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Analysis of community willingness to pay for water environmental services in Wan Abdul Rachman Grand Forest Park

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ABSTRACT
Wan Abdul Rachman Grand Forest Park (Tahura WAR) is a conservation forest area that serves as a source of water resources that the community utilizes daily. This research analyzes the characteristics influencing people's willingness to pay for water environmental services in the Tahura WAR. This research was conducted from October to November 2024. The research location is based on both villages, where water users are from the Tahura WAR area. Based on this research, the results obtained show that the characteristics of respondents' age, occupation, income, water source, and the amount of water demand/day positively influence the willingness to pay of the community. The variable that has a significant influence is income. In contrast, the variables of age, occupation, water source, and the number of water needs/day do not significantly influence the value of the willingness of the community of water environmental service users in Wan Abdul Rachman Forest Park. This research is expected to make a scientific contribution to developing studies on environmental economics, especially in the context of willingness to pay for water environmental services. The results of this study are expected to be a reference for future researchers who are examining social, economic, and environmental factors.
Keywords: Tahura WAR, Water, Willingness to Pay

1. Introduction

Water is an essential natural resource for all living things, so it needs to be managed sustainably. Forests act as areas that provide and channel water to downstream areas, which humans then utilize for various purposes such as consumption, bathing, cooking, and other daily activities. There is a reciprocal relationship between water availability and community participation, where communities in upstream areas act as providers of water environmental services through activities such as tree planting and maintenance of water catchment areas. In contrast, communities downstream utilize these services by compensating the providers. This management aims to create economic value while supporting forest conservation [1].

Water environmental services are one form of environmental services whose value is increasingly threatened due to the imbalance between the level of utilization and conservation efforts [2]. Therefore, the assessment of environmental services needs to be carried out comprehensively from various dimensions, including economic aspects, which can be the basis for determining the amount of compensation for service providers and other interested parties [3]. Sustainable management of environmental services can be realized through economic compensation mechanisms that not only improve community welfare but also encourage resource conservation [4]. For example, downstream communities as water users compensate upstream communities as service providers directly or through third parties based on a cooperation agreement [2]. The economic value of this water environmental service can be measured based on the volume of water utilized [5].

Efforts to maintain water supply originating from forest areas to downstream communities have been implemented in the Wan Abdul Rachman Grand Forest Park (Tahura WAR). This area functions as a protector of water systems and life support [6]. According to Kurniawan et al. [7], water environmental service management has two benefits dimensions: conservation and economy. Communities in the upstream area are compensated for their role in protecting water resources, while user communities are willing to contribute to the conservation efforts. Tanjung Agung Village and Sumber Agung Village are examples of communities that have begun to show a willingness to support environmental service management by paying water service fees.

These two areas are located in the central part of the Tahura WAR area. The problem is the lack of community willingness to pay for water environmental services sourced from the Way Betung watershed [8]. Payment for environmental services is important to realize equitable income distribution for water providers and ensure the sustainability of water availability through appropriate management schemes. Although Tahura WAR has played a role in providing water for the needs of the community and various other parties, studies related to the willingness of the community to pay for water environmental services and the factors that influence it are still limited. This research aims to fill the void by empirically analyzing the socioeconomic factors that influence the willingness to pay for water environmental services in the Way Betung watershed area and Tahura Wan Abdul Rachman. This research focuses on conservation areas that are still rarely studied. It uses a local characteristics-based approach that is expected to be a new contribution to the development of a fairer and more sustainable payment scheme for water environmental services (PES).

2. Method

This research was conducted from October to November 2024. The research locations included Tanjung Agung Village in Teluk Pandan District, Pesawaran Regency, Lampung Province, Longitude 524000. 522000 Latitude 5°2’7”0 S.5°2’7”0 S and Sumber Agung Village in Kemiling District, Bandar Lampung City, Lampung Province, coordinates 5°24′37.33″S 105°11′19.61″E. Both areas are part of the central area of the Wan Abdul Rachman Grand Forest Park. This area has an important role as a conservation area that maintains ecosystem balance, especially in regulating water systems and providing water environmental services for the surrounding community.

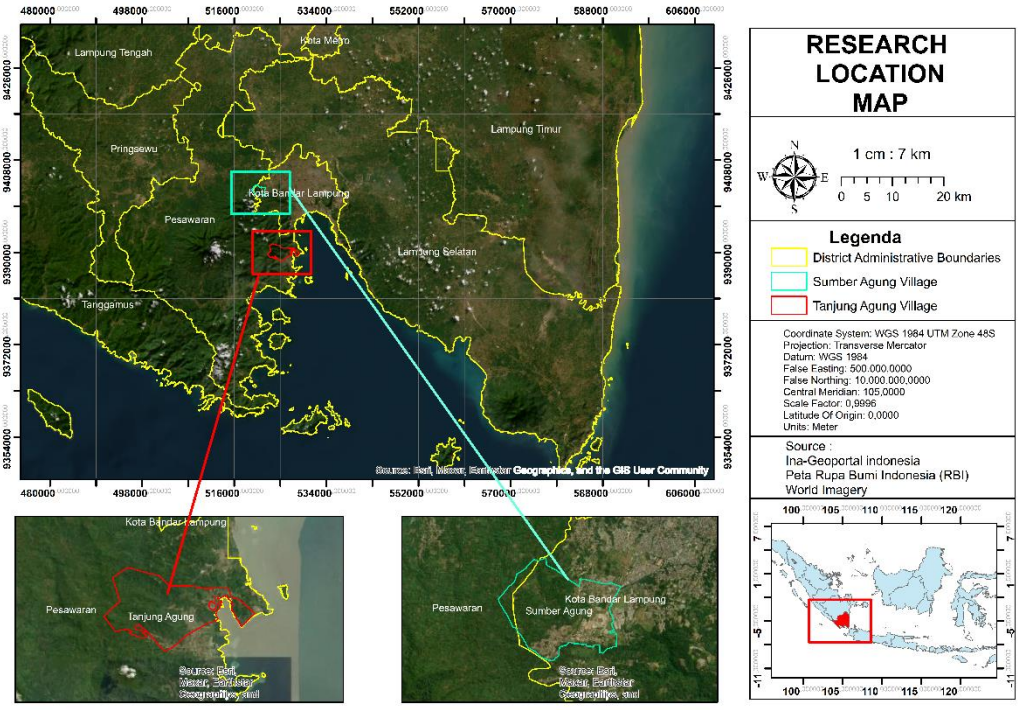

Figure 1. Research location

This research utilizes data derived from two sources, namely primary data and secondary data. Primary data was obtained directly through data collection in the field by conducting interviews using a closed questionnaire that had been prepared previously. Meanwhile, secondary data was obtained from various previous studies that served as reference materials, as well as other supporting data such as profiles of the research areas, namely

Tanjung Agung Village and Sumber Agung Village. The number of respondents involved in this study was 60, and they were selected as a sample to represent the community of water environmental service users in the area. This research utilizes data derived from two sources, namely primary data and secondary data. Primary data was obtained directly through data collection in the field by conducting interviews using a closed questionnaire that had been prepared previously.

Meanwhile, secondary data was obtained from various previous studies that served as reference materials, as well as other supporting data such as profiles of the research areas, namely Tanjung Agung Village and Sumber Agung Village. The number of respondents involved in this study was 60, as a sample to represent the community of water environmental service users in the area. The research sampling used the snowball sampling method, which can provide information about water environmental services based on the criteria of people who live near water sources, use water from the Tahura area, or have been involved in conservation programs. These characteristics are not evenly distributed, thus requiring methods such as snowball sampling to reach respondents [9].

Data processing from the interview results included basic information on respondents and aspects of water environmental service utilization, which included respondents' socioeconomic characteristics such as age, occupation, income level, source of water used, and daily water consumption. In addition, this research also explores respondents' perceptions of the existence and benefits of water environmental services, as well as their willingness to participate in environmental service payment schemes to support the sustainability of water resources management in the Wan Abdul Rachman Tahura area.

3. Data Analysis

Multiple linear regression analysis is one of the statistical methods used to identify the relationship between one dependent variable and two or more independent variables. The main purpose of this technique is to determine the magnitude of the influence of each independent variable on the dependent variable and understand the direction of the relationship. In addition, this analysis is also used to predict the value of the dependent variable based on the known values of the independent variables [10]. In this study, multiple linear regression analysis was applied as a development of simple linear regression analysis to project the impact of more than one independent variable on the dependent variable [11].

The multiple linear regression analysis method is widely used in various disciplines such as economics, management, social sciences, and environmental sciences, because it can explain the factors that influence a phenomenon and make predictions. As an illustration, in a study of work productivity, the independent variables can be leadership style, work environment, and level of discipline. In contrast, the dependent variable is the level of team member performance. For the results of multiple linear regression analysis to be accurate and reliable, several basic assumptions need to be met, including the fact that the relationship between variables is linear, there is no multicollinearity between independent variables, and the residuals or model errors are normally distributed. After the model is tested and declared feasible, the results can be analyzed to determine which variable has the most significant influence on the dependent variable and the amount of its contribution in the model [10].

$$Y = a + b1X1 + b2X2 + b3X3 + b4X4 + b5X5 \quad (1)$$

Description:
Y = Value of willingness to pay for water environmental services of the i-th respondent
A = constant
b1, b2, b3, b4, b5 = regression coefficient
X1 = age
X2 = occupation
X3 = income
X4 = water source
X5 = daily water consumption /day

4. Results and Discussion

4.1. Respondent Characteristics

Respondent characteristics are attributes, characteristics, or criteria possessed by individuals or groups that are the subject of a study. These characteristics include various aspects such as age, gender, education, occupation, socioeconomic status, geographic location, and psychographic aspects such as interests, values, and lifestyle. Understanding the characteristics of respondents is very important in designing research or surveys because it can ensure that the data collected is relevant, valid, and can be analyzed in more depth following the research objectives [12]. The environmental service users of the Way Betung watershed consist of people from Tanjung Agung Village and Sumber Agung Village, who come from the central part of the Way Betung watershed. Public awareness in maintaining water availability is related to the community's willingness to pay for water [13]. The characteristics of respondents used in this study are age, education, occupation, income, water source, and the amount of water demand. Based on the results of interviews in the field with as many as 60 respondents, information on the characteristics of respondents can be seen in Table 1 below.

Table 1. Characteristics of respondents who use water environmental services in Tahura WAR

No.	Characteristics of Respondents	Number of Respondents	Percentage (%)
1.	Age		
	1-20 years	0	0%
	21-30 years	4	7%
	31-40 years	17	28%
	41-50 years	13	22%
	> 50 years	26	43%
	Total	60	100%
2.	Occupation		
	Farmer	53	93%
	Laborer	7	7%
	Trader/livestock	0	0%
	Civil servant	0	0%
	Not working	0	0%
	Total	60	100%
3.	Income		
	IDR 500,000-IDR 2,500,000	49	81%
	IDR 2,500,000-IDR 3,500,000	9	15%
	IDR 3,500,000-IDR 4,500,000	1	2%
	IDR 4,500,000-IDR 5,500,000	1	2%
	>IDR 5,500,000	0	0%
	Total	60	100%
4.	Water source		
	PDAM	1	2%
	Drilled well	8	13%
	Tap well	7	12%
	Forest	35	58%
	Clean water tank	9	15%
	Total	60	100%
5.	Total water demand/day		
	10-20 liters	1	2%
	21-30 liters	10	17%
	31-40 liters	8	13%
	41-50 liters	16	27%
	51->60 liters	25	41%
	Total	60	100%

The percentage distribution of respondents by age category, shown in Table 1, shows that the age group with the highest percentage was in the >50 years category, which amounted to 48%. Meanwhile, the age group with the least percentage was respondents aged 21-30, at only 7%. For the occupation category, respondents

were divided into five groups: farmers, laborers, traders/ranchers, civil servants (PNS), and not working. The data collection results show that the majority of respondents are farmers, with a percentage reaching 93%, while the least occupied profession is laborer, at 7%. Furthermore, the income distribution of respondents based on the income categories listed in Table 1 shows that most respondents, 82%, have monthly incomes in the range of IDR 500,000 to IDR 2,500,000. On the other hand, the income groups with the lowest percentages were respondents with incomes between IDR 3,500,000 and IDR 4,500,000, and IDR 4,500,000 and IDR 5,500,000, at 2% each. Occupation and income level generally influence individual willingness to pay for water environmental services [14]. Based on the category of water source used, Table 1 shows that the majority of respondents, 58%, utilize water sourced from forest areas. In contrast, respondents who used water from the local water company (PDAM) were recorded as the group with the smallest percentage, at only 2%. Meanwhile, for daily water consumption, the data in Table 1 shows that the group of respondents with the highest water needs is in the range of 51 to more than 60 liters per day, at 42%. The group with the least water needs, 10-20 liters per day, was only 2%.

4.1.1. Age

Age indicates how long a person has lived since birth, which is generally measured in years. A person's age can be seen from emotional maturity and physical development; as age increases, individuals tend to have better emotional stability and physical development in accordance with their life stage [15]. Based on the data in Table 1 and Figure 2, respondents in this study were grouped into five age categories. The classification results show that most respondents are in the age group above 50 years, as many as 26 people or around 43% of the total 60 respondents. In contrast, the least represented age group is respondents aged 21-30, which only amounted to 4 people or 7%. In general, older individuals tend to have limitations in accessing information or understanding related to the payment mechanism for water environmental services. In contrast, younger age groups are more concerned about conserving water resources, for example, through participation in conservation activities such as tree planting in water catchment areas. This finding is in line with the results of a study conducted by [16], which concluded that the age variable does not significantly influence people's willingness to pay for water environmental services for irrigation purposes in the Sekampung Watershed area.

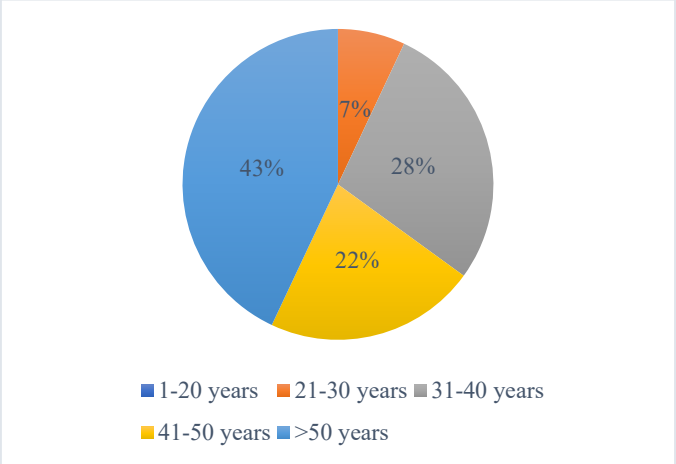

Figure 2. Characteristics of respondents based on age

4.1.2. Employment

Work is an activity carried out by individuals to meet daily living needs [17]. Based on the data presented in Table 1 and Figure 3, the main types of work of respondents in this study are categorized into five groups. The results show that most respondents, as many as 53 people or around 93% of the total 60 respondents, work as farmers. Meanwhile, the number of respondents who work as laborers is recorded as the lowest, at only 7 people or 12%. The dominance of the farming profession as the community's main livelihood in the research area shows a relatively high level of concern and understanding of the importance of the sustainability of water environmental services. This is understandable, considering water availability is crucial in agricultural activities, especially irrigation. To maintain the sustainability of water resources, farmers can contribute by implementing water-saving irrigation systems such as drip irrigation or sprinklers, which are considered more efficient than conventional methods. In addition, the wise use of fertilizers and pesticides is also important to prevent groundwater and river pollution. This finding aligns with research [16], which states that the occupation influences farmers' willingness to pay for water environmental services in the Gudang Village Watershed (DAS) area.

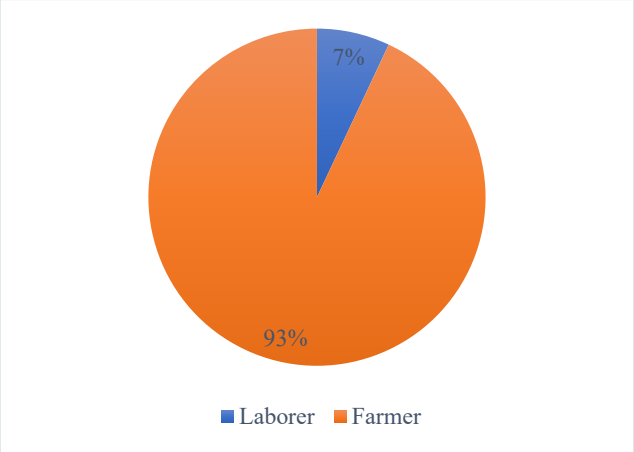

Figure 3. Characteristics of respondents based on occupation

4.1.3. Income

Income can be defined as several rewards, either in the form of money or goods, received by a person due to their work or economic activities. In addition to coming from the main job, income can also be obtained through selling goods or services from various business sectors. Based on the information in Table 1 and Figure 4, this study's respondents' income levels were grouped into five categories. The analysis results show that most respondents have incomes in the range of IDR 500,000–IDR 2,500,000, which is 49 people or around 81% of the total respondents. Meanwhile, the number of respondents with the highest income, namely in the IDR 3,500,000–IDR 4,500,000 and IDR 4,500,000–IDR 5,500,000, is only one person or 2% each. The extent of the community's ability to provide financial contributions to support the preservation of water resources is greatly influenced by their income level. Generally, households with higher incomes tend to have better capacity to participate in various conservation efforts, including investing in technologies and methods supporting sustainable water management [18].

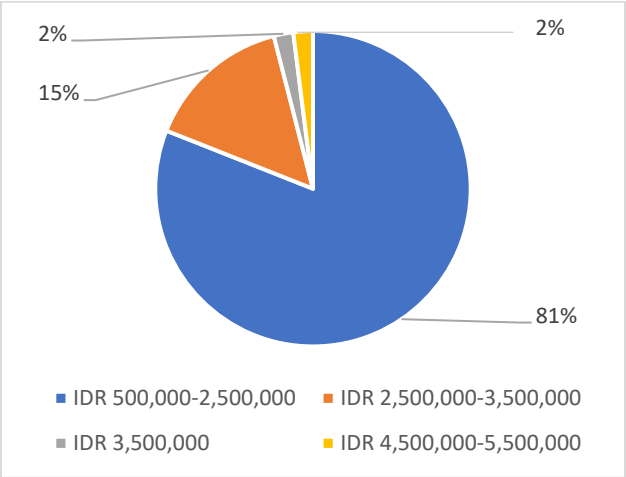

Figure 4. Characteristics of respondents based on income

4.1.4. Water Source

Water sources are locations or areas where water naturally emerges from the ground, either in streams, springs, or puddles, which the community can use directly. Based on the data presented in Table 1 and Figure 5, the water sources used by respondents in this study are classified into five categories. The results show that most respondents, namely 35 people or around 58% of the 60 respondents, use water from forest areas. On the other hand, the number of respondents who use water from PDAM is the smallest, only 1 person, or around 2%. In reality, the quality of water from these various sources is generally maintained or in a condition good enough for daily needs. However, management and maintenance efforts are still limited. This condition causes some people to feel no need to provide additional contributions in the form of payments for water environmental services, especially when they consider that the availability and quality of water currently used already meet their needs without causing direct disruption to the environment or the sustainability of the water source [19].

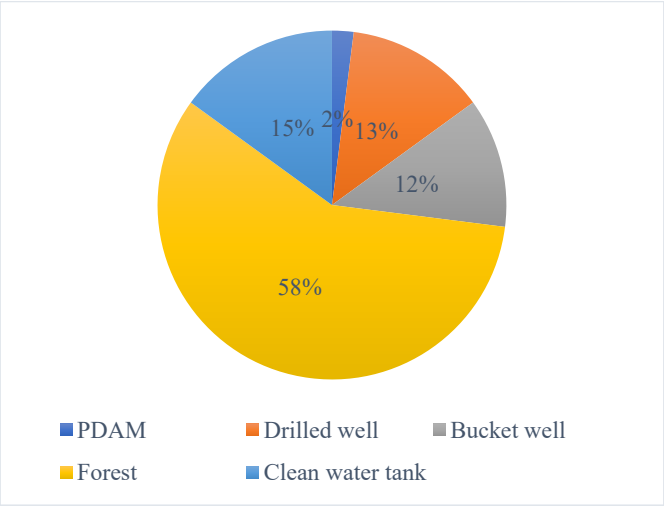

Figure 5. Characteristics of respondents based on water source

4.1.5. Total Water Needs

Table 1 and Figure 6 show that the respondents' daily water needs are grouped into five categories. The analysis results show that most respondents, namely 41% of the total 60 people, need water in the range of 51-60 liters per day. Meanwhile, the lowest water requirement category, namely 10-20 liters per day, is only occupied by one person, or around 2% of all respondents. Understanding the concept of water environmental services means developing a new perspective that better appreciates water resources' existence and strategic role, one of which is limiting excessive consumption [20]. Therefore, water utilization must be accompanied by the principle of efficiency and consumption control, especially in water sources whose availability is limited. This approach is important to raise awareness and appreciation of the value of water as a vital resource [5]. As the community's need for water increases in terms of volume and quality, the community's view of water as a natural commodity with economic value still tends to be stagnant. In fact, amidst the difficult conditions of access to clean water in this area, a change in perception is needed to view water more as an environmental asset with high economic value. Assessment of the economic value of water can be realized by measuring the extent to which the community utilizes the benefits of water sourced from forest areas, adjusted to the volume and intensity of use [21].

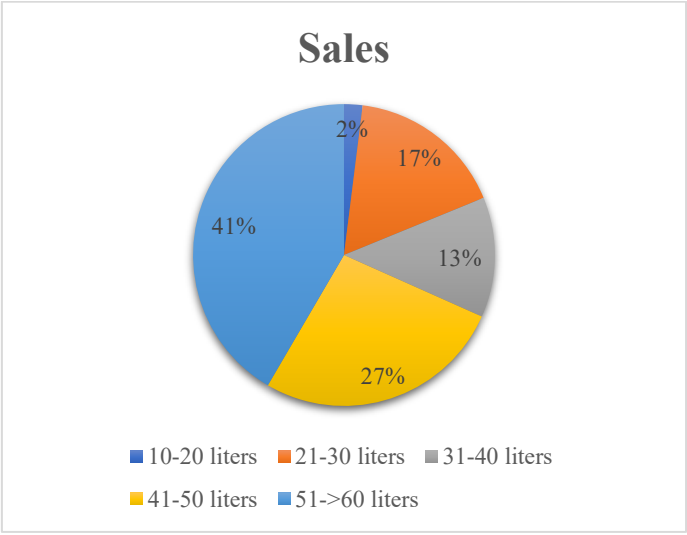

Figure 6. Respondents' characteristics based on the amount of water needed

4.2. Multiple Linear Analysis of Community Willingness to Pay for Water Environmental Services Payment in Tahura WAR

Table 2. Results of multiple linear analysis

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-1.163	0.847		-1.373	0.175
Age	0.130	0.107	0.141	1.218	0.229
Occuption	0.638	0.331	0.223	1.927	0.059
Income	0.625	0.191	0.381	3.266	0.002
Water Source	0.050	0.114	0.051	0.439	0.662
Total Water Needs/ Day	0.201	0.093	0.256	2.174	0.034

Based on the regression coefficient test results shown in Table 2, the multiple linear regression equation can be formulated as follows.

$$Y = -1.163 + (0.130)\,(X1) + (0.638)\,(X2) + (0.625)\,(X3) + 0.50\,(X4) + 0.201\,(X5) \quad (2)$$

The log-linear model above can explain the influence of independent variables as follows:

1. The constant value of -1.163 indicates that if all independent variables, namely gender, age, education, main job, side job, income, water source, number of household members, amount of water needed per day, and type of water use are zero, then the willingness to pay value is estimated at -1.163.

2. The regression coefficient for the age variable is positive at 0.130. This indicates a unidirectional influence between age and willingness to pay. Assuming other variables remain constant, every one-unit increase in the age variable will increase the willingness to pay value by 0.130. This shows that the older the Tanjung Agung Village and Sumber Agung Sub-district respondents, the greater the opportunity to pay for water environmental services [8]. Older respondents tend to be more aware of the importance of water environmental service management, so they are more willing to contribute to financing these services [22].

3. The regression coefficient of the employment variable of 0.638 indicates that employment has a positive relationship with willingness to pay. In other words, every one unit increase in the employment category, if other variables remain constant, then the willingness to pay value will increase by 0.638. This means that the better the status of the respondent's main job, the greater the tendency to be willing to pay for water environmental services also increases [8]. Employment status reflects the income conditions and economic stability of the respondents. Therefore, those with permanent jobs or more economically stable tend to be more able and willing to contribute [19].

4. The positive regression coefficient of the income variable of 0.625 indicates a positive relationship between income levels and willingness to pay for water environmental services. Assuming other variables are constant, every one-unit increase in income will increase the willingness to pay value by 0.625. This means that the higher the Tanjung Agung Village and Sumber Agung Sub-district income, the greater their ability and willingness to pay [8]. This is because higher-income respondents generally have adequate financial capabilities and are more prepared to set aside funds for water environmental services [23].

5. The regression coefficient for the water source variable is positive at 0.50. This means a positive relationship exists between water sources and willingness to pay. Assuming other variables remain constant, every one-unit increase in the water source variable will increase the willingness to pay value by 0.50. This shows that the better the access or quality of water sources in Tanjung Agung Village and Sumber Agung Sub-district, the greater the respondents' willingness to pay for water environmental services [8]. Good and adequate water access encourages respondents to participate in preserving these resources [24].

6. The regression coefficient for the variable amount of water needed daily is positive at 0.189. This shows a positive linear relationship between water needs and willingness to pay. This means that every

one unit increase in the amount of water needed per day, with other variables remaining constant, will increase the willingness to pay value by 0.189. The greater the household water needs in Tanjung Agung Village and Sumber Agung Sub-district, the higher their willingness to pay for water environmental services [8]. This reflects increasing awareness of the importance of sustainability and protection of water resources [24].

5. Conclusions

Based on the results of the study, it can be concluded that respondent characteristics such as age, type of employment, income level, water source, and the amount of water demand per day show a positive relationship with the community's willingness to pay for water environmental services. However, of all these variables, income and the amount of water demand per day are proven to have a significant effect on the amount of willingness to pay. Meanwhile, the variables of age, occupation, and water source, although showing a positive direction of influence, did not have a statistically significant effect on the value of the willingness to pay of the community of water environment service users in the Wan Abdul Rachman Forest Park area.

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