|----------------------|----------------------|------------------------|
|                      | 0 – 10 m³            | > 10 m³                |                      |
| R2                   | 1,900                | 3,100                  | 77                    |
| R3                   | 2,300                | 3,700                  | 17                    |
| R4                   | 2,500                | 4,100                  | 6                     |

Based on information provided by the community, the price of bottled water they consume in April 2018 is between Rp 17,000 and Rp 18,000 per gallon (19 liters), while refilled water is usually purchased at a price between Rp 7,000 and Rp 8,000 per gallon. The diversity of the price of bottled water and refilled water is depended by the seller and the location where the community buys the two types of clean water.

### 3.3. Household Expenditure for Water Consumption

The average household expenditure for water consumption and the percentage of the value of water expenditure relative to the average household income are presented in Table 4. Data Table 4 shows that the second household group has both the highest water consumption and household income. The
highest water consumption expenditure for each type of water consumed is Rp 97,700 per month, which is the expenditure for bottled water by the second household group. The lowest average expenditure is Rp 64,614 per month, derived from the average water consumption expenditure of the fourth household group on PDAM water. This figure shows that the average PDAM water expenditure by the households that jointly use PDAM water and river water is smaller than the PDAM water expenditure of the households that only use PDAM water in meeting all their household water needs.

In general, the allocation of clean water consumption expenditures from all household groups does not exceed four percent of household income with an average expenditure allocation of 3.45 percent. This figure shows that the allocation of KampungPuloGeulis community water consumption has met the principle of affordability based on Minister of Home Affairs Regulation No. 23 of 2006 which states that household expenditure to meet basic needs for drinking water does not exceed four percent of the customer's income (Ministry of Home Affairs 2006). However, total expenditure on clean water in the second and third household groups exceeded four percent of average household income. This occurs due to the high price difference between PDAM water and bottled water and refill water.

Table 4. Average Water Expenditure and Income of the Respondent Households

| Group of Household | Average expenditure for each type of water (Rp/month) | Total expenditure (Rp/month) | Average household income (Rp/month) | Share of water expenditure to income (%) |
|--------------------|-----------------------------------------------------|------------------------------|------------------------------------|-----------------------------------------|
| PDAM               | AMDK 97,700                                        | 194,480                      | 5,000,000                          | 4.88                                    |
| Refill water       | PDAM 64,614                                        | 123,250                      | 4,750,000                          | 2.27                                    |

3.4. Household Perception towards Clean Water

Respondents' perceptions on the three aspects of clean water, namely the performance of water providers, water prices (tariffs), and water quality are shown in Table 5. The assessment given to PDAM performance is based on the responsiveness of PDAM officers when there are complaints from customers and other services provided to customers. The assessment given on the performance of the bottled water provider and refill water is based on the ease of obtaining the water. From Table 5, it can be seen that the majority of PDAM water users, bottled water and refill water provide a "good" on the performance of each provider of the water. These results indicate that all providers of clean water have a good performance in the eyes of their consumers.

Table 5. Perception of the Household toward Performance of Water Provider, Price (Tariff) of Water and Quality of Water

| Source of Water | Household Perception (%) | Total (%) |
|-----------------|--------------------------|-----------|
| Performance of water provider | Very bad | Bad | Good enough | Good | Very good | |
| a. PDAM Water   | 0.00 | 0.00 | 3.41 | 96.59 | 0.00 | 100.00 |
| b. AMDK water   | 0.00 | 0.00 | 0.00 | 100.00 | 0.00 | 100.00 |
| c. Refill water | 0.00 | 0.00 | 0.00 | 100.00 | 0.00 | 100.00 |

| Price (Tariff) of water | Very bad | Bad | Good enough | Good | Very good | |
| a. PDAM Water   | 0.00 | 6.82 | 63.64 | 29.55 | 0.00 | 100.00 |
Community perceptions on prevailing water prices, based on tariffs and prices prevailing in April 2018, indicate that the current PDAM water tariff is in the "sufficient" and "high" categories according to consumers, each with a percentage 63% and 29%. People buy bottled water at a price of between Rp 17,000 to Rp 18,000 per gallon, while the price of refilled water is between Rp 7,000 to Rp 8,000 per gallon. With such price conditions, around 70 percent of households using bottled water state that the price of bottled water is in the "high" category, while for refilled water 100 percent of households state that the price is in the "sufficient" category.

The majority of PDAM water users provide a "good enough" rating on PDAM water quality. This is different from the household assessment on the quality of bottled water and refilled water where the majority of them provide a "good" assessment. In addition, there are 10 percent of households that provide a "very good" assessment of the quality of bottled water, while 1.14 percent of households give a poor assessment of the quality of PDAM water. This can be an indication that bottled water has the highest quality compared to PDAM water and refilled water, while PDAM water has the lowest quality among the three water sources. Consumer perceptions are quite solid when providing a "good enough" rating for PDAM water quality.

3.5. Estimated Willingness to Pay for Clean Water

The estimation of WTP values for clean water in this study uses the contingent valuation method (CVM). CVM analysis involves four main stages: market hypothesis, bidding game, valuation of WTP and WTP curve.

**Market Hypothesis.**

The market hypothesis in this study was formed on the basis of the condition of water consumed by the community in Kampung PuloGeulis in meeting their daily needs. One of the problems that occurred was the perception of some people who thought that the quality of PDAM water was still low and not safe to drink. This resulted in the people of Kampung PuloGeulis buying bottled water and refilled water to meet their water needs, even though the prices of both were higher than the PDAM water rates. Another problem associated with PDAM services is the continuity of water supply, considering that water sometimes does not flow and/or water flow is sometimes very small at certain times. Therefore, the improvement of the PDAM water supply system which covers quantity, quality and continuity needs to be done as an effort to improve water supply services to the whole community.

Submission of this hypothesis market to respondents then produces information about their willingness to pay for getting PDAM water services with quantity, quality and continuity that is better than before. The results of the analysis show that the total households that are willing to pay for the improvement of the water supply system from the PDAM are 54 people or 61 percent of the total respondents.

**Bidding game.**

Bidding games are used to obtain community bidding value for PDAM water. The method is applied by making an offer to the community with a minimum bid based on the customer tariff category of PDAM TirtaPakuan, where Rp 3,500 starting point submitted to R2 class customers; IDR 4,000 for class R3; and Rp 4,500 for class R4. Starting points are set based on rounding up of Rp 300 to Rp 400 from the highest water rate paid per m3, when water use is more than 10 m³ with a multiple increase in...
bid of Rp 500. Determination of the starting point value is based on standard drinking water staples according to the Government The City of Bogor (2012) written in the Bogor Mayor Regulation Number 21 of 2012 is a requirement of 10 m³/household/month, while an additional fee of Rp300 to Rp400 is made as a result of improvements from the PDAM and to avoid undervaluation of the condition of clean water from the PDAM will experience improvements. The Bogor City Government (2012) determined that the lowest water tariff increase of PDAM TirtaPakuan in 2012 was IDR 600 which was used to maintain and improve the quality of drinking water services by carrying out maintenance of drinking water treatment plants and drinking water sources of PDAM TirtaPakuan. Therefore, an additional cost of Rp 300 to Rp 400 is considered to be able to represent the cost of improving the water supply system of the PDAM which includes improving the quality, quantity, and continuity of clean water and can be used as a starting point for supply. The increase in offers with multiples of Rp500 is obtained from the difference in starting points between customer groups. The higher the bidding value chosen, thus the better the improvements made by the PDAM.

**Estimation of Mean WTP.** The estimation of the average value of WTP in this study is differentiated according to household customers in KampungPuloGeulis, namely households in category R2, R3 and R4. This is done so that the average value of the WTP obtained can represent the willingness to pay each class of customers. Data on the average distribution of WTP based on customer groups are presented in Table 5. Based on the results, it was found that the estimated average value of WTP for R2 households was Rp 3,852 per m³ (Table 6). This value reflects the large willingness of R2 households to pay for clean water from PDAM with better conditions. The amount of the WTP value of these households is greater than the current tariff for R3 class customers. The estimation of the average WTP value for R3 households is also greater than the current R4 class customer water tariff, which is Rp 4,572 per m³. The estimated average value of WTP for R4 class households is Rp5,000 per m³, which is also greater than the current R5 class water tariff.

**Estimated WTP Curve.** The WTP curve illustrates the relationship between the value of the WTP paid and the cumulative number of households that are willing to pay at the WTP level. The magnitude of the WTP value and the cumulative number of households who are willing to pay at the WTP level can be seen in Table 7. The information shown in Table 7 is then used to form the household WTP curve. The estimation of household WTP curve is shown in Figure 1. It is an estimate of the household WTP curve that illustrates the household demand curve in KampungPuloGeulis for the improvement of the water supply service system from PDAM TirtaPakuan.

The household WTP curve for the improvement of the water supply system from the PDAM has a negative slope. That is, the higher the value of the WTP, the fewer households are willing to pay. The curve can also be categorized as a demand curve because the higher the price (tariff) of water, the less demand for the improvement of the water supply system from the PDAM. In this case, people prefer to use clean water with the current condition of the water they consume compared to paying for water rates that are much higher than the current tariff.
Table 6. Distribution of Average WTP based on PDAMCustomer (Household) Categories

| Customer category | WTP (Rp/m³) | Frequency (households) | Relative frequency | Average WTP (Rp/m³) |
|-------------------|-------------|------------------------|--------------------|--------------------|
| R2                | 3,500       | 24                     | 0.55               | 1,909              |
|                   | 4,000       | 13                     | 0.29               | 1,182              |
|                   | 4,500       | 3                      | 0.07               | 307                |
|                   | 5,000       | 4                      | 0.09               | 454                |
| Total             |             | 44                     | 1.00               | 3,852              |

| R3                | 3,500       | 0                      | 0.00               | 0                  |
|                   | 4,000       | 2                      | 0.29               | 1,143              |
|                   | 4,500       | 2                      | 0.29               | 1,286              |
|                   | 5,000       | 3                      | 0.42               | 2,143              |
| Total             |             | 7                      | 1.00               | 4,572              |

| R4                | 3,500       | 0                      | 0.00               | 0                  |
|                   | 4,000       | 0                      | 0.00               | 0                  |
|                   | 4,500       | 0                      | 0.00               | 0                  |
|                   | 5,000       | 3                      | 1.00               | 5,000              |
| Total             |             | 3                      | 1.00               | 5,000              |

Table 7 WTP Value and the number of Households who want to pay

| No. | WTP (Rp/m³) | Frequency (household) | Cumulative frequency (household) |
|-----|-------------|-----------------------|---------------------------------|
| 1.  | 3.500       | 24                    | 34                              |
| 2.  | 4.000       | 15                    | 30                              |
| 3.  | 4.500       | 5                     | 15                              |
| 4.  | 5.000       | 10                    | 10                              |

Figure 1. WTP Curve of the Household to Improve PDAM Water Services

3.6. Household Perception on Water Pollution and Environmental Improvement

The problem of sanitation and water pollution is one of the problems that must be considered especially in PuloGulis which has a high population density. One of the problems of environmental cleanliness can be influenced by the behavior of the community in carrying out their daily activities. In
carrying out daily activities, community behavior is influenced by perceptions or perspectives on things, especially those related to the problem of waste pollution and improvement of environmental quality in KampungPuloGeulis.

**Community Perception of the Impact of Waste Pollution.**

In this study, the intended waste is domestic waste or household waste in the form of solid (garbage) and household waste in the form of liquid. The behavior of the community in disposing of waste can be seen in Table 8. Based on the research results it can be seen that all households dispose of their waste through a janitor, but the majority of households deliver their waste to the river directly. Community behavior in disposing of liquid waste causes river water to become polluted. The emergence of community behavior in disposing of waste is usually influenced by the knowledge and perceptions of households on the impact that will be caused due to pollution of the waste. Knowledge and community perceptions about the impact of waste pollution on the quality of surrounding water resources can be seen in Table 9. The results of the analysis show that 100 percent of households in this study stated that they knew about the impact of waste pollution (Table 9). This indicates that the community already knows about the impacts that will be caused by their behavior in disposing of daily waste, but there are still many households that drain their wastewater directly into the river. The behavior of the community in removing liquid waste into the river is forced because there is no other choice. However, developing septic tanks to reduce pollution of household to river wastewater cannot be done by the community because of limited land.

The perception of the impact of waste pollution analyzed in this study is the impact of pollution on the quality of the surrounding water resources. Based on the results of the analysis, there are two perceptions conveyed by the community. As many as 90 percent of households stated that pollution of household waste caused water resources to be severely polluted and cause unpleasant odors, while the remaining 10 percent of households stated that waste pollution only caused unpleasant odors.

**Community Perception of Environmental Quality Improvement.**

The environmental quality improvement program in KampungPuloGeulis is a program designed with the aim of improving the quality of the environment in KampungPuloGeulis. There are several environmental quality improvement programs analyzed in this study. The results of the analysis show that the most desired program for environmental quality improvement is the riverbank embankment creation program and the dredging of waste in the river with the percentage of households agreeing to be 100 percent in each program. According to community statements, both programs have been carried out at PuloGeulis, but the embankments made on the riverbank embankment development program have not covered all of the PuloGeulis riverbank areas. As for the dredging program in the river, the community wants the program to be carried out more often to reduce the amount of waste in the river and reduce the occurrence of river siltation.

**Table 8** Household behavior on disposing waste

| Category                | Frequency (household) | Percentage (%) |
|-------------------------|-----------------------|----------------|
| 1. Solid waste          |                       |                |
| a. Transported by janitors | 88                   | 100,00         |
| 2. Liquid waste         |                       |                |
| a. Septic tank          | 22                    | 25,00          |
| b. River                | 61                    | 69,32          |
| c. River and Public MCK | 5                     | 5,68           |
Table 9 Knowledge and Perception of Households towards Water and Environmental Pollution

| Category                                              | Frequency (household) | Percentage (%) |
|-------------------------------------------------------|-----------------------|----------------|
| 1. Knowledge on solid and liquid wastes               |                       |                |
| a. Know                                               | 88                    | 100            |
| b. Do not know                                        | 0                     | 0              |
| 2. Perception on the impact of pollution on environmental quality |                       |                |
| a. Water sources are severely polluted and bad smell  | 79                    | 90             |
| b. Only cause bad smell                               | 9                     | 10             |

4. Conclusion and Recommendation

4.1. Conclusion
1) The people of KampungPuloGeulis have four sources of clean water that are used to fulfill their daily needs and form five patterns of combined use of clean water. Of the various combinations of clean water sources, in general the average consumption of clean water has exceeded the standard of clean water usage set by the government.
2) Public expenditure for water consumption in general is still less than 5% of their average total income. The highest level of expenditure for water consumption is household water consumption patterns that use a combination of PDAM and AMDK water. This 5% water consumption expenditure is slightly above the standard 4% limit set by the government.
3) The majority of PDAM users and all users of bottled water and refill water provide a "good" assessment of the performance of the clean water provider. The price of PDAM water and refill water is considered "sufficient" by the community, while the price of bottled water is considered "high". As for the quality of clean water, the community provides a "good" assessment of the quality of bottled water and refilled water, and provides a "good enough" assessment of the quality of PDAM water. Public perceptions of clean water can influence the community's desire to get the improved water supply systems from the PDAM. In general, the average estimated value of household WTP for the improvement of the PDAM water supply system is quite high because the value of the WTP obtained exceeds the water level of the customer group one level above.
4) According to community perceptions, the impact of waste pollution on the quality of water resources is that river water becomes seriously polluted and causes unpleasant odors. The most desired program for environmental quality improvement is the riverbank embankment creation program and the dredging program on the river.

4.2. Recommendation
1) The use of river water that has been contaminated with waste can cause various negative impacts on health such as the appearance of skin diseases. Therefore, people who still use river water should reduce the intensity of river water use - even if not for consumption purposes, or stop using river water altogether.
2) Expenditures for consumption of clean water can be reduced by applying the concept of reduce and reuse water resources consumed, such as using a shower when bathing or using rain water or used water from washing the rice to water plants.
3) The average WTP value obtained is expected to be taken into consideration in making policies related to the determination of the increase in the price of clean water from PDAM TirtaPakuan by improving the water supply system, including increasing the quantity, quality and continuity of water supply, so that people get better quality water services.
4) The environmental quality improvement program most desired by the community should be taken
into consideration by the local government in the preparation of environmental quality improvement programs in Kampung Pulo Geulis.

5) Subsequent research on the analysis of community WTPs towards improving the clean water supply system from the PDAM, is suggested to examine the factors that influence it.

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