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Potential Economic Value of Water Resources for Sustainable Environment: Case Study in Tahura Lati Petangis, Paser

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Abstract
Water resources are an important asset in supporting environmental sustainability and local economic development. This study aims to analyze the economic value potential of water resources in the Lati Petangis Forest Park (Tahura), Paser Regency, East Kalimantan, in supporting environmental sustainability. The Individual Travel Cost Method (ITCM) was used to estimate the economic value of water resources for recreational purposes. The potential economic value of water use was calculated based on household water consumption. The ITCM model, using multiple linear regression, had an R-square value of 0.244 with a significance level of 0.00010584, indicating that the model could statistically significantly explain the variability in tourist visits. The variables of travel time (p-value 0.003), availability of substitutes (p-value 0.004), and income level (p-value 0.017) significantly influence tourist visitation levels. The consumer surplus generated reached Rp 150,543,646,200 with an economic value of Rp 23,189,633,151, indicating the significant economic benefits tourists derive from utilizing water resources in this area. The utilization of water resources as a source of clean water for the community generates an economic value of household utilization reaching Rp 333 million per year. The research findings indicate that water resources in Tahura Lati Petangis have significant economic potential in supporting sustainable ecotourism development and meeting the basic needs of the community. The high consumer surplus indicates that tourists derive substantial economic benefits from their visits, exceeding the costs incurred. This confirms that sustainable water resource management not only contributes to environmental conservation but also has the potential to become a sustainable source of economic income for local communities.

Keywords:
Economic value;
Water resources;
Travel cost method,
Ecotourism;
Tahura Lati Petangis;
Sustainable development

1. Introduction

Water resources are a fundamental component (Yustiana et al., 2015) in supporting environmental sustainability and community welfare, especially in conservation areas that serve a dual function as ecosystem guardians and sources of local economic activity. The Lati Petangis Forest Park (Tahura), located in the villages of Saing Prupuk, Petangis, and Tabru Paser Damai, Batu Engau Subdistrict, Paser Regency, East Kalimantan, is a real-world example of the complex interplay between natural resource conservation and the socio-economic dynamics of surrounding communities.

This conservation area, spanning 3,445.37 hectares, was established pursuant to Ministry of Environment and Forestry Decision No. SK.4335/menLHK-PKTL/KUH/2015. It serves not only as a habitat for various endemic species such as the long-tailed macaque, gibbon, white-browed gibbon, and 92 bird species from 36 families, but also possesses significant water resources, including the presence of the Gentung Dayo, which highlights the hydrological richness of the area.

The physical condition of Tahura Lati Petangis is currently undergoing an interesting transformation, where the area that was originally focused on conservation is now being developed as a nature and educational tourism destination. Infrastructure development such as a pier on the lake shore, water rides, and game facilities marks a paradigm shift in the management of the area from a traditional conservation model to a sustainable ecotourism concept. However, this situation also presents challenges in the form of limited access infrastructure, where the road to the area is still damaged in several places, with potholes and slippery conditions when it rains, which can reduce tourist interest.

On the other hand, the socio-economic conditions of the communities around Tahura Lati Petangis show dynamics that are closely related to the development of the conservation area. The community's high enthusiasm for the development of tourist attractions, especially water attractions, which are very popular, reflects the economic potential that can be exploited from the existence of water resources in this area. Since it was opened as a tourist destination, Tahura has received a significant number of visitors, with 3900 tourists in its first year of operation(Visitors 2017, Table 1), demonstrating its economic potential to have a positive impact on the local community.

The increase in tourist visits, especially on holidays, creates new economic opportunities for the surrounding community through the tourism sector, but also demands an increase in human resource capacity in tourism management, including the need for tour guide training and creative economic development(Rohkayati & Hernawan, 2025). This situation illustrates how sustainable water resource management in Tahura Lati Petangis not only contributes to environmental conservation but also has the potential to catalyze the economic empowerment of local communities.

The correlation between the physical conditions of the area and the dynamics of the surrounding community shows that the success of water resource conservation in Tahura Lati Petangis is highly dependent on the ability to integrate ecological, economic, and social aspects into a holistic management system. Research on the economic value of water resources in supporting environmental sustainability (Das et al., 2023; Dong et al., 2023; Lu et al., 2022; Sanabria & Torres, 2020)in this area is urgently needed to provide a scientific basis for the development of an optimal management model, where environmental conservation can go hand in hand with improving the welfare of local communities through the responsible and sustainable use of water resources. Water resource valuation activities open up opportunities for the development of sustainable funding mechanisms such as payment for environmental services or the contributes to Local Own-Source Revenue (PAD). Sustainable management of Tahura Lati Petangis also needs to consider the socio-cultural dimensions of the local communities that depend on the area. Comprehensive valuation enables the integration of economic, ecological, and social interest into a single integrated management framework, thereby supporting the achievement of the SDGs.

2. Method

Travel Cost Analysis (Individual Travel Cost Method) was obtained through primary data by distributing questionnaires to visitors of Tahura Lati Petangis. The stages of implementing the individual travel method are:

a) Identifying the location (tourist attraction) for the questionnaire survey to collect data on visitors related to their travel costs to the location, number of visits, recreational choices, socioeconomic characteristics, and others.
b) Establishing the travel function (equation) and estimating the travel cost model (regression of the relationship between the number of visits and travel costs and other variables).
c) Describing the demand curve and determining consumer surplus based on that curve.
d) Calculating the total consumer surplus for tourist locations.

Table 1
Number of Visitors

No	Year	Number of Visitors
1	2017	3900
2	2018	2900
3	2019	1193
4	2020	*
5	2021	*
6	2022	1381
7	2023	1425
8	2024	4111
	Total	14910
	Average	2485

The sample size was determined using the approach developed by Yamane (1967) (Nanjundeswaraswamy & Divakar, 2021) as follows:

$$= \frac{N}{1 + (N(e^2)}$$

Explanation:
n = Sample size
N = Population size
e = Margin of error (0.1)

Calculation results for the number of respondents visiting Tahura Lati Petangis:

$$= \frac{2485}{1 + (2485(0.1^2)}$$

$$= \frac{2485}{1 + (24.85)}$$

$$= \frac{2485}{25{,}85}$$

= 96.13 ≈ 96

Based on the calculation results of the above formula with the data in Table1, the required sample size is 96 visitors for the evaluation of ecosystem services in the form of tourism. Data collection was conducted using a questionnaire via the G-forms application, which was completed by 103 respondents. The data collection period was from June 15 to 30, 2025. The questionnaire is semi-open-ended and consist of 31 questions related to the respondent identity data, age, education, domicile, income, alternative tourist references, activities during the visit, number of visits, assessment of location conditions, travel costs, and willingness to pay.

The calculation equation for the individual travel cost method (Intan, 2020) with the demand function is written as follows:

$$V_{ij} = f(C_{ij}, T_{ij}, Q_{ij}, S_{ij}, M_i)$$

Description:
Vij = Number of visits by individual i to tourist attraction j
Cij = Travel costs incurred by individual i to visit tourist attraction j
Tij = Time costs incurred by individual i to visit tourist attraction j
Qij = Respondents' perception of the environmental quality of the tourist attraction
Sij = Characteristics of substitute tourist attractions that may exist elsewhere
Mi = Income of individual i

The Y axis as the result of the equation is the frequency of individual visits to Tahura Lati Petangis (Vij). Meanwhile, variable X is a dependent variable in the form of travel costs, time, perceptions of the environmental quality of Tahura Lati Petangis, characteristics of other tourist attractions, and visitor income factors. Multiple linear regression equation using Data Analysis in Excel.

The calculation of willingness to pay/consumer surplus (Jamaludin et al., 2024) uses the Garrod & Willis equation, 1999, as follows:

$$CS = \frac{V^2}{2\beta}$$

Description:
CS = Consumer surplus (Rp/individual/visit)
V = Number of visits made by individuals
β = Travel cost coefficient

Water management

Water management data was obtained in the form of primary data from the community using the Tahura Lati Petangis water pit. The approach used to meet the domestic needs of residents around the Tahura Lati Petangis area. The calculation formula (Lopis et al., 2017) is as follows:

$$NART = RTPA\ x\ JA\ x\ KP\ x\ HAS$$

Description:
NART : Economic value of household water use (Rp/year)
RTPA : Number of households using water (households/household)
JA : Average number of family members (persons/household)
KP : Average water consumption (L/person/year)
HAS : Aquwar equivalent price (Rp/L)

Information on water usage and the costs required to meet water needs was obtained through interviews with sources, namely the village heads of Saing Prupuk, Petangis, and Tabru Paser Damai, conducted on August 4, 2025.

3. Results and Discussion

3.1 Results

The economic potential of Tahura Lati Petangis is marked by the development of ecotourism. Ecotourism has been growing rapidly, especially natural ecotourism(Silwa Al Masih et al., 2022). Tourists are increasingly interested in visiting natural tourist areas that also offer business activities. Several important factors in ecotourism management include: (a) Entrepreneurial Marketing; (b) Entrepreneurial Orientation; (c) Leadership Empowerment; (d) Entrepreneurial Intention; (e) Value Co-Creation; and (f) Smart Tourism (Muthmainnah et al., 2024). The implementation of ecotourism activities at Tahura Lati Petangis is part of the management carried out by the area manager. The manager of the Tahura Lati Petangis area is the Tahura Management Division, led by the Head of Division, which is part of the structure of the Paser Regency Environment Agency. In addition, water use regulations also provide direct information on the value of water resources located in the Lati Petangis Forest Park.

Based on tourism visit data from 2017 to 2024 (Table 1), the average number of visits used as the basis for determining the number of research respondents was 2,485 people. Using Yamane's formula to calculate the sample size from the population with a margin of error of 0.1 (or 10%), the number of respondents was 96 people. The selection of a margin of error of 0.1 takes into account the relatively small number of respondents required, which is more efficient in terms of research time and costs and is suitable for exploratory research or preliminary studies. This study prioritizes efficiency while maintaining acceptable accuracy for the purposes of research on visitors to Tahura Lati Petangis.

The demographic pattern of visitors based on gender and age composition as shown in the diagram below (Diagram 1) indicates that visitors are predominantly female (61%) compared to male (39%). The productive age group of 26-35 years old is the largest segment (31%), followed by 36-45 years old (29%) and 17-25 years old (22%). This provides insight that this area attracts young and adult generations who have high environmental awareness. Education and economic levels are two

components that are closely related. The educational profile of visitors (Diagram 2) shows that the majority of respondents are highly educated individuals, with 63% having a bachelor's/master's degree and 27% being high school graduates. From an economic perspective, the distribution of visitor income levels is quite varied, with 39% earning between Rp1-3 million per month and 31% earning between Rp3-5 million per month. These demographic characteristics indicate that water resource-based ecotourism in Tahura Lati Petangis specifically attracts educated segments of society who have adequate purchasing power and are likely to have high environmental awareness. This demographic profile indicates that Tahura Lati Petangis has the potential to develop high-quality ecotourism products at premium prices, which can increase the economic value of water resources in a sustainable manner.

Figure 1
Visitor Demographics by Age and Gender

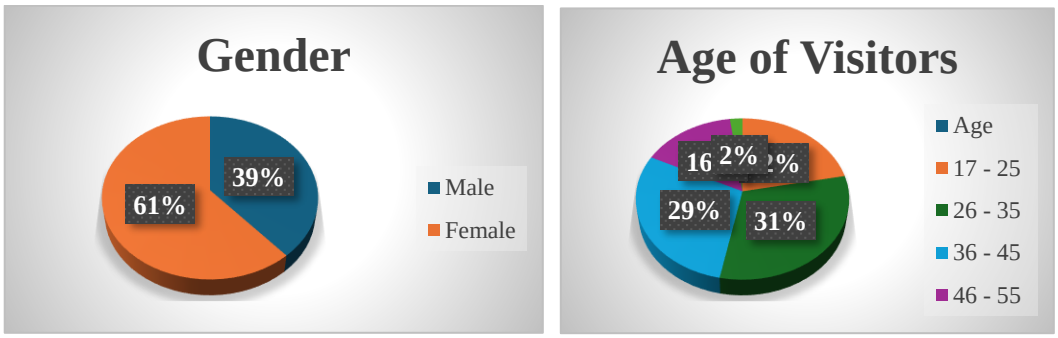
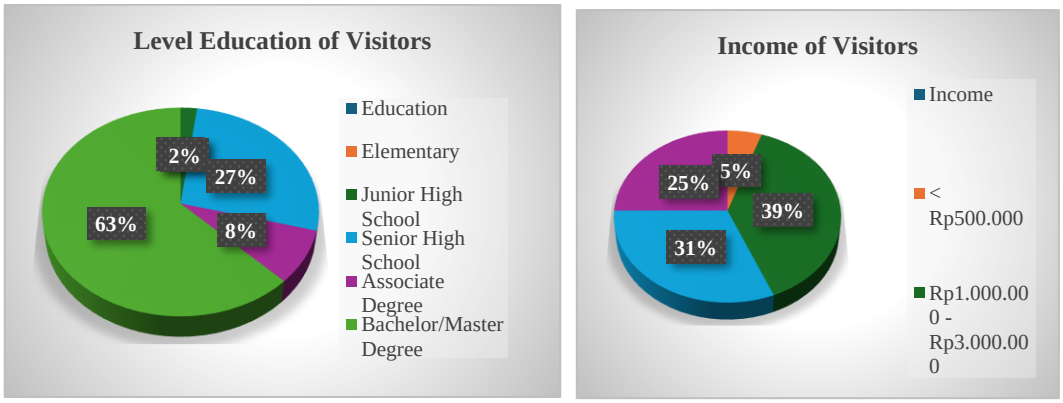


Figure 2
Visitor Education and Economic Levels



In terms of accessibility (Diagram 3), motorcycles are the primary mode of transportation for 54% of visitors, while the remaining 42% use private cars to reach the location. The distribution pattern of travel distances shows that the majority of visitors (54%) travel 41-60 km, indicating that Tahura Lati Petangis has strong regional appeal and is able to attract tourists from a medium radius. The dominance of visitation motivation for tourism purposes reaches 85%, which significantly indicates the great and sustainable economic potential of this conservation area.

The motivation for visiting for tourism purposes reached 85%, which significantly demonstrates the great and sustainable economic potential of this conservation area. The activities most popular with visitors were enjoying the scenery (50%) and photography (22%), which emphasizes the importance of maintaining the visual quality and aesthetics of the environment, especially water resources as the main attraction. A total of 63% of visitors are attracted to the lake, confirming that water resources are a key element in the economic value of this area.

Figure 2
Accessibility of Tourist Attractions

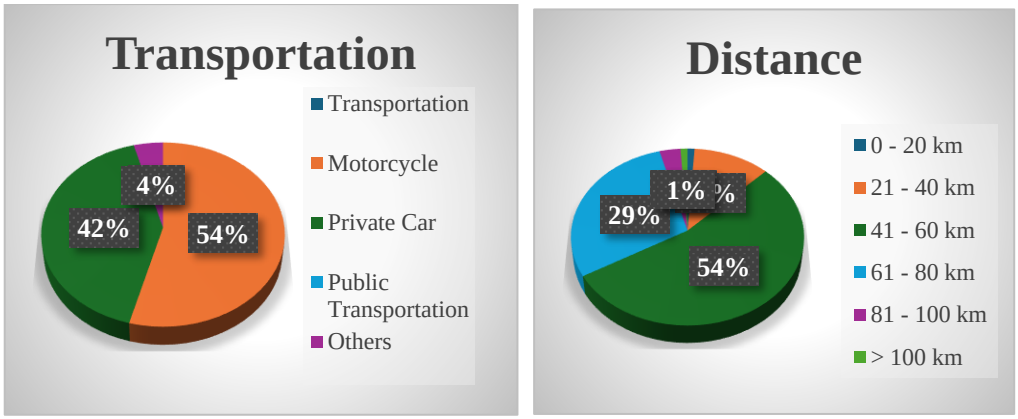


Figure 4
Motivation for Visiting

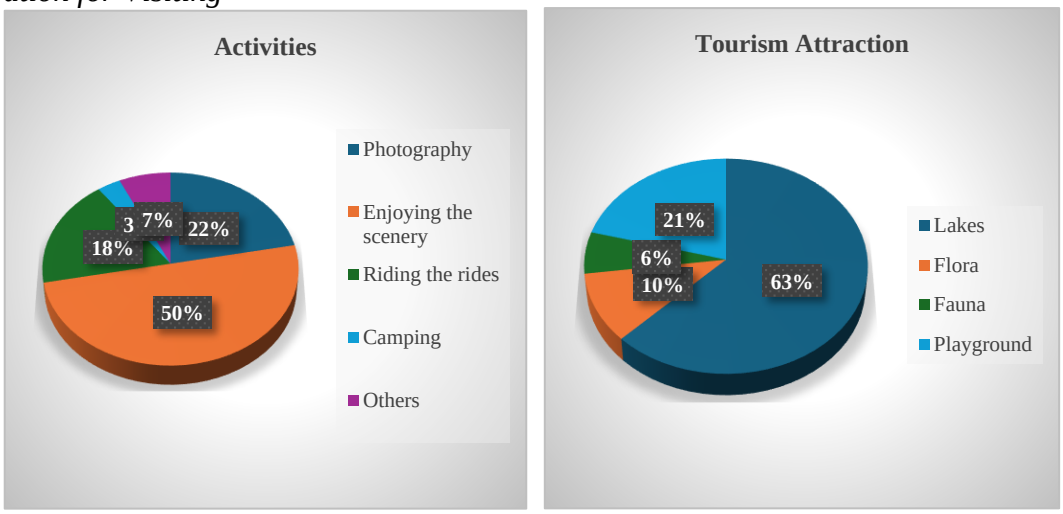


Table 2
Multiple Linear Regression of Individual Travel Cost Method

Regression Statistics	
Multiple R	0.494265626
R Square	0.244298509
Adjusted R Square	0.202315093
Standard Error	1.5194532
Observations	96

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	5	67.171911	13.4343822	5.8189288	0.00010584
Residual	90	207.7864223	2.30873803		
Total	95	274.9583333			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95,0%*	*Upper 95,0%*
Intercept	-0.6378	0.7955	-0.8018	0.4248	-2.2181	0.9425	-2.2181	0.9425
Cij	0.0000	0.0000	0.2697	0.7880	0.0000	0.0000	0.0000	0.0000
Tij	0.2690	0.0890	3.0234	0.0033	0.0922	0.4457	0.0922	0.4457
Qij	0.0943	0.0758	1.2436	0.2169	-0.0563	0.2449	-0.0563	0.2449
Sij	1.6535	0.5620	2.9424	0.0041	0.5371	2.7699	0.5371	2.7699
Mij	0.4475	0.1842	2.4291	0.0171	0.0815	0.8135	0.0815	0.8135

The regression model interpretation shows the quality of the model with visit variability that can be explained by the model as much as 24.4%, as indicated by the R square value. Statistically, the existing model is significant with a Significance F value of 0.00010584 (< 0.05). The correlation between the independent and dependent variables is 49.4%, as shown by the Multiple R. Independent variables that have a significant correlation with the dependent variable are travel time (Tij), the existence of substitute tourist attractions (Sij), and income (Mij), while the variables of travel costs (Cij) and tourist attraction quality (Qij) do not show a significant correlation. Interestingly, the variables of travel costs (Cij) and tourist attraction quality (Qij) did not show a significant correlation, which may indicate that visitors are not very sensitive to travel costs or that the quality of tourist attractions is currently adequate, so it is not a distinguishing factor in their decision to visit. This provides an opportunity to increase rates without significantly reducing visitor interest.

Table 3
Result of Analysis of the Economic Value of Environtmental Services Ecotourism

No	Description	Symbol	Value
1	Number of Respondents	a	96
2	Number of visits by respondents	b	278
3	Number of visits in 2025 (on July)	c	4111
4	ITCM coefficient	d	0,00000025668
5	Consumer Surplus *($e = V^2 / 2\beta$)*	e	150.543.646.200
6	Consumer/Individual/Visit surplus *($f = e / a / b$)*	f	5.640.874
7	Economic Value *($g = f \times c$)*	g	23.189.633.151

Table 4
Water Resources in Tahura Lati Petangis

No	Name	Longitude	Latitude	Circumference (m)	Area (m²)	Volume (m³)
1	Gentung Dayo	116° 5' 48.730" E	2° 3' 49.080" S	3494	124,458.645	3,281,562.5
2	Gentung Saingprupuk Erai	116° 6' 17.349" E	2° 4' 2.878" S	410	10,197.153	41,067.427
3	Gentung Saingprupuk Duo	116° 5' 50.558" E	2° 4' 32.902" S	894	52,007.8121	461,180.779
4	Gentung Petangis Erai	116° 5' 36.635" E	2° 5' 29.228" S	821	10,591.419	52,419.639
5	Gentung Petangis Duo	116° 5' 55.863" E	2° 5' 57.465" S	842	49,256.3709	354,716.006
6	Gentung Petangis Tolu	116° 5' 47.362" E	2° 6' 52.618" S	990	25,746.0192	97,404.876
7	Gentung Tabru Erai	116° 5' 51.334" E	2° 8' 8.471" S	1447	23,534.9933	110,507.418
8	Gentung Tabru Duo	116° 5' 42.136" E	2° 9' 18.020" S	813	10,976.7245	83,641.911

Table 5
Villages Located in the Surrounding Area (Data analysis by Author)

No	Village	Population	Male	Female	Gender Ratio
1	Petangis	1,708	886	822	108
2	Tabru Paser Damai	2,007	1,113	894	124
3	Saing Prupuk	1,104	592	512	116

Table 6
Domestic Needs of Water (Data analysis by Author)

No	Location	RTPA (Households)	JA (Persons)	KP (L/Person/Day)	HAS (Rp)	NART (Rp)
1	Saing Prupuk 1	30	2	60,000	10	36,000,000
2	Saing Prupuk 2	100	2	90,000	10	180,000,000
3	Petangis 1	81	3	30,000	10	72,900,000
4	Petangis 2	49	3	30,000	10	44,100,000
	Total					333,000,000

3.2 Discussion

Based on the results of multiple linear regression analysis, travel costs are insignificant. This is a paradoxical result. Travel costs (Cij) do not affect the decision to visit, even though in tourism theory, costs should be a major determining factor. The correlation and implications for the retribution rates stipulated in the regulations show that the relatively low retribution rates (Rp7,500 for adult visitors) will not have a significant impact on the decline in visits. This condition provides room for local governments to optimize rates without the risk of a drastic decline in visits. The establishment of a tiered tariff structure is appropriate by providing incentives for students (Rp0 – zero rupiah).

Revenue (Mij) was found to have a positive and significant effect on visits (coefficient 0.4475). Tariff segmentation based on visitor categories (adults, students, foreigners) has taken into account the economic capacity of each segment. The tariff for foreign tourists (Rp25,000), which is 3.3 times the domestic tariff, can be maintained due to the correlation between income and visits. Premium activity tariffs (outbound, facilities) can be an additional source of income from high-income segments.

In addition to income, travel time has a significant positive effect with a coefficient of 0.2690. Tourists who travel for longer periods tend to be more committed to visiting. Accommodation rates and multi-day activities can be optimized to accommodate long-distance tourists. Special marketing strategies are needed to attract local and regional tourists. Marketing is a form of communication that must be developed by Tahura Lati Petangis. In evaluating the implementation of environmental management systems in ecotourism, communication requires attention and improvement. According to the results shown in table 3, the economic value of the environtmental services of ecotourism activity in Tahura Lati petangis is the number of visits of 4.111 visitors on 2024 (Tabel 1). Meanwhile, the consumer surplus per individual per visit is Rp222.876,0417. The consumer surplus value of Rp150,543,646,200 is higher than the average travel cost. The consumer surplus value is large compared to the average travel cost. Meanwhile, the economic value is large compared to the actual income, which is the number of consumers per visit and the total number of visits in a year. These results are consistent with previous studies at the same location using the zonal travel cost method formula(Anshary et al., 2023). The individual travel cost method has advantages because it analyzes the visit data of each individual visitor separately and collects data on travel costs, number of visits, recreational choices, and socioeconomic characteristics of each respondent.

The potential economic value of water resources in the Tahura Lati Petangis area, Paser Regency, shows significant economic potential, with the total economic value of household water use reaching hundreds of millions of rupiah per year. This area covers three main villages, namely Petangis, Tabru Paser Damai, and Saing Prupuk, with a total population of 4,819 people spread across diverse and complex water utilization patterns.

Water is a fundamental natural resource for human life and environmental sustainability(Mamedes et al., 2023), with the Lati Petangis Forest Park in Paser Regency, East Kalimantan, serving as an interesting case study in evaluating the economic value of water resources. Based on the latest data as of July 2025, the study area has a significant population distribution, with Petangis Village having 1,708 inhabitants consisting of 886 males and 822 females with a sex ratio of 108, while Tabru Paser Damai Village has the largest population of 2,007 people, consisting of 1,113 men and 894 women, showing a sex ratio of 124. Saing Prupuk Village has 1,104 inhabitants, consisting of 592 males and 512 females, with a sex ratio of 116. The entire area has a total of 1,755 households with an average of 2.24 to 3.39 family members per household.

Water utilization patterns in this area show interesting diversification with four main systems operating simultaneously. The results of chemical content evaluation in Gentung Dayo meet the criteria for clean water, as reported in previous studies(Putra et al., 2024). The Gentung Dayo system through Pamsimas serves RT 1 and RT 3 with a varied fee system ranging from IDR 100,000 to IDR 200,000 per household, while the community also utilizes Tahura water during the dry season by collecting it in 1,000-liter tanks at a cost of IDR 70,000 per tank, with each household requiring a minimum of 3 tanks per month. Residents of RT 6 and RT 9 use water from Gentung Petangis Duo, which is distributed through a self-built pipeline system, with the community paying a fee of IDR 50,000 per household, while residents who do not have access to piping use water tank truck services, requiring 7 to 8 tanks per month at a cost of IDR 70,000 per 1,000-liter tank.

Average water consumption in this region reaches 60,000 liters per person per year, or the equivalent of 164 liters per day, which indicates a relatively moderate level of consumption compared to the WHO standard, which recommends 50 to 100 liters per day for basic needs. The economic value of household water use shows significant variation, with Saing Prupuk Village having an economic value of IDR 180,000,000 per year, particularly for RT 2, while Petangis Village has an economic value of IDR 72,900,000 per year for RT 3, with a total recorded economic value of IDR 333,000,000 for the sample area studied.

The price of water is set at Rp10 per liter, which is relatively affordable compared to the price of commercial bottled water and demonstrates the economic efficiency of local water resources. The cost structure shows a varied financing model with the Pamsimas system using a monthly fee model of Rp100,000 to Rp200,000, self-help piping with a fixed contribution of IDR 50,000 per family head, mobile tanks with a pay-per-use system of IDR 70,000 per 1,000 liters, and Tahura tanks with seasonal usage of IDR 70,000 per 1,000 liters.

From an environmental sustainability perspective, the use of Tahura water sources during the dry season demonstrates adaptation to climate variability, but dependence on water tanks raises questions about long-term sustainability and the environmental impact of transportation activities. The diverse financing models demonstrate economic resilience, but the cost disparity between systems ranging from Rp50,000 to Rp490,000-560,000 for mobile tanks indicates inequity in access to clean water. Self-help systems such as Gentung Petangis Duo demonstrate strong social capital in the community, while dependence on mobile tank services indicates vulnerability for households with limited access.

The economic potential of this region is enormous, with an estimated total of 1,755 households and an average consumption of 60,000 liters per person per year, resulting in an estimated water market potential of around 289,140,000 liters per year with a potential economic value of around IDR 2,891,400,000 per year based on a water price of IDR 10 per liter. Data shows a significant infrastructure gap, especially in areas that rely on mobile tanks, so investment in piping systems can improve efficiency and reduce long-term costs. The integration of smart water management technology can optimize distribution and reduce waste, thereby increasing the overall economic value of the system.

Economic valuation is used as a means of determining the total economic value of natural resources and environment ((Silwa Al Masih et al., 2022; Zulfia Memi Mayasari et al., 2024). One method of economic valuation for non-market goods is to estimate the economic value of the trade-offs experienced by an individual in terms of their willingness to pay for goods and services that are not reflected in market prices(Lasmana, 2022). Economic assessment can be used to assess the impact of an activity on natural wealth in the form of assets that can provide benefits or become burdens or costs(Wibowo, 2021). One method of economic assessment of natural resources through environmental services is the Travel Cost Method. This economic assessment is used to estimate the value of

recreational areas by identifying willingness to pay (WTP) and consumer surplus for the benefits of tourist attractions(Hidayati et al., 2023). More specifically, the Individual Travel Cost Method (ITCM) is used to quantify the economic value of natural resources that do not have a direct market value, using travel costs as the basis for calculation. ITCM uses the Consumer Price Index as an approach to calculate consumer surplus(Fattah et al., 2023). In the context of Tahura Lati Petangis, the use of ITCM for environmental economic valuation shows that this area provides significant economic benefits. The assessment result encourage the community and tourists to participate in conservation efforts, especially considering the special attraction of Tahura Lati Petangis in the form of Gentung Dayo.

Recommended policy implications include immediate actions such as tariff standardization to develop a fair and sustainable tariff structure, infrastructure gap analysis to identify infrastructure development priorities, and quality assurance through the implementation of a water quality monitoring system. Medium-term strategies include integrated water resource management to coordinate existing systems, community empowerment to strengthen self-help systems, and climate adaptation to prepare for seasonal variability. The long-term vision includes sustainable financing mechanisms for the development of sustainable financing models, ecosystem services valuation for comprehensive assessment of Tahura ecosystem services, and regional integration for connection with broader regional systems.

The potential for sustainable development is wide open with several key strengths, namely a high-quality market segment consisting of educated visitors with sufficient purchasing power, strong regional appeal capable of attracting visitors from a considerable distance, a dominant tourism motivation of 85%, and the uniqueness of water resources, which is the main attraction for 63% of visitors. Development opportunities include increasing retribution rates in line with visitors' economic capabilities, developing premium ecotourism packages that utilize the uniqueness of water resources, diversifying water-based activities such as environmental research and underwater photography, and developing environmentally friendly supporting facilities. These findings are consistent with various studies on economic valuation of forest ecosystems, which show that the value of environmental services often far exceeds the value of direct use of natural resources(Pisani et al., 2021; Sari et al., 2022).

However, sustainability challenges also need to be addressed, particularly in terms of conserving water quality as the main attraction, managing carrying capacity to prevent environmental degradation due to overtourism, and increasing environmental education to raise visitor awareness about the importance of conservation. Balancing economic value extraction and ecosystem preservation is key to long-term success.

The Lati Petangis Tahura area shows significant economic potential from water resources, with an estimated value of nearly Rp23 billion per year. The diversification of the water supply system demonstrates the high adaptability of the community, but disparities in access and costs indicate the need for appropriate policy intervention. Economic and environmental sustainability can be achieved through an integrated approach that combines infrastructure investment, community empowerment, and sustainable pricing mechanisms, so that this case model can serve as a reference for other conservation areas in optimizing the economic value of water resources while maintaining environmental integrity.

Key success factors include high community participation, adaptive water source diversification, significant economic potential, and diverse financing models, while critical challenges include disparities in access and affordability, seasonal dependence on certain sources, significant infrastructure gaps, and the need for an integrated management system. This study provides valuable baseline data for the development of sustainable water resource management policies in the Tahura Lati Petangis conservation area, with implications that can be adapted to similar areas in Indonesia in an effort to achieve optimal and sustainable water resource management.

Short-term strategic recommendations include gradually revising retribution rates by considering visitors' willingness to pay, improving service quality through investments in facilities that support ecotourism experiences, and developing environmental education programs. For the long term, it is necessary to develop integrated ecotourism products that combine conservation, education, and recreation, obtain international ecotourism certification to increase competitiveness, and build strategic partnerships with universities and NGOs for research and conservation.

4. Conclusion

Tahura Lati Petangis demonstrates substantial economic potential as a water resource-based ecotourism destination, characterized by three key strengths. First, the site attracts a high-quality visitor demographic with adequate purchasing power and environmental consciousness, positioning it favorably for sustainable tourism development. Second, its regional appeal extends across a medium geographic radius, indicating strong market penetration potential. Third, water resources serve as the primary attraction for 63% of visitors, establishing a clear unique selling proposition that differentiates the site from competing destinations. Additionally, the study reveals important social and economic dynamics within existing water management systems. Community-based initiatives like Gentung Petangis Duo exemplify strong social capital and collective action capacity, while the presence of diverse financing models across different water distribution systems demonstrates economic adaptability and resilience within the local context.

Despite these promising foundations, several critical challenges threaten the sustainable development of water resources at Tahura Lati Petangis. Most prominently, significant economic disparities exist in water access, with costs ranging dramatically from Rp50,000 for piped systems to Rp490,000-560,000 for mobile tank delivery—an inequity that may exacerbate social tensions and limit inclusive development. Infrastructure deficiencies, particularly in areas reliant on mobile water delivery, create service gaps that undermine both community welfare and tourism experience quality. Furthermore, seasonal variability in water source availability introduces supply uncertainty, while the absence of an integrated management framework prevents coordinated planning and resource optimization. These structural weaknesses collectively threaten both the ecological integrity of water resources and the long-term viability of ecotourism operations.

To address these challenges and capitalize on identified opportunities, a phased strategic approach is essential. In the short term (1-2 years), priority actions should include implementing gradual, evidence-based tariff adjustments aligned with visitors' demonstrated willingness to pay, ensuring revenue generation does not compromise accessibility. Concurrent investments in tourism infrastructure—particularly facilities that enhance visitor experience while minimizing environmental impact—will strengthen service delivery and visitor satisfaction. Developing robust environmental education programs will leverage visitor environmental awareness to foster conservation ethics and sustainable behavior. For long-term sustainability (3-5 years), more transformative interventions are necessary. The development of integrated ecotourism products that seamlessly blend conservation objectives, educational content, and recreational experiences will create differentiated offerings with higher value propositions. Pursuing international ecotourism certification will enhance credibility, attract environmentally conscious tourists, and command premium pricing. Finally, establishing strategic partnerships with universities and NGOs will facilitate ongoing research, capacity building, and conservation innovation, creating an ecosystem of support for adaptive management.

Critically, all interventions must adopt a holistic and adaptive management approach that continuously balances economic viability, environmental integrity, and social equity. Success requires not merely implementing individual strategies, but cultivating an integrated governance framework that treats water resources as simultaneously ecological assets, economic engines, and social goods. If achieved, Tahura Lati Petangis can serve as a replicable model for water resource-based ecotourism across Indonesia's conservation areas, demonstrating that economic development and environmental protection are not competing objectives but complementary imperatives in sustainable tourism development.

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