



Capacity Development and Payment of Environmental Services (Study in Surakarta City, Indonesia)

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Abstract : This study aims to: (1) Analyze the capacity development through education and communication to community by government for sustainable development process (2) To determine willingness to pay of the community for water conservation at Cokro Tulung and (3) Identify the determinants that significantly affect WTP of the community for water resources conservation. Respondents from this study are Surakarta citizen, precisely in the southern region of Surakarta, Laweyan District, Central Java. They are the customer of Surakarta Water Utility Company, especially the water distribution of the Cokro Tulung spring. This study employ binary logistic analysis and Contingent Valuation Method (CVM). Based on the interview results from 147 respondents, it is concluded that (1) the Surakarta Water Utility Company (PDAM) is not yet intensively educate and communicate to community regarding to the proper water management. The role of the government to the educational policy is very important to educate community regarding to the complex linkages between water, environment, and the impact of human activities to water availability (2) The average value of WTP in R2 is 1.133,- ; the average value of WTP in R3 is Rp3.368,- ;) The average value of WTP in R4 is Rp2.206,- ; and the average value of WTP of trade group 1 is Rp 3.706,-, (3) Sex, age, education, house ownership, perception of the ease of getting water, and the perception of the importance of conservation significantly affect the value of WTP of water resources conservation.

Keywords : Conservation, *willingness to pay*, environmental service, CVM, education.

Introduction

The increasing need of water is not only caused by the increase of the human population but also the increasing number of activities involving water. Thus, in addition to paying attention to the quality of water, it is also important for the water management agencies to consider the quantity or volume of the water they produce. The demand of clean water in several regions in Surakarta has increased significantly, thus Surakarta Water Utility Company (PDAM) has prepared long term policies and strategies since 2015 to anticipate water deficit in the upcoming years.

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Conflicts arise when the people of Cokro Village sensed the water debit at Cokro water source has been diminishing as PDAM and Aqua Corporation built their branches in some regions around the water source. Through the use their high powered pumps, PDAM and Aqua Corporation suck up adequate amount of water, diminishing the supply of irrigation water for hectares of the citizens' rice field. Another significant issue is the lack of education and the availability of information on water resource management as an attempt of conserving and protecting the environment. Policies and education take an important role in dealing with water scarcity, for instance by providing knowledge and information on how to use water effectively, the importance of protecting the environment for water availability in the future, and the use of technology to preserve water.

The success of water resource management or conservation at upstream area needs to be supported by other stakeholders, in this case the managers and the beneficiaries of water management, to promote more efficient and responsible natural resource management. Society is pushed to embrace the responsibility of managing sustainable ecosystem and stop using natural resources improperly. There must be proper mechanism to regulate the use of water resource in order that the misuse of water can be reduced. Therefore, Payment for Environmental Services (PES) is expected to correct the deviation of environmental services toll, which is too low, i.e. zero when there is no payment for environmental services.

Theoretical Background

Capacity Building can be interpreted as an attempt to strengthen the capacity or capability of an individual, groups, or communities through the development of abilities, skills, and potentials an expert in capacity building for governmental sectors focuses capacity building on three dimensions, i.e. the development of human resource, strengthening organization, and reformation of institutions [1].

Payment for Environmental Services (PES) is a market based instrument for conservation purpose, based on the principle that those who receive benefits from environmental services need to pay for the continuity of the services, and those who provide the services need to be compensated. In the mechanism of PES, the providers of environmental services receive payment according to their capacity in providing requested environmental services or conducting analysis on environmental services [2].

The understanding of PES mechanism can help in constructing interesting scheme that can be utilized by the providers of the services in many levels. The payment mechanism of environmental services according to World Bank (2003) cited in Wunder, is explained at Figure 1 below [3].

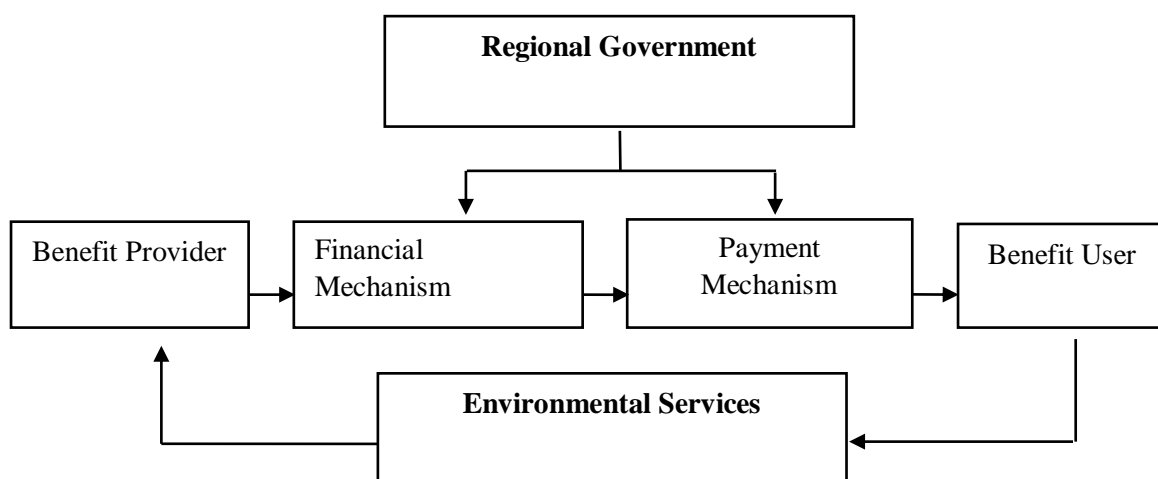


Fig. 1: Payment for Environmental Services

Source: World Bank (2003) in Wunder (2005)

Previous research on Payment for Environmental Services (PES) conducted by Wendland et al. implies that in order to implement PES, there must be initial investment to build infrastructures to support the

success of PES and the establishment of institutions and policies to facilitate many services of ecosystem conservation [4].

Willingness to Pay (WTP) is defined as an amount a consumer is willing to pay to obtain goods or services [5]. Another research is one conducted by Afifah *et al*. They estimated and analysed the factors influencing the WTP value of water consumers in Kerandangan Village, West Lombok, West Nusa Tenggara. The significant variables partially influencing WTP with significance value of $\text{sig} < 0.05$ are income, the use of water, perception of the importance to conserve water, sex, and education. Meanwhile the insignificant variables in the research are age, water source, house location, number of family member, perception about water quantity, quality, and perception about the need of water [6].

A research analysing WTP of citizens in town for land, water, and environmental improvement services was done [7]. Research findings imply that the factors influencing WTP are income, age, number of family member, water availability, complaint about water, and status of the house. Other variables such as education, people's perception about their roles for PES, people's perception about agreement for PES, their trust for environmental improvement, profession, and water choice.

Research Method

This research was specialized for districts that used the service from PDAM of Surakarta, i.e. Laweyan District (Bumi, Jajar, Karang Asem, Laweyan, Kerten, Pajang, Purwosari, and Sondakan). Laweyan District was selected as the research location because it is the consumer of Perumda Packaged Water by Surakarta City whose water source is mainly from Cokro Tulung water spring. The production source at southern regions of Surakarta (Laweyan District) with the total production of 243.19 liter/sec consists of deep well in Karangasem with water debit of 6.19 liter/sec and Cokro Tulung water spring with the debit of 237.00 liter/sec. Surakarta map is shown below:



Fig. 2: Map of Surakarta

Source: Surakarta City Public Works Department (2018)

This study employed binary logistic regression as statistical analysis by using SPSS 16.0 [8]. Contingent Valuation Method (CVM) is a survey technique to inquire society about value or toll they give for commodity that has no market such as environmental goods [9].

Samples were collected by using proportionate stratified random sampling because the estimated amount of WTP was different in each of the family group (R2, R3, R4, dan N1). The number of samples collected based on the calculation using Slovin equation was 98. To anticipate mistakes in the answers/outlier, the number of respondent was added by 50%, so the total number of respondent became 147, with the composition: 71 respondents from R2, 38 respondents from R3, 19 respondents from R4, and 19 respondents from N1.

Estimation Result of Respondents Willingness To Pay

Based on the interview result, the majority (124 respondents or 84%) from 147 respondents are willing to pay water conservation. The reason why they willing is they realize the importance of conservation to get purer water. They expect the water conservation will increase pure water and maintained quality.

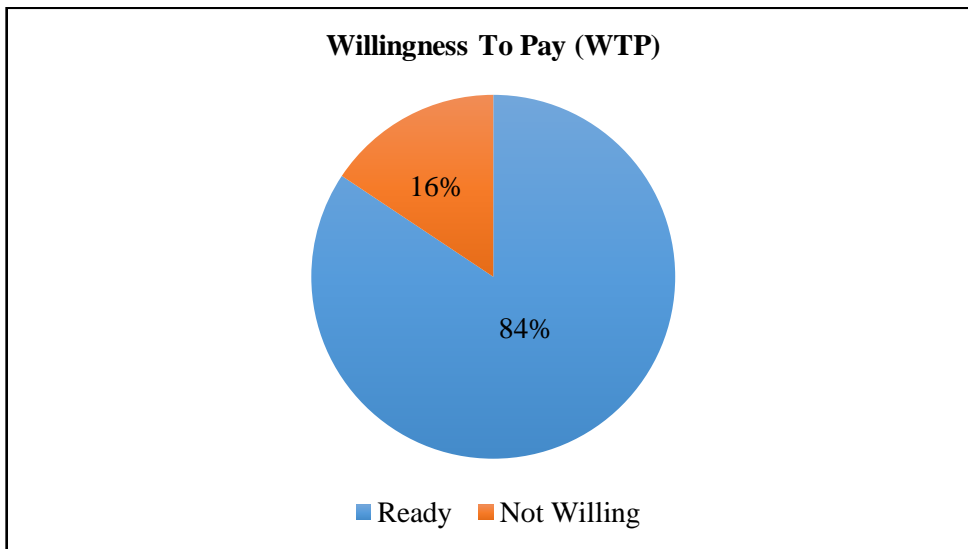


Fig. 3: Willingness to Pay Percentage

The remaining 16% or 23 people are not willing to pay for conservation costs because they do not have more money to pay. Some respondents think that the problem is the government's responsibility to pay conservation costs so that they do not have obligation to pay. In addition there are also those who think that there is no need to conserve water resources at the Cokro Tulung spring because the water quality is already clean.

WTP Value for Water Resources Conservation

The interview result reveal that the WTP of household / respondent for water conservation at Cokro Tulung Spring is varies.

Table 1: Willingness to pay calculation

No.	Customer Group	Total WTP (Rp)	Min. WTP (Rp)	Max. WTP (Rp)	Avg. WTP (Rp)
1.	R2	113.500	500	5.000	1.133
2.	R3	128.000	1.000	10.000	3.368
3.	R4	42.500	1.000	5.000	2.206
4.	N1	67.000	2.000	6.000	3.706

In determining WTP, respondent tend to choose prices with multiples of Rp500, -, such as Rp1,000,- Rp1,500, Rp2,000 - Rp2,500 and so on up to Rp.10,000. Based on Table 4.9, the WTP value of four groups of customer are vary. The lowest WTP value that household 2 want to pay is Rp500,-, household 3 is Rp1.000,-, and trade group is Rp2.000,-. The WTP average value of the four customer groups are differ. The

WTP average value of household 2 is Rp1.133,-, household 3 is Rp3.368,-, household 4 is Rp2.206,-, and trade group 1 is Rp3.706.

The Total Value of WTP

Below is the summary of WTP aggregate from four type of households for all Water Utility Company customers (2016 data).

Table 2: Estimated total value of willingness to pay

No.	Customer Group	Avg. WTP (Rp)	Population	Total (Rp) / Month
1.	R2	1.133	35.991	40.777.803
2.	R3	3.368	11.026	37.135.568
3.	R4	2.206	5.868	12.944.808
4.	N1	3.706	4.563	16.910.478
Jumlah total (R2, R3, R4, N1)		107.768.657		

The aggregate calculation of WTP is Rp 40,777,803 / month for 35,991 R2 customers. The number of customers of R3 is 11,026, thus the aggregate WTP is Rp. 37,135,568, - / month. The number of R4 customers is 5,868, thus that the aggregate WTP is Rp 12,944,808 / month. The number of N1 customers is 4,563 so that the aggregate WTP is Rp 16,910,478 / month.

Goodness of fit test (GoF)

Hosmer and Lemeshow Test is *Goodness of fit test (GoF)*, a test utilized to determine whether the model is proper or not. The test is proper when there is different significance between the model and observation value. If the statistic value of *Hosmer and Lemeshow* is greater than 5% ($\alpha = 0,05$), null hypothesis can't be reject. Thus, the model is able to predict the observation value or it can be said that the model is proper because it fit in with the observation.

Table 3: Hosmer and Lemeshow

Step	Chi-square	df	Sig.
1	4,512	8	0,808

Table 3 revealed the value of Chi-Square is 4,512 and the significance value 0,808 and the df is 8. It can be concluded that the significant value is higher than $\alpha = 0,05$ and the decision is accept H_0 that means there is no difference between predicted classification and observed specification. Thus, it can be concluded that the logistic model regression that utilized is fit the adequacy data.

Coefficient Determination (Nagelkerke R square)

Summary model of logistic regression equals to R square (R^2) test in linear regression model. The aim of summary model test is to identify how large is the combination independent variable are able to explain dependen variable. The summary of model estimation can be seen at Table 4 below:

Table 4: Coefficient determination result (Nagelkerke R square)

Step 1	-2 Log likelihood	41,915 ^a
	Cox & Snell R Square	0,441
	Nagelkerke R Square	0,761

The value of coefficient determination in the model of logistic regression is described by the value of *Nagelkerke R square*. Based on the test above, the value of *Nagelkerke R square* is 0,761 it means that the variability of dependent variable that can be explained by independent variable is 76,1%, while the 23,9% is explained by the other variables outside the model

T-test

This study utilize logistic regression to identify the partial effect of each dependen and independent variable. The output result is as follow:

Table 5:T-test results

Variable	Keterangan (Information)	B	Wald	Sig.
X1	Sex	3,180	6,167	0,013**
X2	Age	-0,123	6,121	0,013**
X3	Education	0,527	4,092	0,043**
X4	Number of family dependents	0,042	0,022	0,883
X5	Monthly household income	0,000	0,243	0,622
X6	House ownership	1,914	4,442	0,035**
X7	Length of stay	0,990	1,885	0,170
X8	Water resource that is used	1,351	1,161	0,281
X9	Water quality perception	-0,161	0,056	0,812
X10	Water needed perception	-0,974	2,271	0,132
X11	Perception of ease of getting water	1,578	4,753	0,029**
X12	Conservation importance perception	9,069	16,676	0,000**
Constant		3,990	0,374	0,541

Remaks: **Sig. on α 5%

Table 5 revealed the coefficient value of logistic regression. Thus, the regression equation is as follow:

$$WTP = 3,990 + 3,180 - 0,123 + 0,527 + 0,042 + 0,000 + 1,914 + 0,990 + 1,351 - 0,161 - 0,974 + 1,578 + 9,069$$

Result and Discussion

Based on data from PERUMDA over business trip of all activities throughout 2018 related to water management, these are the implementation of asset management workshop, workshops for national urban water supply programs, and guidance on domestic wastewater management. The results of an interview with the Head of Research and Development Section at PERUMDA, she is Mrs. Upi Yuniarti, Amd who states that PERUMDA has not yet incentivized education and communication to the public related to proper water management.

It is important to provide knowledge and understanding to the community about the complex interrelationships between water, the environment, and the impact of human activities on water availability. The government's role in policies in the education sector is very important. Thus, it will provide a meaningful contribution to improve the problem of water scarcity, decreasing water supply, and water quality problems. Thus, that the community will understand the importance of protecting water resources, for example the effective way of using water, the importance of environmental protection for water availability and quality, and regarding the use of water-saving technology.

The second hypothesis is "Determining the WTP (willingness to pay) of the community to pay for the conservation of water resources at Cokro Tulung spring". Contingent Valuation Method (CVM) is utilized to valuate WTP. Table 4.10 reveal the WTP average value of household 2 is Rp. 1,133, household 3 is Rp. 3,368, households 4 is Rp. 2,206, and the trade group 1 is Rp. 3,706. This suggests that the second hypothesis which states that the low WTP management for conservation of water resources is not proven true, but vice versa, that WTP management for conservation of water resources is low because it is still below the total price of water received by the government / PERUMDA per month at present.

The WTP value that relatively low reveal that the customer group can not give economic value for conservation activities optimally. In addition, respondents' water source is from Water Utility Company and water well. Thus, it become consideration to provide environmental services costs for water resources conservation. Respondents are mostly do not know yet about Payment Environmental Service and lower the WTP value. The ability to answer the question about willingness to pay on questionnaire when interview session is less. Regarding to this, respondent tend to lower the WTP value.

The result of the third hypothesis is "Understanding the determinants that affect WTP significantly over the additional benefits because of the increasing conservation management at Cokro Tulung spring". The dependent variable in this study is WTP of water resources conservation at Cokro Tulung. While the independent variables are gender, education, number of family dependents, income, home ownership, water sources, perception of water quality, perception of water needs, perception of the importance of conservation, perception of the ease of getting water, length of stay, and age. However, from the twelve independent variables there are only six variables that have a significant effect on WTP because a significant value is below 0.05, that are gender, education, home ownership, perception of the importance of conservation, perception of the ease of getting water, and age.

Conclusion

Based on the discussion above, it can be concluded that:

1. Surakarta Water Utility Company is not yet insensitively educate and communicate with community regarding to the proper water management. The government's role in policy in term of education is very important to provide knowledge and understanding to the public about the complex linkages between water, environment and the impact of human activities on water availability.
2. The WTP average value of household 2 is Rp1.133,-. Thus, the aggregate value of WTP is Rp2.242.207,-/month and Rp26.906.484,-/year. The WTP average value of household 3 is Rp3.368,-. Thus, the aggregate value of WTP is Rp3.556.608,-/month and Rp42.679.296,-/year. The WTP average value of household 4 is Rp2.206,-. Thus, the aggregate value of WTP Rp1.158.150,-/month and Rp13.897.800,-/year. And the WTP average value of trade group 1 is Rp3.706,-. Thus, the WTP aggregate value is Rp1.927.120,-/month and Rp23.125.440,-/year.
3. Sex, age, education, and house ownership, persepsi kemudahan mendapatkan air, and perception the importance of conservationsignificantly affect the WTP value for water conservation.

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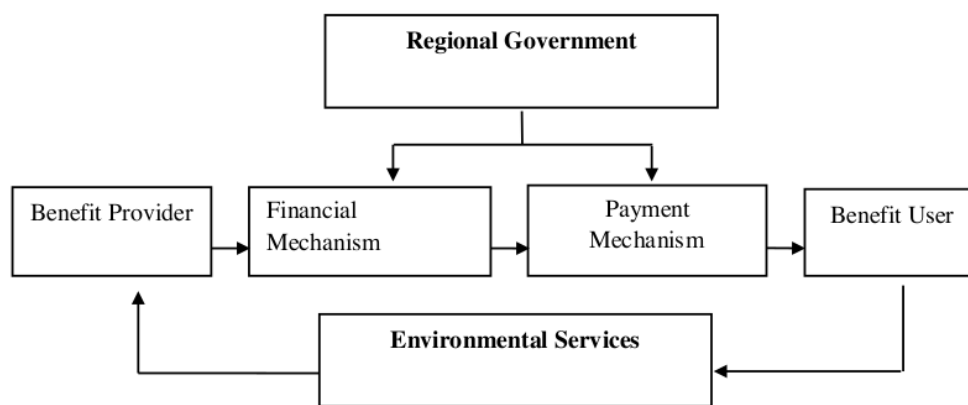


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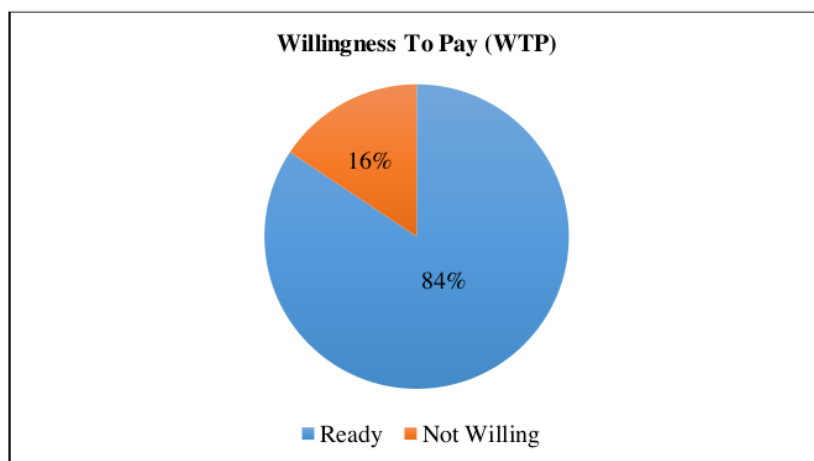


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Step	Chi-square	df	Sig.
1	4,512	8	0,808

Table 3 revealed the value of Chi-Square is 4,512 and the significance value 0,808 and the df is 8. It can be concluded that the significant value is higher than $\alpha = 0,05$ and the decision is accept Ho that means there is no difference between predicted classification and observed specification. Thus, it can be concluded that the logistic model regression that utilized is fit the adequacy data.

Coefficient Determination (Nagelkerke R square)

Summary model of logistic regression equals to R square (R^2) test in linear regression model. The aim of summary model test is to identify how large is the combination independent variable are able to explain dependen variable. The summary of model estimation can be seen at Table 4 below:

Table 4: Coefficient determination result (Nagelkerke R square)

Step 1	-2 Log likelihood	41,915 ^a
	Cox & Snell R Square	0,441
	Nagelkerke R Square	0,761

The value of coefficient determination in the model of logistic regression is described by the value of *Nagelkerke R square*. Based on the test above, the value of *Nagelkerke R square* is 0,761 it means that the variability of dependent variable that can be explained by independent variable is 76,1%, while the 23,9% is explained by the other variables outside the model

T-test

This study utilize logistic regression to identify the partial effect of each dependen and independent variable. The output result is as follow:

Table 5:T-test results

Variable	Keterangan (Information)	B	Wald	Sig.
X1	Sex	3,180	6,167	0,013**
X2	Age	-0,123	6,121	0,013**
X3	Education	0,527	4,092	0,043**
X4	Number of family dependents	0,042	0,022	0,883
X5	Monthly household income	0,000	0,243	0,622
X6	House ownership	1,914	4,442	0,035**
X7	Length of stay	0,990	1,885	0,170
X8	Water resource that is used	1,351	1,161	0,281
X9	Water quality perception	-0,161	0,056	0,812
X10	Water needed perception	-0,974	2,271	0,132
X11	Perception of ease of getting water	1,578	4,753	0,029**
X12	Conservation importance perception	9,069	16,676	0,000**
Constant		3,990	0,374	0,541

Remaks: **Sig. on α 5%

Table 5 revealed the coefficient value of logistic regression. Thus, the regression equation is as follow:

$$WTP = 3,990 + 3,180 - 0,123 + 0,527 + 0,042 + 0,000 + 1,914 + 0,990 + 1,351 - 0,161 - 0,974 + 1,578 + 9,069$$

Result and Discussion

Based on data from PERUMDA over business trip of all activities throughout 2018 related to water management, these are the implementation of asset management workshop, workshops for national urban water supply programs, and guidance on domestic wastewater management. The results of an interview with the Head of Research and Development Section at PERUMDA, she is Mrs. Upi Yuniarti, Amd who states that PERUMDA has not yet incentivized education and communication to the public related to proper water management.

It is important to provide knowledge and understanding to the community about the complex interrelationships between water, the environment, and the impact of human activities on water availability. The government's role in policies in the education sector is very important. Thus, it will provide a meaningful contribution to improve the problem of water scarcity, decreasing water supply, and water quality problems. Thus, that the community will understand the importance of protecting water resources, for example the effective way of using water, the importance of environmental protection for water availability and quality, and regarding the use of water-saving technology.

The second hypothesis is "Determining the WTP (willingness to pay) of the community to pay for the conservation of water resources at Cokro Tulung spring". Contingent Valuation Method (CVM) is utilized to valuate WTP. Table 4.10 reveal the WTP average value of household 2 is Rp. 1,133, household 3 is Rp. 3,368, households 4 is Rp. 2,206, and the trade group 1 is Rp. 3,706. This suggests that the second hypothesis which states that the low WTP management for conservation of water resources is not proven true, but vice versa, that WTP management for conservation of water resources is low because it is still below the total price of water received by the government / PERUMDA per month at present.

The WTP value that relatively low reveal that the customer group can not give economic value for conservation activities optimally. In addition, respondents' water source is from Water Utility Company and water well. Thus, it become consideration to provide environmental services costs for water resources conservation. Respondents are mostly do not know yet about Payment Environmental Service and lower the WTP value. The ability to answer the question about willingness to pay on questionnaire when interview session is less. Regarding to this, respondent tend to lower the WTP value.

The result of the third hypothesis is "Understanding the determinants that affect WTP significantly over the additional benefits because of the increasing conservation management at Cokro Tulung spring". The dependent variable in this study is WTP of water resources conservation at Cokro Tulung. While the independent variables are gender, education, number of family dependents, income, home ownership, water sources, perception of water quality, perception of water needs, perception of the importance of conservation, perception of the ease of getting water, length of stay, and age. However, from the twelve independent variables there are only six variables that have a significant effect on WTP because a significant value is below 0.05, that are gender, education, home ownership, perception of the importance of conservation, perception of the ease of getting water, and age.

Conclusion

Based on the discussion above, it can be concluded that:

1. Surakarta Water Utility Company is not yet insensitively educate and communicate with community regarding to the proper water management. The government's role in policy in term of education is very important to provide knowledge and understanding to the public about the complex linkages between water, environment and the impact of human activities on water availability.
2. The WTP average value of household 2 is Rp1.133,-. Thus, the aggregate value of WTP is Rp2.242.207,-/month and Rp26.906.484,-/year. The WTP average value of household 3 is Rp3.368,-. Thus, the aggregate value of WTP is Rp3.556.608,-/month and Rp42.679.296,-/year. The WTP average value of household 4 is Rp2.206,-. Thus, the aggregate value of WTP Rp1.158.150,-/month and Rp13.897.800,-/year. And the WTP average value of trade group 1 is Rp3.706,-. Thus, the WTP aggregate value is Rp1.927.120,-/month and Rp23.125.440,-/year.
3. Sex, age, education, and house ownership, persepsi kemudahan mendapatkan air, and perception the importance of conservationsignificantly affect the WTP value for water conservation.

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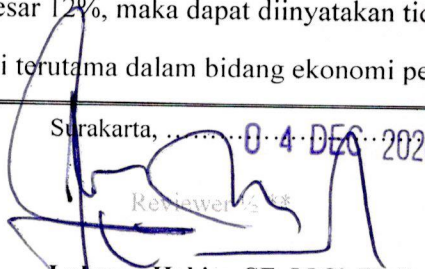
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