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Economic Valuation of Biodiversity Services in Tanjung Puting National Park Using the Willingness to Pay Approach

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ABSTRACT

Biodiversity constitutes a fundamental pillar of sustainable development by providing ecological, social, and economic benefits. National parks play a crucial role in conserving biodiversity while simultaneously delivering ecosystem services that support human well-being. However, many of these services are non-market in nature and are often undervalued in policy-making processes. This study aims to estimate the economic value of biodiversity services in Tanjung Puting National Park using the Willingness to Pay (WTP) approach and to analyze socio-demographic factors influencing visitors' willingness to contribute to conservation efforts. Data were collected through a structured survey administered to visitors and local communities. The results indicate that respondents demonstrate a positive willingness to pay for biodiversity conservation, with income, education level, and environmental perception significantly influencing WTP values. These findings provide empirical evidence to support conservation financing strategies and sustainable management policies for national parks.

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1. Introduction

Biodiversity is one of the essential foundations of sustainable development, playing a strategic role in maintaining ecosystem stability and supporting social and economic welfare (Blicharska et al., 2019). Conservation areas, particularly national parks, are designed to protect biodiversity while simultaneously providing high-value ecosystem services, both directly and indirectly (Tomczyk et al., 2015). Tanjung Puting National Park is widely recognized as a critical habitat for various endemic and protected species and as an important destination for nature-based tourism. Nevertheless, the ecological and social benefits generated by this area are largely non-market in nature and therefore often excluded from formal planning and policy decision-making processes (Cruz, 2021).

The absence of explicit market values causes biodiversity services to be perceived as free goods, making them vulnerable to overexploitation and environmental degradation (Heal,

2020). In this context, economic valuation serves as a vital instrument for revealing the hidden value of ecosystem services by translating them into monetary terms (Brander et al., 2024). Such valuation information is essential to strengthen scientific arguments in conservation policy formulation, management priority setting, and sustainable financing planning (Burke et al., 2011).

The Willingness to Pay (WTP) approach is widely applied in environmental economic valuation studies because it captures individual preferences for environmental quality and sustainability, including both use and non-use values (Yelboğa et al., 2022). WTP reflects the extent to which individuals value the existence and continuity of ecosystems and the benefits they provide. Therefore, this study focuses on estimating the economic value of biodiversity services in Tanjung Puting National Park using the WTP approach while also examining socio-demographic factors influencing such willingness (Pribadi et al., 2023). The results are expected to contribute empirical evidence for evidence-based and sustainability-oriented national park management.

2. Literature Review

Total Economic Value (TEV) Framework in Natural Resource Valuation

Economic valuation of natural resources is commonly grounded in the concept of Total Economic Value (TEV), which provides a comprehensive framework for capturing the full range of benefits derived from environmental resources. TEV consists of direct use values, indirect use values, and non-use values, including existence, option, and bequest values (Pearce & Turner, 1990; Freeman et al., 2014).

Direct use values refer to benefits obtained through direct interaction with natural resources, such as ecotourism, recreation, and harvesting activities (Barbier et al., 2011). Indirect use values reflect ecological functions that support human welfare indirectly, including habitat protection, climate regulation, and ecosystem life-support services (Costanza et al., 1997). Non-use values capture individuals' utility derived from the mere existence of environmental assets, regardless of actual or intended use, highlighting the ethical and intergenerational dimensions of conservation (Krutilla, 1967).

Non-Market Valuation and Contingent Valuation Method

In conservation areas, non-market valuation methods are particularly important because most ecosystem services are not traded in conventional markets. Among these methods, the Contingent Valuation Method (CVM) has been widely applied to estimate non-market values by eliciting individuals' willingness to pay (WTP) for environmental goods under hypothetical scenarios (Mitchell & Carson, 1989; Hanemann, 1994).

CVM is especially effective in capturing non-use values such as existence and option values, which are otherwise difficult to measure using revealed preference techniques (Bateman et al., 2002). As a stated-preference approach, CVM allows researchers to assess public support for conservation initiatives and environmental quality improvements in protected areas.

Determinants of Willingness to Pay in Conservation Areas

Empirical studies consistently show that WTP values are influenced by respondents' socio-demographic characteristics, including income, education level, age, and visitation frequency (Togridou et al., 2006; Wang & Jia, 2012). Higher income and education levels are generally associated with greater environmental awareness and stronger preferences for conservation outcomes.

Beyond socio-demographic factors, environmental perception, ecological knowledge, and satisfaction with environmental quality play a significant role in shaping individual preferences and WTP levels (López-Mosquera & Sánchez, 2012). In the context of national park management, WTP estimates have been used to inform entrance fee policies, payment for ecosystem services (PES) schemes, and the evaluation of conservation strategies (Whittington, 2010). Consequently, the literature confirms that the WTP approach offers a robust conceptual and methodological basis for valuing biodiversity services in protected areas such as Tanjung Puting National Park.

3. Research Methodology

This study employs a quantitative descriptive approach using a survey method as the primary data collection instrument. Primary data were obtained through structured questionnaires distributed to visitors and communities surrounding Tanjung Puting National Park. Respondents were selected using purposive sampling, with criteria including a minimum age of 17 years and prior experience visiting or interacting with the national park area.

The questionnaire collected information on socio-demographic characteristics, visitation frequency, perceptions of environmental quality, and core questions related to willingness to pay for biodiversity conservation. The collected data were subjected to validity and reliability tests prior to analysis. Data analysis consisted of descriptive statistics to profile respondents and multiple linear regression analysis to identify factors influencing WTP values. All statistical tests were conducted at a 5 percent significance level.

4. Result and Discussion

The empirical analysis shows that respondents generally express a favorable attitude toward contributing financially to biodiversity conservation in Tanjung Puting National Park. Most participants acknowledge the ecological importance of the park and perceive conservation efforts as necessary to maintain ecosystem sustainability. This positive perception is reflected in the calculated willingness to pay values, which indicate that biodiversity services are not regarded merely as environmental amenities, but as assets with measurable economic significance.

Further statistical analysis using multiple linear regression demonstrates that socio-economic variables play an important role in shaping respondents' willingness to pay. Income level emerges as a key determinant, with higher-income respondents displaying a greater propensity to contribute financially to conservation initiatives. Education level also

shows a significant positive relationship with WTP, suggesting that individuals with higher educational backgrounds tend to possess stronger environmental awareness and appreciation of biodiversity values.

In addition, respondents' perceptions of environmental quality significantly influence their willingness to pay. Those who perceive the condition of the national park as well-managed and ecologically valuable are more inclined to support conservation financially. Conversely, demographic variables such as age and gender do not exhibit statistically significant effects on WTP. Diagnostic tests confirm that the regression model satisfies classical assumptions, indicating that the estimation results are statistically robust and suitable for interpretation.

Validity Test

The results of the validity test can be seen in Table 2 and Table 2 shows that the instrument is valid.

Table 2. Validity Test Results

Research Variable	r-calculated	r-table	Result
Visitation Level (Y)	0.529	0.2006	Valid
Total Travel Cost (X1)	0.426	0.2006	Valid
Income Level (X2)	0.633	0.2006	Valid
Purpose of Visit (X3)	0.678	0.2006	Valid
Source of Information (X4)	0.593	0.2006	Valid
Education Level (X5)	0.651	0.2006	Valid
Group Size (X6)	0.426	0.2006	Valid

Reliability Test

Calculation using the Cronbach Alpha method . The results of the reliability test can be seen in Table 3.

Table 3. Reliability Test Results

Research Variables	Cronbach Alpha	Standard	Results
Y, X1, X2, X3, X4, X5, X6	0,611	0,6	Reliable

Based on the results of the reliability test in Table 3, it shows that the Cronbach Alpha value for all research variables is greater than 0.6 (Cronbach Alpha > 0.6), so that the data instrument is declared reliable or reliable to be used as a research measuring tool.

Normality Test

Table 4. Normality Test

Variabel Penelitian	Cronbach Alpha	Standart	Hasil
Y, X1, X2, X3, X4, X5, X6	0,611	0,6	Reliabel

Based on the results of the normality test in Table 4, it shows that the significance value for the research data is 0.46 > 0.05 so it has been normally distributed.

Multicollinearity Test

The methods used were Variance Inflating Factor (VIF) and Tolerance. The results of the multicollinearity test can be seen in Table 5.

Table 5. Multicollinearity Test Results

Independent Variable (X)	Tolerance	VIF
Total Travel Cost (X1)	0.6295	1.6438
Income Level (X2)	0.714	1.400
Purpose of Visit (X3)	0.944	1.060
Information Source (X4)	0.847	1.180
Education Level (X5)	0.856	1.168
Number of Groups (X6)	0.955	1.047

Heteroscedasticity Test

Based on the test results obtained , the value for each independent variable is less than 0.05 or 5%. This proves that the residual variance is the same as the independent variable. The test results can be seen in Table 6.

Table 6. Heteroscedasticity Test Results

Independent Variable (X)	Tolerance
Total Travel Cost (X1)	.032
Income Level (X2)	.683
Purpose of Visit (X3)	.457
Information Source (X4)	.327
Education Level (X5)	.568
Number of Groups (X6)	.397

Economic Valuation Calculation

Respondents visiting Tanjung Putting National Park Ecotourism incurred costs such as transportation, entrance fees, meals, accommodation, and animal feed. The costs incurred by visitors are shown in Table 7.

Table 7. Visitor Expenditure Costs

Cost Component	Average per Individual	Total Cost of All Respondents
Transportation	IDR 3,236,458.33	IDR 310,700,000.00
Entrance Ticket	IDR 7,500.00	IDR 720,000.00
Consumption	IDR 655,208.33	IDR 62,900,000.00
Accommodation Cost	IDR 427,760.42	IDR 41,065,000.00
Animal Feed	IDR 0.00	IDR 0.00
Total	IDR 4,326,927.08	IDR 415,385,000.00

Table 8. Results of Travel Cost Regression Test (X)

Model	Unstandardized Coefficients	
	B	Say
Constant	1.741	0.000
Travel Cost (X)	7.037E-8	0.00

The table above shows that the coefficient value of travel costs is 0.488. An example of calculating consumer surplus is in Table 9.

Table 9. Example of Consumer Surplus Value Calculation

Respondent	Consumer Surplus /Individual	Consumer Surplus /Individual / Visit
1.	SK/ In = Y2 / 2*b1 SK/ In = 42 /2 * 7.04E-08 SK/ Ind = Rp. 113.684.809	SK/Ind/Kjgn = Rp. 113.684.809 / 4 SK/Ind/Kjgn = Rp. 28.421.202
2.	SK/ In = Y2 / 2*b1 SK/ In = 32 /2 * 7.04E-08 SK/ Ind = Rp. 63.947.705 ,-	SK/Ind/Kjgn = Rp. 63.947.705 - / 3 SK/Ind/Kjgn = Rp. 15.986.926
3.	SK/ In = Y2 / 2*b1 SK/ In = 22 /2 * 7.04E-08 SK/ Ind = Rp. 28.421.202 ,-	SK/Ind/Kjgn = Rp. 28.421.202 ,- / 2 SK/Ind/Kjgn = Rp. 7.105.301 -

The travel cost approach obtained from the calculation of consumer surplus/individual/visit from 96 respondents which has been averaged at Rp7,105,000 per individual per visit. The calculation results of consumer surplus /individual/visit from 96 respondents were then averaged and obtained the value of consumer surplus/individual/visit in the results of multiple linear regression analysis with the travel cost approach of Rp. 7,105,301,- per individual per visit. The total economic value obtained by:

"Total Economic Value = Consumer Surplus × Number of Visits per Year"

The assumed number of ecotourism visitors in 2021 is 1,268 . The following formula is used:

Total Economic Value = Consumer Surplus × Number of Visits in 2021
Total Economic Value = IDR 7,105,301 × 1,268
Total Economic Value = IDR 9,009,521,103 per year

So, based on the calculation of the total economic value generated from Ecotourism, it is IDR 9,009,521,103 per year.

Discussion

The results of this study demonstrate that biodiversity services in Tanjung Puting National Park possess tangible economic value that is recognized by visitors. Positive willingness to pay reflects public preference for conservation and indicates opportunities for developing participatory conservation financing mechanisms.

The significant influence of income and education on WTP suggests that economic capacity and environmental awareness play crucial roles in shaping individual preferences. This finding aligns with environmental economic theory, which posits that individuals with greater economic resources and environmental knowledge tend to assign higher values to public environmental goods. Consequently, enhancing environmental literacy through education and awareness programs may serve as an effective strategy to strengthen public support for conservation initiatives.

From a policy perspective, the findings highlight the importance of integrating economic valuation results into national park management planning. WTP estimates can inform proportional entrance fee adjustments, the development of payment for ecosystem services schemes, and the design of sustainable and inclusive conservation programs.

5. Conclusions

This study concludes that biodiversity services in Tanjung Puting National Park have significant economic value as reflected in visitors' willingness to pay for conservation. Socio-demographic factors, particularly income, education level, and environmental perception, significantly influence WTP values. These findings underscore the relevance of economic valuation as a decision-support tool for sustainable national park management. Future research is encouraged to expand sample coverage and incorporate comparative valuation approaches to further enrich conservation policy formulation.

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