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ECONOMIC VALUATION OF MANGROVES IN SEKOTONG TENGAH, WEST LOMBOK

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ABSTRACT

This research aims to calculate the economic value of mangrove ecosystems and estimate the average Willingness to Pay (WTP) of the community in Sekotong Tengah Village. Data were collected through observations and interviews with the Contingent Valuation Method (CVM) using the Double-Bounded Dichotomous Choice (DBDC) approach to 100 household respondents. The results showed that the Direct Economic Value (DEV) of mangrove utilization reached IDR 2,790,890,400 per year, while the Indirect Use Value (IUV) derived from ecosystem services was worth IDR 2,845,291,680 per year. The Option Value (OV) is estimated at IDR 2,797,560 per year so that the Total Economic Value (TEV) reaches IDR 6,727,204,152 per year. The estimated average WTP with binary logistic and bivariate probit models were IDR 417,264 (25.17 USD) and IDR 403,452 (24.33 USD) per household per year, respectively. Employment and supply factors negatively affect WTP, while education and income have a positive and significant effect. These results provide insights for mangrove conservation policy and alternative funding for ecosystem protection.

KEYWORDS *Contingent Valuation, Economic Valuation, Sekotong Tengah, Mangrove Conservation, Parametric estimation*

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INTRODUCTION

Mangroves are recognized as providing a wide range of ecosystem services such as food, raw materials, climate regulation, pollution control, coastal protection, recreational opportunities, and spiritual experiences, to name a few (Chow, 2018). Mangrove ecosystems are critical for ecological and economic reasons, acting as

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natural coastal protection against erosion and storms, and contributing to the carbon cycle through the sequestration and storage of blue carbon (Elwin Bukoski et al., 2019; Maurya Mahajan & Chaube, 2016; Parida & Kumari, A., 2021; Su et al., 2021). Mangrove forests have various biological functions such as providing spawning grounds for fish and shrimp, nesting grounds for birds, and natural habitats for various biota, acting as shelter and nesting grounds for diverse species including shrimp, fish, and other biota (Brito Campos et al., 2018). In addition, mangrove forests also have important economic roles as fuel sources, support aquaculture activities, facilitate salt production, and provide building materials (Njana Bollandsås et al., 2020). Despite their immense value, mangrove forests around the world are experiencing severe degradation (Goldberg Lagomasino et al., 2020).

Global mangrove forests are in substantial decline mainly due to human activities such as aquaculture, agriculture, and industrialization, as well as natural factors such as sea level rise and erosion (Bhowmik Padmanaban et al., 2022). Between 1990 and 2020, there was a global decline in mangrove area of 8,600 km2, with the most significant losses occurring in South Asia and Southeast Asia (Goldberg Lagomasino et al., 2020). On Lombok Island, mangrove ecosystems are also experiencing significant degradation, with approximately 50.3% of the total 3,305 hectares in degraded condition (Mujiono, 2016) Sari et al., (2022). Mangrove loss also occurred in this study area. Several areas in the mangrove area of Sekotong Tengah Village have been degraded due to land conversion for settlements, ponds, and agricultural land. This alarming rate of degradation underscores the need for immediate conservation action.

To anticipate the damage and reduction of mangrove areas, it is necessary to increase public awareness of the function and potential of mangrove ecosystems. Several efforts and strategies have been proposed, such as rehabilitation and conservation, but additional measures are needed to address the widespread destruction of mangroves. One approach is to calculate the total economic value of mangrove ecosystems. This calculation will serve as a reference in utilizing mangroves as part of efforts to conserve their ecosystems. Valuation of the economic benefits of mangrove ecosystems has been widely conducted in Indonesia (Malik Fensholt & Mertz, O., 2020; Mariana, 2015; Parida & Kumari, A., 2021; Patria Rosadi & Nisyawati., 2019; Rumahorbo et al., 2019). Although mangrove valuation studies have been conducted in various regions in Indonesia, unfortunately, few studies have specifically valued mangrove ecosystem services and estimated Willingness to Pay (WTP) to restore the perceived mangrove benefits in Sekotong Tengah Village. Farista & Virgota (2021) have assessed mangrove ecosystem services as a carbon sink in the Sekotong sub-district, but WTP estimation for mangrove conservation has not been conducted in this region. Furthermore, Sasmito et al (2023) stated that Indonesia's low success in mangrove restoration projects is due to a lack of community participation. Through this WTP study, the contribution of local communities to mangrove conservation can be further explored.

Estimating the value of mangrove forest conservation using the Willingness to Pay (WTP) approach has a crucial role in providing alternative sources of

financing for conservation through community participation. This is especially relevant in developing countries that generally have limited budgets for conservation programs. In addition, these conservation value estimates are very useful in cost-benefit analyses and are important information for policymakers (Himes-Cornell Grose & Pendleton, L., 2020). Furthermore, the Contingent Valuation Method (CVM) has been widely used in previous studies as both a survey-based approach and a broad-stated preference method. CVM is the dominant technique applied in both developing and developed countries to evaluate various environmental changes and obtain WTP estimates for environmental services (Arifin & Priyono, R., 2021; Mau & Nguyen, 2015; Witt, 2019). In addition, identifying socio-demographic and perceptual factors that influence WTP is also an important aspect of policy planning and implementation (Fauziyah et al., 2023; Zaiton et al., 2019; Zimo et al., 2023). In this study area, the economic valuation of mangrove ecosystem services as a carbon sink has been conducted by Farista & Virgota (2021). However, the study did not apply the Total Economic Value (TEV) approach. In addition, the community's WTP for mangrove conservation has yet to be revealed. Therefore, this study aims to estimate the total economic value of mangroves and analyze the factors that influence community WTP for mangrove conservation in Sekotong Tengah Village, West Lombok, Indonesia.

The degradation of mangrove ecosystems in Sekotong Tengah Village, West Lombok, presents significant environmental and economic challenges. Mangroves are vital for coastal protection, biodiversity, and economic activities like fishing and ecotourism. However, human activities such as land conversion for agriculture and settlements, along with the natural impacts of sea-level rise, have led to the rapid loss of mangrove areas. Despite the known ecological importance of these ecosystems, the local community’s engagement in their conservation remains limited. A major challenge is the lack of financial resources and effective mechanisms to support mangrove restoration efforts, especially when conservation budgets are constrained. Therefore, understanding the economic value of mangroves, including the community's willingness to pay (WTP) for their conservation, is essential to inform effective policy and funding strategies.

Moreover, existing research on mangrove valuation often lacks a comprehensive assessment of the community’s willingness to pay for the conservation and restoration of these ecosystems, particularly in rural coastal areas like Sekotong Tengah. While some studies have quantified the direct and indirect benefits of mangrove ecosystems, they have not fully explored how socio-demographic factors influence WTP for mangrove conservation in the region. This study, therefore, aims to address this gap by estimating the total economic value (TEV) of mangroves in Sekotong Tengah and analyzing the socio-economic factors influencing WTP for their preservation.

The urgency of this research is heightened by the rapid decline of mangrove ecosystems and the critical role they play in coastal protection and local livelihoods. Mangrove ecosystems are essential for mitigating the effects of coastal erosion, providing habitats for marine species, and supporting the livelihoods of local communities. With the loss of mangroves threatening the ecological balance and the economic stability of Sekotong Tengah, immediate action is required to prevent

further degradation. This study is crucial for informing policy decisions, promoting community engagement, and securing alternative funding for mangrove conservation through community participation, especially in the face of limited government resources.

Previous studies have demonstrated the significant ecological and economic value of mangrove ecosystems in coastal areas. For example, Himes-Cornell et al. (Himes-Cornell Grose & Pendleton, L., 2020) highlighted the role of mangroves in providing essential ecosystem services such as carbon sequestration, coastal protection, and supporting biodiversity. Studies in Indonesia, such as those by Malik et al. (2020), have quantified the direct economic value of mangrove ecosystems in various regions, emphasizing their importance for local economies, particularly in fishing and tourism. Furthermore, the research by Farista & Virgota (2021) assessed the carbon sink value of mangroves in Sekotong sub-district, although it did not explore the community's willingness to pay for mangrove conservation.

In addition, contingent valuation methods (CVM) have been widely used to estimate the willingness to pay (WTP) for environmental conservation, particularly in assessing the public's value of ecosystem services. Studies by Fauziyah et al. (2023) and Zaiton et al. (2019) have used CVM to estimate WTP for mangrove conservation in various parts of Southeast Asia, highlighting the economic potential of mangrove ecosystems as a means to engage local communities in conservation efforts. However, few studies have specifically focused on WTP in Sekotong Tengah Village or similar coastal communities, where socio-demographic factors such as income, occupation, and education levels may significantly influence WTP.

Furthermore, research by Gagarin et al. (2018) and Thuy et al. (2024) has indicated that socio-economic factors like income and education have a significant impact on WTP for environmental conservation, although the influence of occupation and household size remains underexplored. This study addresses the lack of region-specific research by providing an in-depth analysis of these socio-demographic factors in Sekotong Tengah and offers valuable insights into the role of community participation in mangrove conservation.

Although substantial research has been conducted on the economic value of mangroves and the community's willingness to pay for their conservation, there is a significant gap in studies focused on the specific socio-economic factors influencing WTP in rural coastal areas like Sekotong Tengah. Existing studies have often overlooked how local community characteristics, such as occupation and income, affect their willingness to contribute to conservation efforts. This research fills this gap by analyzing the Total Economic Value (TEV) of mangrove ecosystems in Sekotong Tengah, estimating the community's WTP, and identifying the socio-demographic factors that influence their willingness to pay for conservation and restoration programs.

This study is novel in its application of the Total Economic Value (TEV) approach to estimate the economic value of mangrove ecosystems in Sekotong Tengah Village, a region not extensively studied for its mangrove ecosystem services. The study employs the Contingent Valuation Method (CVM) using the Double-Bounded Dichotomous Choice (DBDC) model to estimate the

community's Willingness to Pay (WTP) for mangrove conservation. This methodological approach, coupled with a focus on socio-demographic factors such as education, occupation, and income, provides a comprehensive understanding of the economic value of mangroves and the role of community participation in their conservation.

The primary objective of this study is to estimate the Total Economic Value (TEV) of mangrove ecosystems in Sekotong Tengah Village, including the Direct Use Value (DUV), Indirect Use Value (IUV), Option Value (OV), and Existence Value (EV). Additionally, the study aims to determine the community's willingness to pay (WTP) for mangrove conservation and to analyze the socio-demographic factors that influence WTP. By doing so, the study seeks to provide actionable insights for policymakers and conservation organizations to develop sustainable funding mechanisms for mangrove conservation in the region.

This research offers significant theoretical and practical benefits. Theoretically, it contributes to the literature on mangrove ecosystem valuation by providing new insights into the economic value of mangroves in Sekotong Tengah Village and how community characteristics influence WTP for environmental conservation. Practically, the findings can inform local government and conservation organizations in Sekotong Tengah and similar regions on how to secure alternative funding for mangrove restoration and conservation efforts. By engaging the community in conservation through WTP mechanisms, this study can help enhance public awareness and foster a sense of ownership and responsibility for preserving vital coastal ecosystems.

RESEARCH METHOD

The research uses a mixed-method approach, integrating both quantitative and qualitative techniques to estimate the Total Economic Value (TEV) of mangrove ecosystems and assess the community's willingness to pay (WTP) for their conservation in Sekotong Tengah Village. The quantitative method involves the application of the Contingent Valuation Method (CVM), which is commonly used in environmental economics to determine the non-market value of natural resources. This method measures individuals' willingness to pay for ecosystem services by constructing a hypothetical market for the respondents to make decisions about the value they place on the conservation of the mangrove ecosystem. The study uses a double-bounded dichotomous choice (DBDC) format in the survey to estimate WTP, where respondents are asked two bid values (one initial and one follow-up) and their responses help to determine the level of payment they are willing to make.

To collect data, the researchers first conducted a pre-test survey with 20 respondents to evaluate and refine the questionnaire format. This pre-test helped ensure that the survey questions were clear and the bid range was appropriate. The formal survey was then conducted using a purposive sampling method, targeting 100 households in Sekotong Tengah Village, a coastal area with a high dependence on mangrove ecosystems. The respondents, primarily fishermen, crabbers, shrimpers, and traders, were selected based on their direct interaction with the mangrove ecosystems. The survey covered socio-demographic characteristics,

direct economic benefits from mangroves, and questions about their willingness to pay for conservation.

The parametric estimation for analyzing WTP was conducted using bivariate probit and binary logistic regression models. These statistical models were used to estimate the relationship between socio-demographic variables (such as income, occupation, and education) and the probability that respondents would be willing to pay for mangrove conservation. The data analysis involved running these models in STATA 17.0 software, which allowed for efficient estimation of the average WTP based on the socio-demographic characteristics and the respondents' responses to the bid values.

The qualitative method was also employed to understand the community's perceptions of the mangrove ecosystem and to explore the underlying reasons behind their willingness to pay or their refusal. Through interviews and direct observations, the researchers were able to capture the community's experiences, attitudes, and knowledge about mangrove benefits, which helped contextualize the findings from the quantitative analysis. This integration of qualitative insights and quantitative data strengthens the study's overall conclusions and provides a more comprehensive understanding of the community's engagement with mangrove conservation.

RESULT AND DISCUSSION

Characteristics of Respondents

Characteristics of respondents based on socio-demographic conditions can be seen in Table 2. The results of data processing show that the majority of respondents around the mangrove area in Sekotong Tengah Village are between 31-40 years old. However, this does not mean that the male population in Sekotong Tengah Village is greater than the female population. Men, especially those who are the head of the household, are considered the main decision-makers, and some of them work in the mangrove area as a side job.

Table 2 shows the distribution of respondent characteristics by age, education, income, occupation, and household size. The main finding is that 41% of respondents belong to the age group above 31-40 years, followed by respondents in the age group 41-50 years (27%), 21-30 years (25%), above 30 years (3%), and below or equal to 20 years (3%). Based on gender, there were more male (86%) than female (14%) respondents. This result reflects that men tend to be the household representatives in economic decision-making.

In terms of education level, most respondents (44%) completed primary school, followed by junior secondary school (26%), senior secondary school (24%), and no education level (6%). By income category, 66% of this group had a primary income below IDR1 million per month, 32% had an income between IDR1-2 million per month, and another 2% had an income above IDR2 million per month.

Table 1. Characteristic of respondents

Variables	Category	Frequency	Percentage
Age	≤ 20	3	3%
	21 – 30	26	26%
	31 – 40	41	41%
	41 – 50	27	27%
	>50	3	3%
Gender	Male	14	86%
	Female	86	14%
Education	No education	6	6%
	Primary school	44	44%
	Secondary School	26	26%
	High School	24	24%
Income (millions IDR)	< 1	66	66%
	1 – 2	32	32%
	> 2	2	2%
Occupation	Fisherman	89	89%
	Traders	11	11%
Household size (person)	≤ 2	21	21%
	3 – 4	75	75%
	> 4	4	4%

Source: Data Processeed, 2025

Among the respondents surveyed, most of them are fishermen (89%), while others are traders (11%). Finally, more than half of the respondents (75%) have a household size of between 3 and 4 people, followed by a group with a household size of below or equal to 2 people (21%), and one other group with a household size of above 4 people (4%).

Direct Use Value

Direct utilization of the mangrove ecosystem obtained by the community of Sekotong Tengah Village is a provider of fish, crab, shrimp, and tourism value. Based on the calculation of the number of fish, crabs, and shrimp multiplied by the number of productive days and the number of households, the total fish production was 1,944.75 kg/month or 23,337 kg/year, total crab production was 1,498.25 kg/month or 17,979 kg/year, shrimp production was 279.25 kg/month or 3,351 kg/year. The average production costs incurred were IDR 2,739,130.4/month or IDR 32,869,665/year for fishing activities, IDR 8,596,491.25/month or IDR 103,157,895/year for crab fishing, and IDR 1,396,428.58/month or IDR 16,547,857/year for shrimp fishing. Most fish, shrimp, and shellfish catches are usually sold in units per kg. From the rough estimation, the selling price of mixed fish is IDR 20,000 - IDR 30,000/kg, mangrove crab IDR 80,000 - 100,000/kg, and shrimp IDR 40,000 - IDR 60,000/kg. Based on data on the amount of production, product selling prices, and production costs, the benefits of mangroves as a provider of fish, crab, shrimp, and shellfish products as follows for each product are IDR 667,240,435/year, IDR 1,604,847,110/year, and IDR 167,547,857/year.

The direct benefit value of mangrove forests as an ecotourism object is estimated based on the visit rate multiplied by the average number of tourists visiting per year and obtained from the approach of community income selling in the mangrove forest area per year. Then the value of the direct benefit value obtained from mangrove forests per year is IDR 351,255,000.

Table 2. The direct use value of mangrove

No	Type of Direct Use Vale	Amount (IDR/Year)	%
1.	Fish	667,240,435	23.91
2.	Crab	1,604,847,110	57.50
3.	Shrimp	167,547,857	6
4.	Ecotourism	351,255,000	12.58
	Total	**2,790,890,400**	

Source: Data Processed, 2025

Based on the results of the calculation of the direct benefits of mangrove ecosystems reached IDR 2,790,890,400/year, of which 23.91% came from the benefits of fish products, 57.50% crab benefits, 6% shrimp benefits, and 12.58% ecotourism benefits (Table 3). This proves that the mangrove ecosystem directly provides significant benefits to the economic life of indigenous people in the mangrove forest area of Sekotong Tengah Village. It can be seen that each household can obtain direct benefits from mangroves amounting to IDR 3,987.20/household/year.

This finding is lower than previous research in Semarang City, which amounted to IDR 38,766,085,000 (Perdana Fitroh et al., 2020). However, this finding is higher than the research in Gerung District, West Lombok Regency, which amounted to IDR 256,514,000 per year (Patria Rosadi & Nisyawati., 2019).

Indirect Use Value

Indirect values of mangroves in Sekotong Tengah Village evaluated included abrasion, wave, and tsunami (Table 4). Economic values were quantified using the replacement cost method by estimating the economic value of building a breakwater. The cost of constructing a 50 x 1.5 x 2.5 m (p x l x t) embankment with 5-year durability was IDR 291,994,000, or IDR 5,839,880/meter. The length of the coastline in Sekotong Tengah Village is 2,430 meters, so the economic value is IDR 14,190,908,400/meter or IDR 2,838,181,680/year.

Other indirect benefits evaluated were nursery, spawning, and feeding grounds. The value was quantified from the catch of fishery products obtained by the community from the mangrove area. The calculation results showed that the economic value obtained reached IDR. 7,110,000, -/year.

Table 3. The indirect use value of mangrove

No	Type of Direct Use Vale	Amount (IDR/Year)
1.	Breakwater	2,838,181,680
2.	Nursery ground, spawning ground, and feeding ground	7,110,000
	Total	**2,845,291,680**

Source: Data Processed, 2025

The economic value generated from the indirect benefits of mangroves in Sekotong Tengah Village reached IDR. 2,845,291,680, -/year (Table 3). The value obtained shows that mangroves play a major role in generating economic value even though these benefits cannot be felt directly.

This finding is lower than previous research in Muara Indragiri, amounting to IDR 155,399,531,305 (Mariana, 2015). However, this finding is higher than previous research in Geung Sub-district, West Lombok Regency, which only amounted to IDR 1,405,041,200 (Patria Rosadi & Nisyawati., 2019).

Option Value

These values are generally quantified using the benefit transfer method, which calculates the amount of biodiversity in the mangrove ecosystem. Mangrove forests in Indonesia have a biodiversity value of US$15/ha (Lotilla, 1992). This value can be applied to all Indonesian mangroves if they are ecologically and naturally present. Based on this, the economic option value of mangroves in Sekotong Tengah Village in 2022, reached US$180/ha or IDR 2,797,560/ha. The value of biodiversity can explain the important role of the diversity of organisms that make up an ecosystem. Plants, animals, and microorganisms that exist in the ecosystem can certainly provide great benefits (Barbier et al. 1994).

This finding is lower compared to previous research in Muara Indragiri, amounting to IDR 57,615,025.20 (3496.80 USD) per year (Rumahorbo et al., 2019). However, this finding is higher compared to previous research in the Gerung Sub-district, West Lombok Regency, amounting to only IDR 1,200,000 per year (Patria Rosadi & Nisyawati., 2019).

Existence Value

This value measures how much economic value is given by the community, which reflects the level of community concern for natural resources and the environment. Quantification of value is done by measuring individual preferences directly through the Contingent Valuation Method (CVM). This method is done by asking how the Willingness to Pay (WTP) of the community to maintain the existence of mangroves. Economic value was obtained by summing up the average value (IDR) given by informants to the existence of mangroves per ha per year. Based on the binary logistic model, the average WTP was IDR 34,772 (2.10 USD) per household per month, or equivalent to IDR 417,264 (25.17 USD) per household per year. Meanwhile, the average WTP estimated through the bivariate probit model produces a slightly lower estimate, almost the same as the binary logistic model of IDR 33,621 (2.03 USD) per household per month or equivalent to IDR 403,452

(24.33 USD) per household per year. Based on field data, 90 respondents were willing to contribute or pay for mangrove conservation programs. While 10 respondents were not willing to contribute or pay for the program because mangrove conservation and rehabilitation programs are the responsibility of the government and the lack of economic income is the reason why people do not contribute to mangrove conservation programs.

If the average WTP is multiplied by the number of households in Sekotong Tengah Village, the WTP value is IDR 1,088,224,512/year or IDR 90,685,376/ha/year. The high value of WTP indicates that the community gets great economic benefits and makes the community appreciate or respect the value of the existence of mangrove ecosystems (Owuor Mulwa et al., 2019; Rumahorbo et al., 2019). The WTP value that reached USD 34,425,200/ha/year is higher than the WTP value of mangrove ecosystems in other regions in Indonesia. The results of Rumahorbo's research (2019) obtained an average WTP for the existence of mangroves in Youtefa Bay, Jayapura reaching USD 8.73 ha/year.

Table 4. Estimating the WTP for mangrove conservation

	Binary logistic			**Probit Bivariate**		
	β_i	$\bar{X}_i$	$\beta_i \bar{X}_i$	β_i	$\bar{X}_i$	$\beta_i \bar{X}_i$
Constan	5.160		5.16	3.224		3.224
Age	-0.076	36.89	-2.804	-0.042	36.89	-1.549
Gender	1.952	0.87	1.698	1.164	0.87	1.013
HH size	-0.025	3.18	-0.080	-0.159	3.18	-0.506
Education	2.507	1.68	4.212	1.353	1.68	2.273
Occupation	-2.862	1.11	-3.177	-1.664	1.11	-1.847
Martial status	-1.417	0.91	-1.289	-0.538	0.91	-0.490
Income	0.000	844,000	0.000	0.000	844,000	0.000
Bid	-0.107	21.20		-0.063	21.20	
Total			3.721			2.118
Mean	34,772			33,621		

Note: $\bar{X}_i$ is the mean value of the independent variable and β_i is the coefficient regression

Source: Data Processed, 2025

Total Economic Value

Mangrove ecosystems in Sekotong Tengah Village, West Lombok Regency have great natural resource potential. This can be seen from the magnitude of the TEV value of the mangrove ecosystem in this study. The TEV value of mangrove ecosystems in Sekotong Tengah Village reached IDR 6,727,204,152 (408,948.58 USD) per year or equivalent to IDR 560,600,346 (34,079.05 USD) per ha per year (Table 6). When compared to the entire economic value of mangroves based on benefit categories, the value of indirect benefits has a greater value (about 42.30%) compared to other benefit values. The high value of indirect benefits is due to the desire of the community to utilize these natural resources for economic needs and improve their welfare. The results of this study also showed the ecological function of mangrove ecosystems in Sekotong Tengah Village (direct benefits amounted to 41.49%). Option value reached 0.04% and existence value reached 16.18% of the total economic value of mangroves in Sekotong Tengah Village. The TEV of

mangrove ecosystems (34,079.05 USD per ha per year) in this study is relatively high when compared to previous studies in the Coastal Area of Merauke Regency, with a value of Rp 21,075,240.00/ha/year (Widiastuti Ruata & Arifin, T., 2016) and TEV of USD 15,937.49/ha/year in Youteva Bay, Jayapura (Rumahorbo et al., 2019). In general, differences in TEV across studies depend on the number of mangrove benefits identified and quantified as well as the condition and extent of mangrove areas.

Table 5. The result of model estimation

No.	Types of Value	Amount (IDR/Year)	%
1	Direct Use Value	2,790,890,400	41.49
2	Indirect use Value	2,845,291,680	47.01
3	Option Value	2,797,560	0.04
4	Existence Value	1,088,224,512	16.18
	Total	**6,727,204,152**	

Source: Data Processed, 2025

Parametric Analysis

This study estimates households' Willingness to Pay (WTP) for mangrove conservation efforts and analyzes the influence of socio-demographic characteristics on their WTP response. Prior to the main survey, a two-stage pre-test and revision of some questions in the questionnaire were conducted to ensure that respondents could understand the questions asked. This step aims to minimize hypothetical bias, in line with previous studies (Fauziyah et al., 2023; Gagarin Eslava et al., 2018; Pham et al., 2018; Vo Trung & Simioni, M., 2020). The results showed that local communities expressed their preference for WTP by being willing to contribute to mangrove conservation. They believe that there is a link between the benefits of mangrove ecosystems and their livelihoods.

Table 7 reveals that education level, employment type, income level, and offer size are the main factors influencing WTP based on both regression models used. In contrast, the variables of age, gender, household size, and marital status did not have a significant influence on WTP. Specifically, the variables of occupation and offer size have a significant negative impact on the WTP response, while education level and income have a positive and significant effect, as indicated by the positive regression coefficients with p values <0.05. Interestingly, in the context of occupation, fishers were less willing to pay for mangrove conservation than other occupational groups, even though the occupation variable was statistically insignificant, as reflected by negative regression coefficients and p-values greater than 0.05.

The model fit test using Pearson Chi-Square showed that the model fits the data ($p > 0.05$), with p values for the Binary Logistic and Probit models of 0.9973 and 0.9757, respectively. Meanwhile, the Likelihood Ratio Chi-Square from the Omnibus Test shows that the overall model is statistically significant ($p = 0.000 < 0.05$). Thus, the independent variables in this model have better predictive power in estimating the average WTP.

Based on respondents' characteristics and perceptions, it was found that WTP responses to mangrove conservation varied. A total of 10% of respondents showed a negative response to WTP (rejecting offers or stating zero WTP) for mangrove conservation in Sekotong Tengah Village. Among the 90% of respondents who expressed positive WTP, the majority accepted the second lower price offer (IDR 10,000), followed by those who accepted the first offer (IDR 20,000). Meanwhile, 10% of respondents accepted the higher offer price (IDR50,000), and 39% only accepted the first offer price.

Table 6. Factors affecting WTP for mangrove conservation

Item	Logit		Probit	
	Coefficient	**Sig.**	**Coefficient**	**Sig.**
Constan	5.160	0.085	3.224	0.028
Age	-0.076	0.548	-0.042	0.519
Gender	1.952	0.297	1.164	0.168
HH size	-0.025	0.984	-0.159	0.790
Education	2.507	0.046**	1.353	0.031**
Occupation	-2.862	0.007*	-1.664	0.005*
Martial status	-1.417	0.680	-0.538	0.750
Income	0.000	0.027**	0.000	0.001*
Bid	-0.107	0.000*	-0.063	0.000*
Goodness of fit (Pearson Chi-Square	0.9973		0.9757	
Likelihood Ratio Chi-Square (p-value)	0.000		0.000	
Mean WTP (IDR)	34.77		33.62	

Note: * 1% significant level, ** 5% significant level, ***10% significant leve

Source: Data Processed, 2025

The parametric model shows that WTP for mangrove conservation is significantly influenced by education level, employment type, and offer size. In contrast, the variables of age, gender, household size, and marital status had no significant influence on WTP. In terms of age, although different age groups showed variations in willingness to pay, their responses to the value of the offer followed a similar pattern. Older respondents tended to be less willing to pay than younger respondents, although this difference was not statistically significant. Younger respondents are more aware of the degradation of mangrove ecosystems in their neighborhood, which may negatively affect their WTP response towards mangrove conservation. This negative relationship is in line with the findings of Vo Trung et al. (2020) and Thuy et al (2024), but contradicts the results of Fauziyah et al. (Fauziyah et al., 2023) and Gagarin et al (2018), who found a negative correlation between age and WTP.

Like the age variable, marital status also has a negative relationship with WTP but is not statistically significant. This finding indicates that married individuals are less likely to be willing to pay than unmarried individuals. This negative relationship is in line with the findings of Musa et al (2020) and Ramli (2017), which show that marital status has an impact on decreasing WTP. However,

other studies show that marital status has a positive and significant relationship with WTP (Zaiton et al., 2019).

In this study, the gender variable has a positive correlation with WTP, although it is not statistically significant. This finding indicates that men are more willing to pay than women. This result is also reinforced by parametric analysis which shows a positive sign for the gender variable, in line with the research of Thuy et al. (2024) and Gagarin et al. (2018). In contrast, several other studies found that this variable has a negative relationship with WTP (Fauziyah et al., 2023 (Pham et al., 2018).

In addition, this study found that household size has no significant effect on WTP. Nonetheless, this variable has a positive sign, indicating that respondents with a larger number of family members tend to be more willing to pay than those with a smaller number of family members, assuming other factors are constant. In other words, the larger the number of family members, the higher their willingness to pay in the context of mangrove conservation. This finding is in line with the research of Thuy et al. (2024) and Musa et al. (2020), but contradicts other studies.

Among the significant variables, education level has a positive correlation with WTP. This relationship suggests that individuals with higher education levels tend to have greater WTP for mangrove conservation. This result is in line with the research of Pham (2018) and Lan et al (2019), as well as the findings of Zaiton et al. (2019), who also found that education level has a significant influence on WTP. However, other studies report a negative and significant correlation between these two variables (Basri Samdin & Ghani, 2020; Li, 2022) .

income variable also has a positive and significant influence on WTP, indicating that respondents with higher incomes tend to be more willing to pay. The rejection of the offer in this study was mainly due to financial limitations. This finding is consistent with the research of Fauziyah et al. (2023), which showed that an increase in respondents' income was directly proportional to an increase in their WTP. Furthermore, Vo Trung et al. (2020) found that individuals with higher incomes showed greater concern for mangrove conservation. However, these results contradict the findings of Zaiton et al. (2019), who reported that income did not significantly affect WTP.

In addition to education and income levels, employment type also has a significant negative influence on WTP. This finding is in line with the study of Fauziyah et al. (2023) but contradicts the results of Thuy et al. (2024) and Pham (2018). In particular, this result shows that fishermen have a lower level of WTP compared to other occupational groups.

Finally, the supply variable has a significant negative effect on WTP. In this study, an increase in the size of the offer led to a decrease in the probability of respondents being willing to pay for the mangrove rehabilitation project. This finding is in accordance with the law of supply and demand, which states that the demand for a good or service will decrease as the price increases. This result is also supported by previous studies (Fauziyah et al., 2023; Pham et al., 2018; Vo Trung & Simioni, M., 2020; Zaiton et al., 2019).

Regarding the average WTP, the estimation results using the parametric method showed a value of IDR 34,772 (2.10 USD) per household per month, or

equivalent to IDR 417,264 (25.17 USD) per household per year. Meanwhile, other WTP values were recorded at IDR 33,621 (2.03 USD) per household per month, or equivalent to IDR 403,452 (24.33 USD) per household per year. These values are lower compared to previous studies in Vietnam, such as the average WTP of 26.73 USD for mangrove conservation in Xuan Thuy National Park (Thuy et al., 2024). However, these results are higher compared to other studies in Vietnam, such as an average WTP of 15 USD for mangrove ecosystem service payments in Phu Long (Thuy et al., 2024) and an average WTP of 3.48 USD for mangrove rehabilitation in Santo Angel, Quezon Province, Philippines (Gagarin Eslava et al., 2018). In addition, the average WTP for mangrove conservation in Matang Mangrove Forest, Perak, Malaysia, only reached MYR 17.60 (Ramli, 2017). This difference in results is likely influenced by variations in socio-demographic characteristics and preferences of respondents in each study area. In addition, differences in survey methods and analysis approaches may also contribute to variations in WTP estimates.

The results of this study indicate that mangrove ecosystems in Jerowaru Village have the potential to create alternative sources of income through community participation, beyond government budgets and other funding sources. To increase the effectiveness of the program in attracting financial resources, the government needs to implement various strategies, such as strengthening transparency in the management and implementation of environmental policies, accepting social monitoring, and rebuilding and increasing public trust in environmental protection institutions. Thus, it is expected that more parties will be willing to invest in environmental protection and preservation efforts.

CONCLUSION

The Direct Use Value (DUV) of mangrove forests in Sekotong Tengah Village was estimated at IDR 2,790,890,400 per year. Meanwhile, the Indirect Use Value (IUV) reached IDR 2,845,291,680 per year. Existence Value (EV) was recorded at IDR 1,088,224,512 per year, while Option Value (OV) was IDR 2,797,560 per year. Thus, the Total Economic Value (TEV) of the mangrove ecosystem in the region reached IDR 6,727,204,152 per year. These results show that mangrove ecosystems have an economic value that comes not only from direct benefits, but also from indirect benefits, existence value, and option value. In addition, the empirical findings show that the average Willingness to Pay (WTP) obtained through parametric estimation using binary logistic and bivariate probit models is IDR 417,264 (25.17 USD) and IDR 403,452 (24.33 USD) per household per year. Furthermore, this study identified that education level, type of employment, income level, and bid size are the main factors that influence people's WTP for mangrove conservation. Thus, the results of this study can be used as a consideration in developing alternative funding sources for mangrove conservation efforts, especially when limited funds are the main constraint. In addition, the WTP estimates obtained can be integrated as part of an incentive-based mangrove management strategy to improve the effectiveness of conservation programs.

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