

HEALTH WATER MANAGEMENT SYSTEM IN URBAN AREA

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Abstract: Conservation of water resources in Indonesia is based on the management of springs on a large scale or in terms of water production. The approach that is often used is management from the demand side so that the mindset of the people is still trapped that water resources are free goods that can be taken without having to renew them again. This research tries to achieve direct community participation to participate in realizing and managing water resources directly. Community participation techniques use advice on implementing policies to improve water resources. The policies offered include infiltration wells, biopori, and reforestation. The policy offer is the right alternative for households/communities directly. The purpose of this study is divided into 3, namely knowing the level of community WTP, knowing the variables that affect the PAP and preference analysis of alternative policy choices. The results of the analysis show that the WTP level of the city of Surakarta is still low, which is equal to $WTP \leq \text{Rp. } 50,000$. Policy variables can influence the level of willingness to pay by 42.60% compared to other variables only able to influence by 15.95% calculated using multinomial logistic regression. The results of the Analytical Hierarchy Process (AHP) analysis show that the ranking 1 weighting is the infiltration well policy.

Keywords: *Water; Policy; Willingness to Pay; Multinomial Logit; Analytical Hierarchy Process.*

1. Introduction

The condition of water resources in Indonesia is constrained by several complex problems and until now it has not been overcome. Some of the problems of water resources in Indonesia that have yet to be overcome are the low level of water services, the quality of raw water, the quantity of water that is very volatile in the rainy season and dry season, the lack of technology used for raw water processing. The target of Millennium Development Goals (MDGs) achievement in 2015, especially in the aim of the proportion of households with access to drinking water and proper sanitation has still not been achieved from the target of 67% reached 57.2%.

This study will analyze the willingness to pay for the improvement of urban water resources management. Improved management of water resources through a choice of regional policies on the manufacture of infiltration wells, biopori, and reforestation. One of the policies in Presidential Regulation No. 33 of 2011 is a policy of increasing the role of the community and business world in the management of water resources. Increasing the role of the community can be realized effectively in environmental tax collection to improve the management of water resources.

If this component of cost is included in the policy as an element of environmental tax, it will cause an increase in the cost of environmental management of water. The added value that can be given in this research is that it is expected to be able to provide input in the preparation of regional regulations on the management of water resources more applicatively, increase community participation, and increase public knowledge and concern.

2. Research Method

The types of data used primary data and secondary data. Primary data is data that is collected by way of making direct observations of the object under study. The method used to obtain primary data is a survey method with direct interview techniques with the help of a list of questions (questionnaire).

The implementation of this research is divided into 3 parts, including:

a. **Questionnaire Design**

The first stage in this study was to identify the problems of urban water resources in the city of Surakarta and find solutions to be offered to the community. In addition, the making of questionnaires was also carried out at this stage through discussion and literature review to form the appropriate questionnaire form.

b. **Fieldwork**

Field research was conducted to clarify problems in the field. The questionnaire was given to 100 respondents in the city of Surakarta. In each sub-district is divided equally according to the cluster.

c. **Valuation**

1) **Contingent Valuation Method**

CVM techniques are based on fundamental assumptions about ownership rights (Garrod and Willis, 1999), if the individual asked does not have rights to goods and services produced from natural resources, relevant measurements are the maximum willingness to pay for obtain the item. Conversely, if the individual we ask has rights to resources, the relevant measurement is the willingness to accept the most minimum compensation for the loss or damage of the natural resources he has.

Factors that influence WTP and their probability values are one of the objectives of this study. These objectives can be answered using econometric analysis tools, namely using the logit model. The logit model is a non-linear regression model that produces an equation where the dependent variable is categorical. Respondents were asked about willingness to pay for improvements in urban water resources management, and what determinants were thought to affect significantly.

2) **Analytic Hierarchy Process (AHP)**

The data analysis used in this study is the AHP (Analytical Hierarchy Process) method. Calculations can be done manually using Microsoft Excel or with the help of expert choice software.

3. Results and Discussion

3.1. Results

a. Contingent Valuation Method (CVM)

Willingness to pay (WTP) is one indicator to see the level of willingness of respondents to pay a number of costs in order to protect the environment. The level of willingness to pay aside from being determined by economic, social factors can also be determined through the application of policies. The policies offered to improve water resources management include infiltration wells, biopori and reforestation.

Table 1. WTP Household Society towards Water Management Policies

No	WTP Health Water Management	Infiltration Wells Policy		Biopori Policy		Greening Policy	
		Total	%	Total	%	Total	%
1	WTP ≤ Rp. 50.000	170	40.8	100	24.0	75	18.0
2	Rp. 51.000 < WTP < Rp. 80.000	75	18.0	95	22.8	80	19.2
3	Rp. 81.000 < WTP < Rp. 100.000	60	14.4	55	13.2	45	10.8
4	Rp. 101.000 < WTP < Rp. 150.000	15	3.6	6	1.4	0	0.0
5	WTP ≥ Rp. 150.0000	3	0.7		0.0		0.0
TOTAL		323	77.5	256	61.4	200	48.0

Tabel 2. Results of Multinomial Logistic Regression Without Policy Variables

Independent Var	WTP 0		WTP 1		WTP 2	
	P > z	Odds Ratio	P > z	Odds Ratio	P > z	Odds Ratio
Gender	0.419	1.52044	0.366	1.44196	0.618	1.85521
Education	0.001	1.00100	0.551	1.73499	0.069	1.07144
Income	0.008	1.00803	0.599	1.82030	0.143	1.15373
Family Member	0.368	1.44484	0.159	1.17234	0.002	1.00200
Knowledge of Water Scarcity	0.480	1.61607	0.345	1.41199	0.965	2.62479
Awareness of Water Scarcity	0.000	1.00000	0.198	1.21896	0.734	2.08340
Water Supply	0.137	1.14683	0.034	1.03458	0.595	1.81303
Water Usage	0.031	1.03149	0.477	1.61123	0.735	2.08548
2 Log likelihood			-370.11726			
Pseudo R-Square			0.1595			
WTP Average			WTP < 50.000			

Tabel 3. Results of Multinomial Logistic Regression with Policy Variables

Independent Var	WTP 0		WTP 1		WTP 2	
	P > z	Odds Ratio	P > z	Odds Ratio	P > z	Odds Ratio
Gender	0.167	1.91453	0.367	1.25348	0.363	0.69898
Education	0.131	0.66696	0.314	0.85813	0.059	0.53018
Income	0.123	1.00000	0.308	1.00000	0.281	1.00000
Family Member	0.632	1.02704	0.062	0.75730	0.002	2.02222
Knowledge of Water Scarcity	0.493	1.29128	0.222	0.62682	0.561	0.83147
Awareness of Water Scarcity	0.119	0.43666	0.129	1.73034	0.424	1.38473
Water Supply	0.427	0.78125	0.074	1.52358	0.319	0.67093
Water Usage	0.533	1.03771	0.068	1.15390	0.480	0.93816
Infiltration wells policy	0.000	95.33939	0.506	1.21706	0.694	0.000000000794
Biopori policy	0.020	4.70182	0.008	3.16000	0.087	2.99236
Greening policy	0.000	16.44315	0.000	0.19005	0.203	1.95240
2 Log likelihood			-252.74321			
Pseudo R-Square			0.4260			
WTP Average			WTP < 50.000			

b. Analytical Hierarchy Process (AHP)

Tabel 3. Priority Weight of AHP Criteria for Selection of Policy for Health Water Management in Surakarta

Kriteria	Bobot	Ranking
Infiltration Well	38%	1
Biopori	32%	2
Greening	30%	3

3.2. Discussion

a. Contingent Valuation Method (CVM)

Table 1 presented the frequency of description analysis show the level of WTP of the city of Surakarta to improve the management of water resources of less than or equal to Rp. 50,000 ($WTP \leq \text{Rp. } 50,000$). The policy of infiltration wells became a conservation technique chosen by 323 respondents or 77.5% of the people of Surakarta city.

The processing of multinomial logistic regression results is divided into 2 parts to capture how much influence the policy has as an independent variable on the willingness to pay households in each WTP rank. The multinomial logistic regression first processes the

independent variable on the dependent variable without the existence of an independent variable policy. After finding the results are then compared with the second processed result where the independent policy variable is included.

Multinomial logistic regression results without policy variables :

- 1) Effect factors that affect the willingness of households to pay for improved water management at the WTP level 0 = $WTP \leq \text{Rp. } 50.000$ are influenced by education, income, awareness of water scarcity, and water usage. WTP Level 1 = $51.000 < WTP < \text{Rp. } 80.000$ is influenced by water supply sources and the level of WTP 2 = $81.000 < WTP < \text{Rp. } 100.000$ is influenced by the number of family members.
- 2) WTP level 0 = $WTP \leq 50.000$, the higher the variable education, income, awareness of water scarcity, water usage, the tendency of 1.0000 - 1.008 times to pay compared to other WTPs.
- 3) WTP level 1, the improvement in water supply has a tendency to pay 1.03 times compared to other levels of WTP.
- 4) WTP Level 2 = $81.000 < WTP < \text{Rp. } 100.000$, the higher the number of family members has the tendency to pay 1.002 times more than paying at other WTP levels.
- 5) Every 1% increase in education variables, awareness of water scarcity, and sources of water supply will reduce the willingness to pay households in paying for improvements in water resources management by 5% - 22.5%. Educational variables have a negative influence because environmental awareness education is not obtained by the elderly (with higher education), unlike young people who have received environmental awareness education from an early age.

Every 1% increase in income, water usage, and the number of family members will increase the willingness to pay households to pay for improvements in water resources management by 0.0000006% - 1.75%.

Multinomial logistic regression results with policy variables :

- 1) Effect factors that affect willingness of households to pay for improvements in water management at the WTP 0 level are influenced by infiltration well policies, biopore policies, and greening policies. The WTP 1 level is influenced by biopori policies and greening policies. The level of WTP 2 is influenced by the number of family members.
- 2) WTP level 0 = $WTP \leq 50.000$ with the application of infiltration well, biopori and greening policies, the tendency of a person to pay 4.7 - 95.34 fold to pay compared to other WTPs.
- 3) Implementation of biopori and greening policies, the tendency to pay someone is 0.1900 - 3.160 times in WTP 1 = $51.000 < WTP < \text{Rp. } 80.000$ compared to other WTP levels.
- 4) WTP Level 2 = $81.000 < WTP < \text{Rp. } 100.000$, more and more family members will have a tendency to pay 2.022 times compared to paying at other WTP levels.
- 5) The implementation of infiltration wells, biopori and reforestation policies will increase the willingness to pay 5.2% - 21-13%. And a 1% increase in the number of family members will increase the willingness to pay by 0.1513%.

b. Analytical Hierarchy Process (AHP)

Alternative policies for improving water resources management offered for residents of Surakarta city were analyzed using AHP. The results of pairwise comparison calculations on each criterion are weighted by ranking 1 infiltration well policy by 38%, ranking 2 biopori policies by 32% and ranking 3 greening policies by 30%.

4. Conclusion

People in Surakarta have a low level of willingness to pay for conservation of water resources for the realization of healthy water management in cities. This is indicated by the WTP of Surakarta city community showing a figure of less than or equal to Rp. 50,000.00. The current conditions in Surakarta city have no policies related to the conservation management of healthy water resources. Statistical calculation of the application of policies in the city of Surakarta is more able to influence the community when compared to the variables of sex, education, opinion, number of family members, knowledge, concern, sources of water supply and water use. So that policy making related to the management of healthy water resources management in Surakarta is feasible to be considered by the city government. The calculation using multinomial logit and AHP shows that the policy chosen by the people of Surakarta is the policy of making infiltration wells. This is an input for the government to implement the policy of making infiltration wells when requesting permission to establish new buildings.

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