Economic Valuation of Tojang Spring, East Lombok

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Abstract

Water resource existence in the rural area faces many challenges and threats driven by climate changes or socio-economic activity. As one of few water resources in East Lombok, Tojang spring face degradation threats due to the rapid growth of population and its activity. This study adopted a stated preference approach to investigate willingness to pay for the conservation and maintenance of Tojang spring and its influencing factors. Data was collected through a survey of 100 households which were selected randomly. As part of the findings, the survey result showed evidence that the majority of the respondent was willing to pay an average of IDR 8,350 per month with an annual economic value of IDR 1,144,584,600.00. Influencing factors that determined willingness to pay include age, household income, education, family size, water bill, length of usage, water quantity, and existence value. This study seeks to provide information that could affect decision-making toward the restoration and development of Tojang spring for its sustainability.

Keywords: Economic Valuation, Willingness to Pat, Contingent Valuation Method, Tojang Spring

1. INTRODUCTION

Water resources existence provides an opportunity for economic development and food sustainability through its surrounding area due to water's ability to support the basic needs of a human being. In addition, water also generates an important role in hydrologic cycle processes and in regulating the earth system. Various studies have demonstrated the critical value of natural water resources for the local population's basic needs. For example the critical value of Gemulo Spring as the only clean water source for locals in Dusun Cangar (Ningrum, 2017) and the importance of Lake Malombe for the local community (Makwinja et al., 2022). Despite its significant contributions, water resources face many challenges due to the rapid growth of population and climate change over the past decade.

Rapid growth in the human population and increasing socio-economic activity result in higher demand for clean water. In addition, challenges for water resources management often come from combined climate change and stakeholder interest (Phan et al., 2021). This phenomenon also has a significant impact on the sustainability issue of an ecosystem, especially for clean water supply (Makwinja et al., 2022; Ningrum, 2017).

As one of the main water supplier in East Lombok, Tojang Spring face similar threats as many natural water resources around the world. While exploitation grows in line with the rapid growth of the human population and needs, the conservation aspect is not enough given attention which results in the degradation of an ecosystem (Diswandi et al., 2021). In general, ecosystem changes will affect the quality and quantity of water therefore conservation is needed to maintain the ecosystem and reduce water pollution (Kreye et al., 2014). However, due to the nature of water resources as non-market goods, it is difficult to estimate the value for Tojang Spring therefore stated preference approaches are used to estimate the value for conservation.

2. RESEARCH METHOD

This study employed a quantitative method in which the data were collected through a survey of 100 households selected randomly and relying on the contingent valuation method to seek to elicit value for non-market base goods (Abdullah et al., 2011). The survey also sought respondents' willingness to pay for ecosystem conservation and maintenance of Tojang spring. In this survey, a hypothetical market scenario is that every household will be

charged a certain amount of money for ecosystem restoration and maintenance of the Tojang spring. To maximize the accuracy of the survey, a bidding game was applied in a structured questionnaire which was administered in four regions in Lendang Nangka. The questionnaire was structured in a certain way to obtain specific data including respondent demography, economy, water dependency, and environmental awareness.

3. MODEL SPECIFICATION

This study sought to not only estimate the Tojang Spring's value for ecosystem restoration and maintenance programs but also to identify determining factors for willingness to pay. The relations between variables can be described with a model as follow,

$$\text{WTP}i=\beta+\mathbf{X}i\beta+ui \qquad (1)$$

Where WTPi represents the value of willingness to pay of respondent and β represents a vector of slope parameter in the relationship between variables. In this model, xi is an observation vector for independent variables which are mostly household characteristics and ui represents stochastic terms that are assumed to be normally distributed (Amoah et al., 2022). The value of WTP was hypothesized to be influenced by age, education level, income, family size, water bill, usage length, alternative water resources, water utilization activities, existence value, water quality, and quantity.

4. RESULTS AND DISCUSSIONS

Respondent Characteristics

1. Age

Respondent age distribution was found almost equally distributed, with exception of the 65-79 age interval. The distribution indicated that the demographic pyramid of the respondent was stationary where every age category has an almost similar population.

Figure 1 Age

Age	*Frequency*	*Percentage*
20-34	*34*	*34%*
35-49	*35*	*35%*
50-64	*26*	*26%*
65-79	*5*	*5%*
Total	*100*	*100%*

2. Education

Education was measured by the last educational level that respondents graduate from. Out of hundred respondents, most respondents graduated from high school or college with 22% of the respondent graduating with a bachelor and 37% are graduated from high school.

Figure 2 Education

Education Level	*Total*	*Persentase*
Never Finish Elementary	*5*	*5%*
Graduated Elementary	*15*	*15%*
Junior High School	*13*	*13%*
Senior High School	*37*	*37%*
Diploma	*6*	*6%*
Bachelor	*22*	*22%*
Post Graduate	*2*	*2%*
Total	*100*	*100%*

3. Income

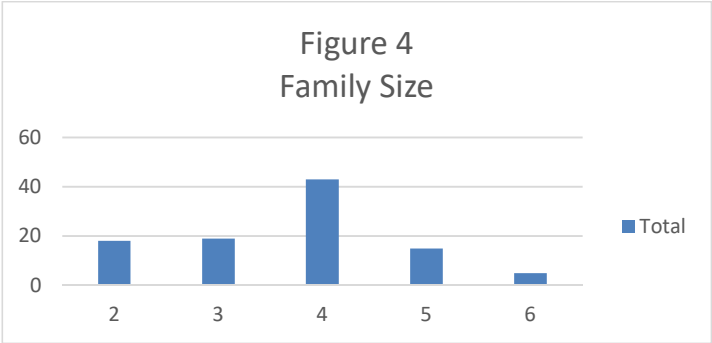
Respondent income was distinguished into four different categories which represent general respondent household income. This survey showed that the majority of respondent income were in the first category with 51% of respondent. This phenomenon also indicated most of the respondents were living with a lower level of income than the minimum regional wage rate.

Figure 3

Income	*Frequency*	*Percentage*
< Rp 1.000.000	*51*	*51%*
Rp 1.000.000 - Rp 3.000.000	*34*	*34%*
Rp 3.000.000 - Rp 5.000.000	*13*	*13%*
>Rp 5.000.000	*2*	*2%*
Total	***100***	***100%***

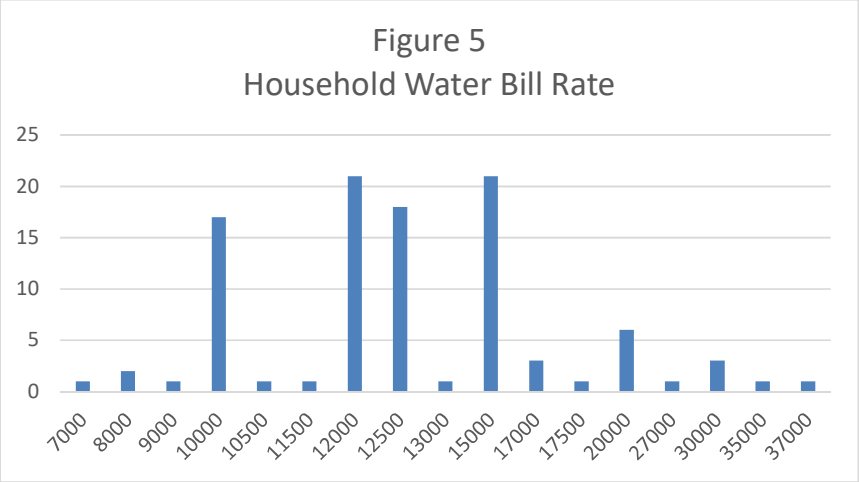
4. Family size

Data on family size shows that out of one hundred respondents, the majority of the respondent has a family ranging from 2 person – 4 person per household with more than 80% of total respondent. This result indicated that respondents tend to have a small family number per household.



5. Water bill per household

Data distribution for the bill of water usage for every household shows that the majority of respondents pay around IDR 10.000 – IDR 15.000 per month with 77% of the total respondent and other categories distributed almost equally.



6. Usage length

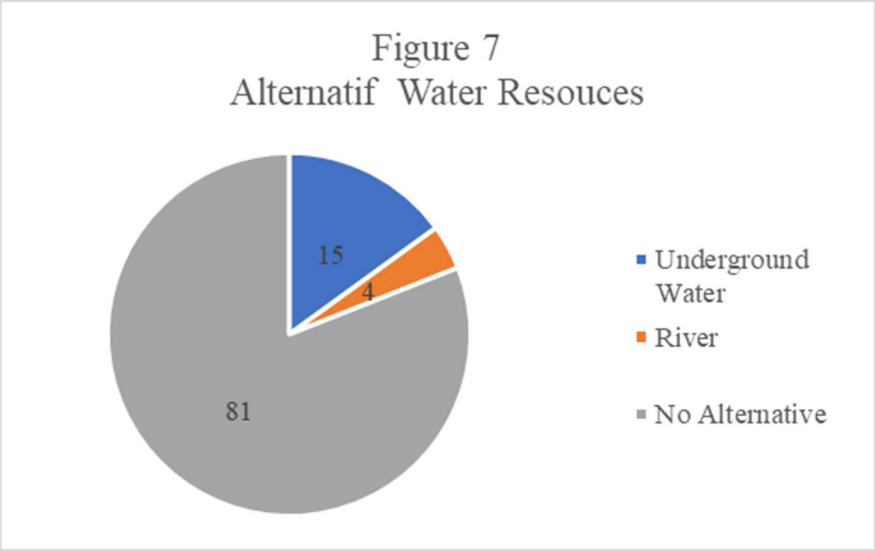
Usage length was estimated by years of using ecosystem service for water per household. The data shows that most of the respondents had been using ecosystem service for more than ten years with 69% of the total respondent.

Figure 6

Usage Length	*Frequency*
<3	*11*
4-6	*10*
7-9	*10*
10-12	*19*
13-15	*16*
>15	*34*
Total	*100*

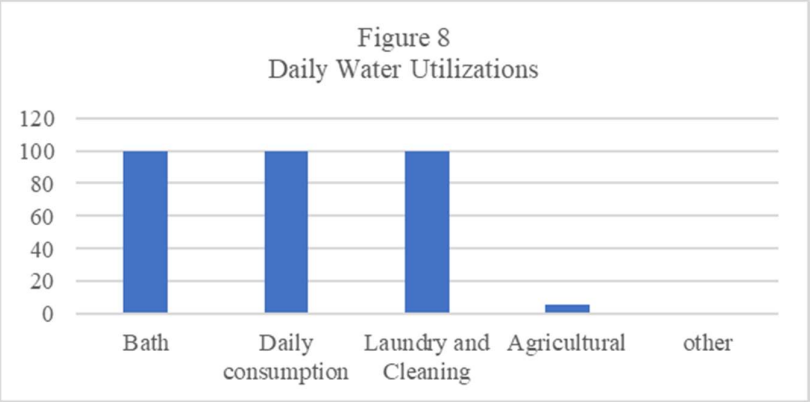
7. Alternative water resources

In this study, alternative water resources were used as a parameter to investigate the dependency that came from Tojang Spring upstream. The survey result shows that most respondents tend to have highly dependent on Tojang Spring upstream with 81% of respondents stating that the source of water for daily use mainly came from Tojang Spring. This study also shows that the most common alternative water resources came from underground water.



8. Daily water utilizations

Water utilization in this study refers to a specific activity that involves water as the main tool to fulfill the task. The surveys result shows that almost all respondent utilized water to fulfill their basic needs and only a minority group of respondents utilized water for agricultural use.



9. Water quality

Data on water quality represent the respondent's perception of general conditions of water that came from Tojang Spring, whether it is water upstream or water that respondents utilized for daily needs. the survey shows that most respondents' perception of water quality ranged from clean enough and clean with 84% of respondents stated in this quality level.

Figure 9 Water Quality

Quality Perception	*Total*	*Percentage*
Very Clean (5)	*5*	*5%*
Clean (4)	*65*	*65%*
Clean Enough (3)	*29*	*29%*
Poor (2)	*1*	*1%*
Very Poor (1)	*0*	*0%*
Total	*100*	*100%*

10. Perception of water quantity

In this study, water quantity was defined as the amount of water in Tojang Spring upstream as well as water that is available for daily use. Data for the quantity of water shows that the majority of respondents stated that the water quantity is sufficient enough, while a minority proportion of respondents noted that the quantity is not sufficient. The data also indicate that the water distribution for daily use was not well distributed among the respondent.

Figure 10 Water Quantity

Quantity Perception	*Total*	*Percentage*
Abundant (5)	*0*	*0%*
Ample (4)	*12*	*12%*
Sufficient (3)	*68*	*68%*
Lacking (2)	*20*	*20%*
Shortage (1)	*0*	*0%*
Total	*100*	*100%*

11. Perception of existence value

This variable tried to capture respondent perceptions about how important Tojang Spring is as part of their daily life and for the future generation. The result of the survey shows that almost all of the respondents stated that the existence of Tojang Spring is very important for the sustainability of their daily life and future with only a small proportion of the group stating that it is not important.

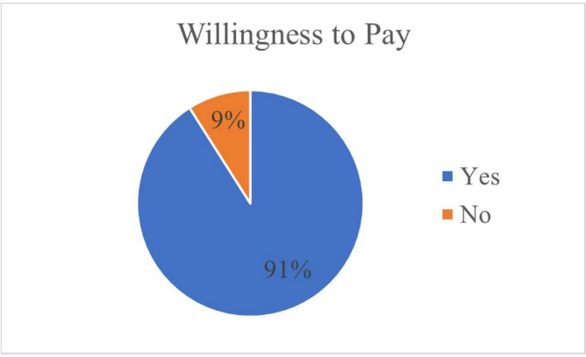
Figure 11 Perception for Existence

Perception Level	*Total*	*Percentage*
Very Important (5)	*96*	*96%*
Important (4)	*2*	*2%*
Important Enough (3)	*1*	*1%*
Unimportant (2)	*0*	*0%*
Very Unimportant (1)	*1*	*1%*
Total	*100*	*100%*

12. Willingness to pay for conservation and maintenance of Tojang Spring

The CVM-based survey showed that most of the respondent respondents were willing to participate in the conservation program with only a small number of respondents being unwilling to participate. This small portion of respondents was aware of the value of this program but felt unable to participate due to economic issues. Another respondent also stated that respondent doesn't believe the local government will be able to do this program consistently.

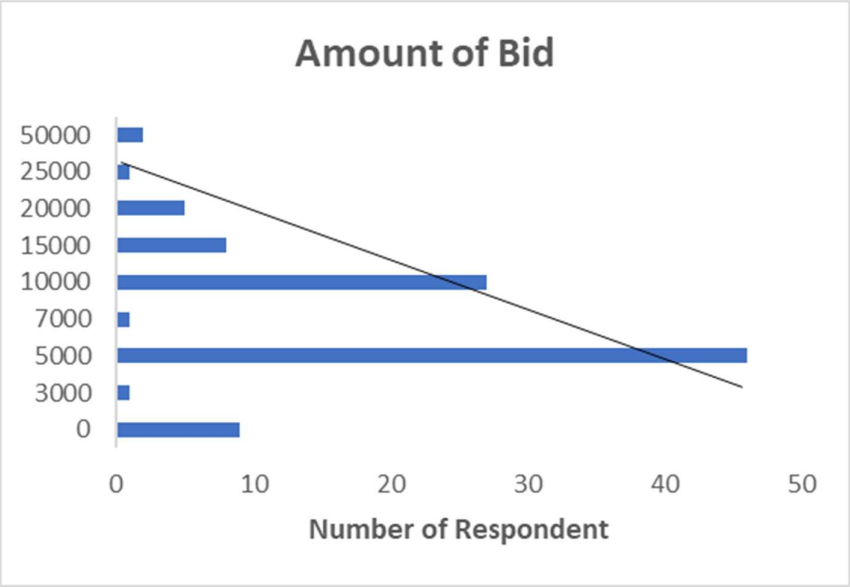
Figure 12



This survey also showed the average amount of willingness to pay for conservation was IDR 8.350 with an average bid range from IDR 5.000 to IDR10.000 per month. The highest bid that was obtained from the survey was IDR 50.000 while the lowest bid was zero which indicated that the respondent was unwilling to pay for conservation. In general, the amount

of bids in this study shows a negative relationship between the amount of WTP and the number of respondents. This phenomenon was validation for the demand theory that the CVM-based survey try to prove (Dasgupta et al., 2022).

Figure 13



Multiple linear regression was applied to estimate the relationship between variables and their influencing factors which affect the maximum amount of WTP. The regression model shows that out of 11 variables estimated, 8 variables were statistically significant as factors affecting the amount of WTP at a significant level of 95%.

Figure 14

Model	Standardized Coefficients B	T	Sig.
(Constant)	.222	-1.356	0.179
Age	.283	2.018	0.047
Education	.179	2.928	0.004
Family size	.395	2.441	0.017
Income	.323	4.253	0.000
Water bill	-.234	3.861	0.000
Usage length	.021	-2.152	0.034
Water resources alternative	.020	0.275	0.784
Daily water utilization	-.123	0.235	0.815
Water quality	-.223	-1.45	0.151
Water quantity	.216	-2.659	0.009
Existence value	.222	2.06	0.042

a. Dependent Variable: WTP (Y)

The model suggests that age positively and significantly affects the amount of WTP with every year age addition will increase the amount of WTP by 28.3%. It also indicated that older respondents tended to have higher WTP than younger respondents. This finding had the same result as the previous finding conducted by (Makwinja et al., 2022; Obeng & Aguilar, 2021) but has the opposite result in the variable relationship in a conducted study by (Amoah et al., 2022). Education level had a positive and significant coefficient for an average amount of WTP with an ever-increasing level of education would increase the average amount of WTP by 17.9 %.

Family size was found significant and has a positive relationship with an average amount of WTP. It indicated that higher family sizes will pay more than those with lower family sizes due to higher daily water needs. every addition of one family size will increase the amount of WTP by 39.5% keeping other factors constant at their mean value. The coefficient of family size has the opposite result (Hu et al., 2022) and was completely rejected as an insignificant factor by (Wassihun et al., 2021).

Income showed positively significant as a factor affecting the amount of WTP with every 1% increase in income will result in an increasing amount of WTP for 32.3% keeping other factors stay constant. Consistent with the theory, this result is also in line with (Amoah et al., 2022). The water bill showed a negatively significant relationship with the amount of WTP with every 1% addition in the water bill would decrease the amount for WTP by 23.4% assuming other factors stay constant.

Length of usage had a positive and significant relationship with the amount of WTP with every addition in a year for the length of usage would result in an increasing amount of average WTP for 2.1% assuming other factors stay constant.

Existence value and water quantity showed a positive and significant effect on the average amount of WTP with an ever-increasing level of perception that will increase the amount of WTP by 21.6% and 22.2% respectively. The coefficient for water quantity has a similar result even though had a different result in water quality (Saraswaty, 2013)

5. Conclusion

This study presents arguments from perspective literature to support the claim that water resources existence faces many challenges and threats to its sustainability, especially in East Lombok. Therefore, further actions are needed to prevent degradation in value and ability to support the socio-economic activity of human beings. This study found that there is a potency to achieve sustainability for the conservation and maintenance of Tojang Spring. The survey result showed the majority of respondents were willing to participate in this program and the average willingness to pay for conservation and maintenance of Tojang Spring was IDR 8.350 per month for every individual. This amount of WTP was influenced by several factors such as age, education, family size, income, water bill, usage length, quantity, and existence value. The higher level of these influencing factors the higher the average amount of WTP will be except for the water bill which showed the opposite relationship. Considering the result of these studies, the average amount of WTP should be considered as a base for the local authority in decision-making to meet the demand for conservation. The surveys also suggested that the local authority needs to open a new watershed in the northwest of Tojang Spring to ensure. However, this study is not perfect and has many aspects to be improved therefore further study with a larger sample needs to be done.

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