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Assessing Willingness to Pay for Improved Water Services from Forest Area in Bayas Jaya Village, Lampung Province

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Abstract. One of the important functions of the forest is to provide water to the community. Improvement of water services from forest areas requires the community's participation. This study aims at (1) identifying the community's willingness to pay for improved water services and (2) determining factors affecting the community's willingness to pay. This study is located in Bayas Jaya Villages and the upland area of Kedondong Sub-District, Pesawaran District, Lampung Province. The study interviewed 75 farmers of 3 water services management, i.e.: (1) independent, (2) PAMSIMAS, and (3) PDAM. Each management water service was represented by 25 members who were randomly selected. Objective one is analyzed using descriptive analysis, and objective two is analyzed using a regression analysis model. The study suggests that, on average community received 10,6m^3 per day, which is far higher than their daily consumed, i.e., 460 *l* per day. However, water surplus is not optimized as they are drained to the local sewer. Further, 56% of the community is willing to pay should water services be improved. The average willingness to pay is Rp 440,357.14 annually per family. Factors affecting the community's willingness to pay, include (1) the PDAM model, (2) the PAMSIMAS model, (3) age, and (4) daily water discharge to family.

Keywords: willingness to pay, water services, community

1. Introduction

1.1 Background

Water is one of the results obtained from forest areas because one of the functions of the forest is to regulate water systems such as: storing, cleaning, and draining [1]. In the Sustainable Development Goals (SDGs), the provision of clean water and sanitation is one of the targets to be achieved. In the SDGs, the availability of affordable and quality water as well as good sanitation is included in target no 6, namely Clean Water and Sanitation [2], [3]. Access to cheap and quality clean water is a human right which includes the right to life, education, health, and a decent place to live. In 2021, the budget allocated for drinking water facilities was Rp. 6.99 trillion or only 0.25% of Indonesia's 2021 State Budget expenditure of Rp. 2,786.8. [4]. The budget for the construction of clean water facilities in rural areas is even lower, while the area and household coverage are scattered. Thus, clean water at the rural level requires the local capacity to be part of efforts to increase access to clean water for the community. Community-based clean water services are initiated by the community and for the community. The community-based rural water service model has various names in various regions, such as PAMDes,

PDAMDes, and Clean Water Management Groups (KPAB) in Way Besai Sub-watershed [5]. However, there is also a model like this facilitated by the government through the PAMSIMAS model (Community-Based Drinking Water and Sanitation Program)

In Lampung Province, although managed clean water services have increased in the 2018-2021 period, from 33.81% to 52.31 [6], that increase is still below Indonesia's SDGs target, which is above 69% for access to safe drinking water for Indonesians.

In developing countries, improving clean water services both in quantity and quality can improve the welfare and economy of the community [7]. The right to clean water is a human right that must be fulfilled by all countries, even though the results are still far from what is expected [2] [8].

This study is located in Bayas Jaya village, located nearby the state forest area in Pesawaran District of Lampung Province. In Bayas Jaya Village, the condition of the clean water network is still not good. For this reason, efforts are needed to improve network conditions and services so that the clean water service is better in terms of water quality and quantity. The initiative to improve the water network has never been carried out, considering the lack of funds from the village budget as well as the district and provincial government. The objectives of the study include (1) to identify the community's willingness to pay and (2) to determine factors affecting the community's willingness to pay should water services be improved.

1.2 Literature review

The study on CVM (Contingent Valuation Method) has been carried out by many scholars in both developed and developing countries [9]. This method is very popularly used in valuing natural resources, although it is also quite controversial [10]. According to [11], this method was originally proposed by Ciriacy-Wantrup (1947). However, the CVM was first applied by Davis in 1963 in a study of hunting geese in Maine [12].

The CVM is essentially an assessment method that relies on recorded questions (questionnaires) that provide opportunities for community responses in making decisions about economic opportunities that do not yet have a market. So CVM is designed to simulate a market to respondents where the market has not yet been formed or a hypothetical market [10] [13].

Willingness to pay as part of CVM for water services has been widely used. The CVM method to analyze willingness to pay for clean water is a robust method [14]. Using a discrete model, [15] differentiates willingness to pay for different groups. It was concluded that annual income determines the WTP of the respondent in Goro-Gutu, Eastern Ethiopia. Other studies carried out by [8] reveal that investments in physical infrastructure, especially in the urban area, as well as in education and the encouragement of paid employment for women, all have a positive effect on access to improved water sources.

Using a stepwise regression model, a study by [16] in Kazakhstan revealed that the main influencing factors in WTP for improved water quality included the condition of sources of water and the payment fee for private providers.

This study explores the novelty of the community's willingness to pay for water services system in rural areas surrounded by state forests. In this, the community is benefitting from forest services which in turn stimulates the community to protect the forest as it provides the livelihood for the community. The question is whether the community is willing to pay more should water quality and quantity be improved.

2. Research Methodology

2.1 Research site and date of field research

This is a case study in the upland village of Pesawaran District, Lampung Province. The study is located in Bayas Jaya village, located near the state/protected forest area. Bayas Jaya village is situated around 60 km from Bandar Lampung city, the capital city of Lampung Province. The reasons for selecting this village included (1) it has a protected forest nearby, which is used as a water source, and (2) it has three

water services models, i.e., community-based, PAMSIMAS, and PDAM models. The detail of each model is described in Chapter 3 (Result and Discussion).

The forest area is not owned by the village but belongs to and is managed by Kesatuan Pemangku Hutan (Forest Management Unit) of Pesawaran District. Community, however, has access to and benefits of forest such as environmental services, such as water, and non-forest products.

The study was carried out from April to August 2022 that included activities: 1. Research preparation, 2. Field data collection, 3. Data tabulation and analysis, and 4. Report and publication

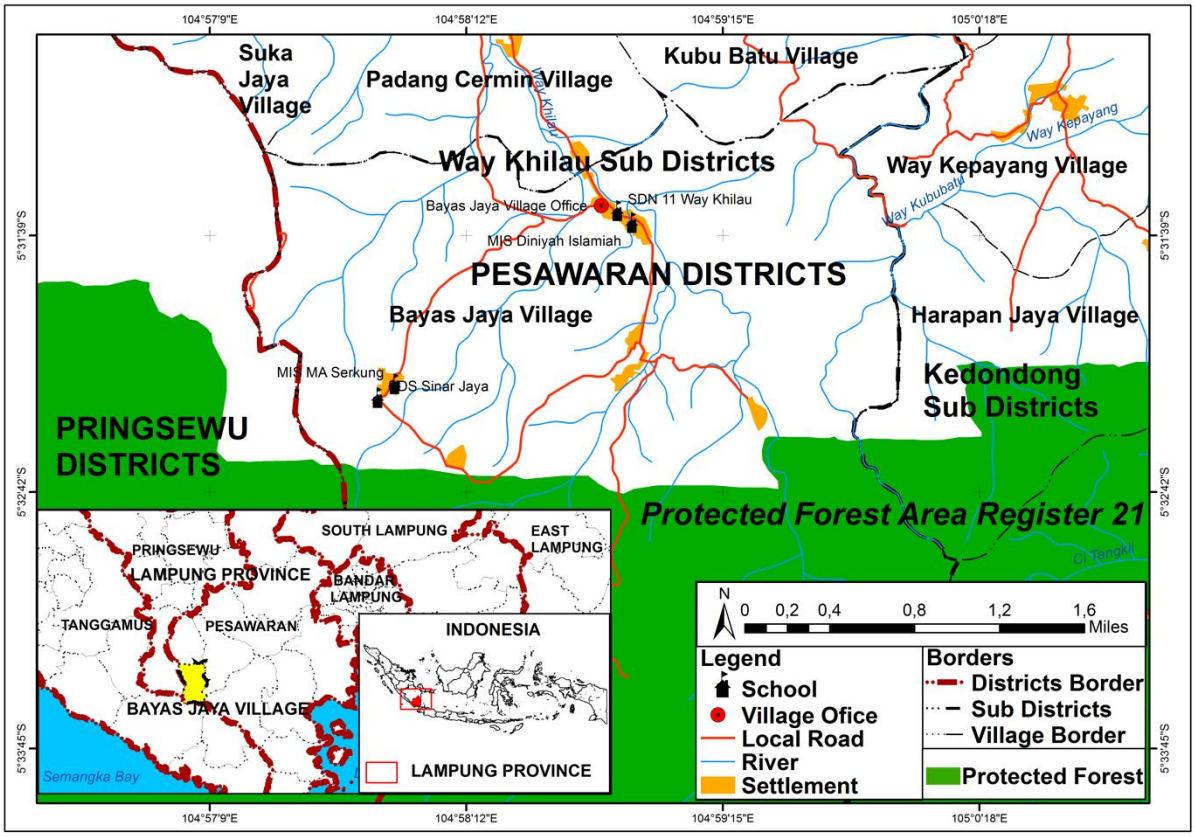

Figure 1. Map of research site

2.2 Respondents

Respondents are those who received water services. They are selected randomly from the three water service models. Each model is represented by 25 respondents. Therefore, there are 75 respondents involved in this study.

It is estimated that the recipients (population) of clean water service in the study area is around 238 (N) households. To determine the sample size, the study employed [17] formulae:

$$n = \frac{NZ^2\,\sigma^2}{Nu^2 + Z^2\,\sigma^2}$$

Where:

N = population of the family that received clean water services, which was 238 families

n = sample size

Z = Z distribution value at 95% yaitu t= 1,96

σ = standard deviation assuming at 0,25

u. = error at 5% or 0,05

With this formula, the sample size/respondent is 73 families and rounded up to 75 households. Each water management model --self-community-based, PAMSIMAS, and PDAM-- is represented by 25 respondents.

2.3 Analysis

To analyze community satisfaction with clean water services, this research uses qualitative methods. There are five indicators used to assess satisfaction with clean water services. This indicator is an adaptation of the thesis by [18] to assess community satisfaction with the sustainability of clean water services. These indicators include (1) physical aspects, (2) reliability aspects, (3) responsiveness aspects, (4) assurance aspects, and (5) empathy aspects.

To assess willingness to pay, there were several steps being carried out as suggested in [19] [20], including (1) creating a hypothetical market where water quality and quantity are improved, (2) undertaking a household survey asking whether respondents are willing to pay and how much, should water quality and quantity is improved, (3) undertaking community/group discussion with important stakeholders about water services in the area, and (4) data verification, analysis, and interpretations.

To analyze factors affecting community willingness to pay for clean water services, the study employed multiple regression analysis, as formulated in the following [21]

$$y=\beta 1x1 +...+\beta pxp +\varepsilon, \varepsilon i \sim N(0,\sigma^2)$$

where
y = dependent variable, which is the willingness to pay
β_i = intercept
$\beta_{p..}$ = regression coefficient
$X_{i..p}$ = independent variables
ε = error tern

Previous studies using regression models on willingness to pay for water services suggest some variables affecting willingness to pay. A study in two communities in South Africa suggests that family size, age, income, and literacy level (education) have significantly affected willingness to pay [22]. Other studies in Indonesia using multiple regression model suggested that education, income, and family size affected willingness to pay for clean water services [23] [24] Since the water services in the study area has three models, i.e. PAMSIMAS, PDAM, and community-based; therefore the study also investigates willingness to pay on those three model using dummy variables.

Therefore, the study formulates a model of factors affecting the community's willingness to pay if water quality and quantity improved, as follows:

$$Y = \beta_0 + D1X + D2X + \beta_c X1 + \beta_d X_2 + \beta_e X_3 + \beta_f X4 + \beta_g X5 + \beta_h X6 + \beta_i X7 + \beta_j X8 + \beta_k X9 + \beta_l X10e$$

Where:
Y= willingness to pay per year (IDR/yr)β_0= intercept
β_{a-i}= coefficient of regression of each variable
D1 = dummy of water service model (1= PDAM, 0 = others)
D2 = dummy of water service model (1 = PAMSIMAS; 0: others)
X_a= age of respondent (year)
X_2 = length of living in the village (year)
X_3= number of the family member (persons)
X_4 = size of landholding (ha)
X_5 = annual revenue (IDR/yr)
X_6 = annual family expenditures (IDR/year)
X_7 = saving (IDR/yr)

X_8 = daily water discharge to family (lt/day)
X_9 = daily water use (lt/day)
X_{10}= investment for water facility (IDR)
e=error

The definitions and units of measurement of those variables are presented in the following table.

Table 1. Definition of variables

No	Variable name	Definition	Unit
1	D1	Dummy variable of water service model no 1	1 = PDAM 0 = other
2	D2	Dummy variable of water service No 2	1 = PAMSIMA 0 = others
3	Age (X_1)	Respondent's age when interviewed was carried out	year
4	Length of living (X_2)	Length of living respondents have lived in the village	year
5	Number of family member (X_3)	Number of persons live in the same house which may include parents, children, other relatives	persons
6	Size of landholding (X4)	Total area owned or managed by respondents	hectare
7	Annual family revenue (X_5)	Annual revenues obtained by respondent's family in one year	IDR/year
8	Annual family expenditures (X_6)	Annual expenditure respondent's family spent in one year	IDR/year
9	Saving (X_7)	Annual saving of respondent's family in one year	IDR/year
10	Daily water discharge (X_8)	Volume of water received by respondent's family every day	Lt/day
11	Daily water use (X_9)	Volume of water use or consumed everyday by respondent's family everyday	Lt/day
12	Investment in water facility (X_{10})	Money paid by family to obtain water services including for purchasing plastic pipe, water meter, and others	IDR

Data is analyzed using Microsoft Excel for Mac version 16.66.1.

3. Result and Discussion

3.1 Socio-economic of respondents

The following table summarizes the socio-economic status of respondents. The table reveals that the average respondent is in the medium age generation while the youngest is still in their 20s, and the oldest is above 73 years of age. All respondents already have families, and most family size is 4 to 5. In terms of education, the majority have completed elementary and high school, and no family completed diploma level.

In terms of family income or revenues, annual income on average is IDR 35 million per year, which is far below the current Indonesia average income, which is around US 4000/per year/per capita or IDR 60 million. In addition, on average, families spend IDR 25.2 million a year on family expenditures. Expenditures consist of food and nonfood expenditures.

In terms of occupation, the majority of the respondents are farmers, with some exceptions, those who work non-farm jobs such as doing retail shops and motorbike transportation services.

Table 2. Socio-economic status of respondents

No	Socio-economic characters	data		
1	Age (year)	youngest: 24	oldest = 73	average= 45.6
2	No. of the family member (person)	<3 = 25 (33)	4-5= 48 (64)	>5 = 2 (3)
3	Education	ElS= 59 (77)	JHS = 10(13)	SHS= 6 (8)
4	Fam. revenue (IDR mi/yr)	lowest= 15.1	highest=81.1	Average= 35.8
5	Fam expenditure (IDR mi/yr)	Lowest= 15.3	Highest= 50.3	Average= 25.2
6	Main occupations	Farmers: 87%; Retail vendor: 11%; others: 2%		

Note: ElS = elementary school, JHS = junior high school, SHS = senior high school, IDR= Indonesian rupiahs

3.2 Governance of clean water services

Governance of clean water services of 3 management models is described in the following

1. Community self-management model. In this model, water management is initiated by the community and built by several households with members from the immediate environment. This community-independent water management model uses water sources from the upstream area of the nearest area, which is an area that has water resources such as small upstream rivers. Independent governance is located in hamlet 2, Bayas Jaya Village.
2. PAMSIMAS Governance (COMMUNITY-BASED DRINKING WATER MANAGEMENT) is clean water management developed by the government with government funding, especially for the construction of clean water networks. The construction of the clean water supply network was discussed with the community, such as the location of water sources, pipelines, and households receiving clean water. The cost of preparation, construction and distribution of water is provided by the PAMSIMAS Program. However, after the water flows into households, routine management is handed over to community groups with the approval of the Village Head. Clean water management includes determining the number of subscriptions per month, installation of meters, billing systems, maintenance, and coordination. The determination of water tariffs is determined in consultation with the community, village offices, and managers. The determination of water price is determined at the end of the year, namely in December.
3. Model of PDAM (Regional Drinking Water Company). This model was initiated by the regional drinking water company, a business entity owned by Pesawaran District. Governance thus follows the model applied by PDAM. The tariff for drinking water itself is determined based on the Regulation of the District of Pesawaran No. 9 of 2014, which states that the water tariff is from Rp. 3200 to 5400 per m3, depending on the amount of water used. The more there are, the higher the rates.

   In addition to setting tariffs, the governance of the clean water service model with the PDAM scheme is determined by PDAM employees, such as the timing of monthly bill withdrawals, network repair/maintenance, supervision, and planning. The company assigned a representative to be a technician as well as a PDAM administrative officer.

3.3. Consumption and supply of water to households

The average water consumption per household in Bayas Jaya Village is 460 litres per day, with the highest consumption being 913 litres and the lowest being 226 litres per day. Meanwhile, the water supply per day when the study was conducted was, on average, 10.6 m3, with the highest supply being 64 m3 and the lowest being 4.8 m3 per day. From the figures above, there is a very large surplus of water every day. Unfortunately, the surplus water is only wasted because it is not used by the community for other purposes. For the PAMSIMA and PDAM models, a large surplus occurred because the

PAMSIMAS and PDAM participants carried out water efficiency so that they did not consume their water potential. It seems that the potential for developing the number of village PDAM customers is possible with the current water debit, which is still quite large. The large surplus also indicates that the clean water service system is still inefficient, which is economically a loss of water resources.

3.4. Water price

The price of water between the three models of clean water management is different from one another. The lowest water price is in the self-help model, which only pays around Rp. 60-000 s.d. IDR 100,000 per year. Meanwhile, the price of PAMSIMAS is determined based on an agreement, which is between Rp. 120,000 to Rp. IDR 240,000 per year. The highest price for water services is in the PDAM model, which is IDR 540,000 per year.

3.5 Community's satisfaction towards water service

Community satisfaction is measured by modifying [18] model. The study asked respondents about 5 dimensions and their sub-indicators of clean water services. There were two columns of responses, i.e., degree of expectation and degree of performance. Each response is rated from 1 (most disagree) to 5 (most agree).

The results of the gap analysis also show that there is a small gap between what is in the interests of the community and what is achieved (performance) by clean water management. The gap between significance and performance is only 16%, which means that 84% of community satisfaction indicators have been met. Detailed results of customer satisfaction analysis are presented in the following table.

Table 3. Perception of the community towards water management

Perception on	Expectation	Performance	Gap
Physical dimension			
Quantity of water	3.99	3.41	0.57
Clarity of water	3.99	3.41	0.57
Odorless water	4.00	3.60	0.40
Pollution free water	4.00	3.49	0.51
Reliable dimension			
Water availability	3.99	3.33	0.64
Securing water	3.96	3.04	0.92
Responsiveness dimension			
Responsive when problems occur	3.98	3.30	0.68
Agreement	3.96	3.16	0.80
Maintenance of water	4.00	3.28	0.72
Assurance dimension			
Providing solution	3.99	3.43	0.56
Clarity in responding community	3.99	3.32	0.67
Openness	3.93	3.28	0.65
Empathy dimension			
Overcoming complaint	4.00	3.41	0.59
Service fee is discussed	3.99	3.49	0.49
Total	55.76	46.97	8.77
		84%	16%

The high satisfaction is due to the ability of management to satisfy all dimensions. For example, the gap between expectation and performance on water quality, such as odorless and free of pollution, is very small, suggesting that management can narrow between what is important to the community and management performance in fulfilling that indicator.

This result is different from many studies on consumer satisfaction with water service, as shown in the study of [19] in Bogor, Indonesia, and [15] in Ethiopia. In both studies, consumers are generally dissatisfied with the water services provided by the institution.

3.6. Willingness to Pay

This study makes a hypothetical market condition, namely with the condition that there will be improvements in the supply and quality of clean water provided to households. Respondents were asked a hypothetical condition if the quality and quantity of water improved and whether they would be willing to pay more than what is currently given to the water utility. The question is an open question with the price mark is the existing monthly service charge.

The results showed that 56% of respondents were willing to pay extra if the water supply and quality conditions improved. This percentage number who refused to pay is quite similar to a study carried out by [25] in Malawi. Of the three models of clean water services, for the PAMSIMAS model, 10 (13%), households are not willing to pay, for PDAM, there are 14 respondents (19%), and for self-help, there are nine members (12%) who are not willing to make additional payments.

Multiple regression analysis on factors affecting respondents' willingness to pay is summarized in the following table.

Table 4. Regression analysis factors affecting willingness to pay for clean water services

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	154353.558	280694.517	0.54989873	0.586599449
D1 water management*** (1=PDAM; 0= others)	592428.348	62297.8163	9.50961661	2.03932E-10
D2 water management*** (1= PAMSIMAS; 0= others	389666.192	42520.96	9.16409676	4.60154E-10
Age (x1)*	-2439.3351	1563.1005	-1.5605747	#NUM!
Length of living in the village (X2)	-414.08594	1067.10548	-0.3880459	0.700815989
No of family member (X3)	45426.1304	60307.9843	0.75323576	0.45738013
Size of landholding (X4)	-3092.7347	23127.8108	-0.1337236	0.894544812
Annual income (X5)	-0.0089959	0.00821967	-1.0944305	0.282773353
Family expenditures (X6)	0.27960421	0.40041817	0.69828053	#NUM!
Saving (X7)	0.01032873	0.00833498	1.23920299	0.225206118
Water discharge for fam (X8)**	164.245665	91.6064113	1.79294945	0.083418185
Daily water use (X9)	-187.99606	188.249598	-0.9986532	0.32622312
Investment for water facility (X10)	0.08020267	0.06442808	1.2448403	0.223156632

Multiple R	0.97377464
R Square	0.94823705
Adjusted R Square	0.85785238
Standard Error	78309.2479
Observations	42

Annova	df	SS	MS	F	Significance F
Regression	12	3254791729980	271232644165	49.0892395	0.00000000
Residual	30	180827912877	6027597096		
Total	42	3435619642857			

The result suggests that all variables have simultaneously influenced willingness to pay for improved water services, with the F test that satisfies the probability of 99%. (i.e., water management, length of living in the village, number of family members, annual income, family expenditures, saving, water discharge, daily water use, and investment in water facilities), The value of R^2 is also very high amounting to 95% which suggests that 95% of independent variable have been explained by dependent variables. However, only four variables have significantly affected willingness to pay. Those variables are (1) dummy 1 PDAM model, (2) dummy 2 PAMSIMAS model, (3) age, and (4) water discharge. This suggests that respondents of PDAM and PAMSIMAS models are keen to pay more should water services improve, with the t-test value of 9.5 and p-value of 0.0. Age variable negatively affects the community's willingness to pay, with the t-test at – 1.56 meaning that the older respondent tends to be less willing to pay. Water discharge, or the amount of water received daily by the family, has a positive effect on willingness to pay, with the t-test at 1.79 and p-value at 0.08. It means that the more water discharged to the family, the more the respondents are willing to pay.

4. Conclusion

1. The majority (56%) of the people of Bayas Jaya are willing to pay more if clean water services, both in quantity and quality of water increase. However, there is a large portion of the community (44%) who says they are not willing to increase payments.
2. The average nominal value of willingness to pay (WTP) is IDR 440,357 per year. Factors that significantly affect willingness to pay are (a) the PDAM management model and PAMSIMAS, (b) customer age (negative), and (c) water discharge (positive).
3. It is imperative that the local government increase its budget for improving water services with a self-management model, as their water facilities are ill-equipped.

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