Jurnal Ilmu dan Teknologi Kelautan Tropis

p-ISSN : 2087-9423
e-ISSN : 2620-309X

Check for updates

OPEN ACCESS

Article Info:
Received 14 January 2026
Revised 13 April 2026
Accepted 29 April 2026

Corresponding Author:
Amalia Febryane Adhani Mazaya
Socio-Economic of Fisheries Study Program, Department of Fisheries and Marine Socio-Economy
University of Brawijaya
E-mail: amaliafebryane@ub.ac.id

Economic Value of Coastal Resources based on Ecotourism Activity in the Sanggar Beach, Tulungagung

Amalia Febryane Adhani Mazaya[a], Pramesthi Dua Agrilina[a], Elrika Wafa Sabrina Pribadi[a], Anissa Aprilia Nurkhasanah[a], Rini[b]

[a] Socio-Economic of Fisheries Study Program, Department of Fisheries and Marine Socio-Economy, Faculty of Fisheries and Marine Science, PSDKU, University of Brawijaya, Pringgodani Street, Mrican, Mojoroto District, Kediri City, East Java 64111, Indonesia

[b] Wakatobi National Park, Ministry of Forestry, Lipu, Betoambari, Kota Bau-Bau, Southeast Sulawesi, 93724, Indonesia

Abstract

This study was conducted to calculate the economic value of coastal resources based on ecotourism activities at Sanggar Beach, Tulungagung, East Java, Indonesia. As a turtle nesting habitat and tourist destination, Sanggar Beach offers ecological and economic value. However, economic values such as non-market benefits are often overlooked in tourism assessments. In fact, economic assessment is one of the inputs for sustainable coastal tourism destination management. Therefore, a mixed approach was used with a decision tree model to describe tourist characteristics, the Travel Cost Method (TCM) to analyze tourism demand, Principal Component Analysis (PCA) to describe the relationship between demographics and tourism demand, and consumer surplus analysis to calculate economic value. Data were collected from 30 tourists selected purposively through a structured questionnaire. The results show that travel costs, age, education, and income are predictors of tourism demand with the age being a ignificant predictor. The decision tree model further showed that older visitors reported higher levels of satisfaction, while younger groups were more influenced by socioeconomic factors. PCA revealed that the first two components explained 73.9% of the total variance, simplifying the analysis of visitor characteristics. Consumer surplus was estimated at IDR 64,016 per visitor, with the economic value of tourism activities projected at around IDR 18,064,987,438.00 per year. These results indicate that the indirect benefits of conservation areas can be considered in supporting sustainable ecotourism strategies, such as determining entrance fees and area incentives.

Keywords: Consumer Suplus, Economic Valuation, Ecotourism, Sanggar Beach, Travel Cost Method

1. Introduction

Coastal areas, including beaches, estuaries, and the sea play an important role in supporting the sustainability of the ecosystem and the economy of the local community (Kurniati et al., 2024). One area that has ecological value is Sanggar Beach in Tulungagung, which serves as a landing area and nesting habitat for sea turtles. The presence of green turtles (*Chelonia mydas*) as a protected species gives this area conservation value. In addition, Sanggar Beach has ecotourism potential that can provide economic benefits for the local community (Gutic, 2016; Fahrizal et al., 2025). As we know, potential economic value of marine resources and services is a source of economic strength for the community, especially coastal communities (Riadi et al., 2024). However, indirect economic values such as tourist travel costs, tourist satisfaction, aesthetic value, and ecosystem sustainability are still not widely considered in conservation area management planning (Tisdell and Wilson, 2014). One way to estimate the indirect economic value of coastal areas is by calculating the value of benefits for maritime tourism activities. These marine tourism activities include diving, snorkeling, sailing, and other water recreation that appreciate the natural beauty and unique ecosystems of coastal areas (Tegar and Gurning, 2017).

Sanggar Beach is located in Tulungagung Regency, East Java. This beach is unique and known as a conservation-based tourist destination. In the economic sector, the sea turtle conservation has brought about positive impacts in developing the coastal areas particularly case study in Penimbangan Beach in North Bali region (Wijaya et al., 2020).

Economic valuation methods such as the Travel Cost Method (TCM) and Consumer Surplus can be used to estimate the economic value of indirect coastal resources such as tourism activities (Koshy et al., 2019; Rahat et al., 2024). The TCM method is used to measure the economic benefits of ecotourism based on travel costs incurred by tourists and its predictors, while consumer surplus describes the added value obtained by tourists compared to the costs they incur (Leh et al., 2018; Parsons, 2022). With this approach, this study aims to calculate the indirect economic value of Sanggar Beach, which can serve as an indicator of sustainability and input for ecotourism policy in this conservation area. Calculating the estimated economic value can be a scientific basis for the management and protection of mangrove ecosystems and other coastal ecosystems (Lubis et al., 2025).

The sustainability of ecotourism depends not only on the number of tourists who visit, but also on conservation efforts and sustainable ecosystem management (Patil and Pattanshetti 2024). Previous studies have shown that well-managed conservation areas can provide greater economic benefits and improved welfare through sustainable ecotourism (Meleddu, 2014). On the other hand, without proper management strategies, an uncontrolled increase in the number of tourists can have a negative impact on the ecosystem and cause environmental damage, including disrupting turtle nesting habitats (Campbell, 2008). Therefore, estimating the indirect economic value of coastal resources is crucial to support conservation policies based on sustainable economics (Torres et al., 2016; Elegbede et al., 2023). Sustainable marine spatial planning in coastal areas requires a comprehensive management strategy (Tiworo et.al, 2021).

Research on the economic assessment of coastal areas has been conducted extensively, but few studies focus on intangible aspects that include indirect benefits such as visitor satisfaction, tourism demand, and concern for conservation (Loomis and White, 1996; Gómez-zapata et al., 2025). Research on Sanggar Beach has also not been conducted extensively, considering that this beach is small with limited access but has great potential. By measuring these values, conservation area managers can better understand the extent to which ecotourism can contribute to the local economy without compromising the sustainability of coastal ecosystems (Rizal, 2018; Iqbal et al., 2024).

This study was conducted to calculate the economic value of coastal resources based on ecotourism activities at Sanggar Beach, Tulungagung. The results of this study are expected to serve as a basis for formulating policies that support the development of sustainable conservation-based ecotourism. Therefore, this study is very important in providing an overview of the indirect economic value of the Sanggar Beach area. Understanding tourist characteristics, analyzing travel costs, and applying the consumer surplus approach are expected to provide more accurate estimates of the economic benefits gained by tourists and local communities (Centeno, 2000; Konwar and Goswami, 2020). Therefore, the results of this study can be used as recommendations in designing sustainable ecotourism policies, so that conservation and economic benefits can be balanced.

2. Materials and Methods

2.1. Reasearch Time and Location

The research was conducted at Sanggar Beach, Tulungagung on April 2025. Located in Jengglungharjo Village, Tanggunggunung District, Tulungagung Regency, at coordinates -8.297^{o}N, 111.909^{o}E. Directly bordering Ngalur Beach and Karang Bintolo Beach, Sanggar Beach is a turtle nesting area, making it a conservation-based tourism location. Seasonal activities that can be done include turtle breeding and releasing hatchlings in August. The Research Map is shown in **Figure 1.**

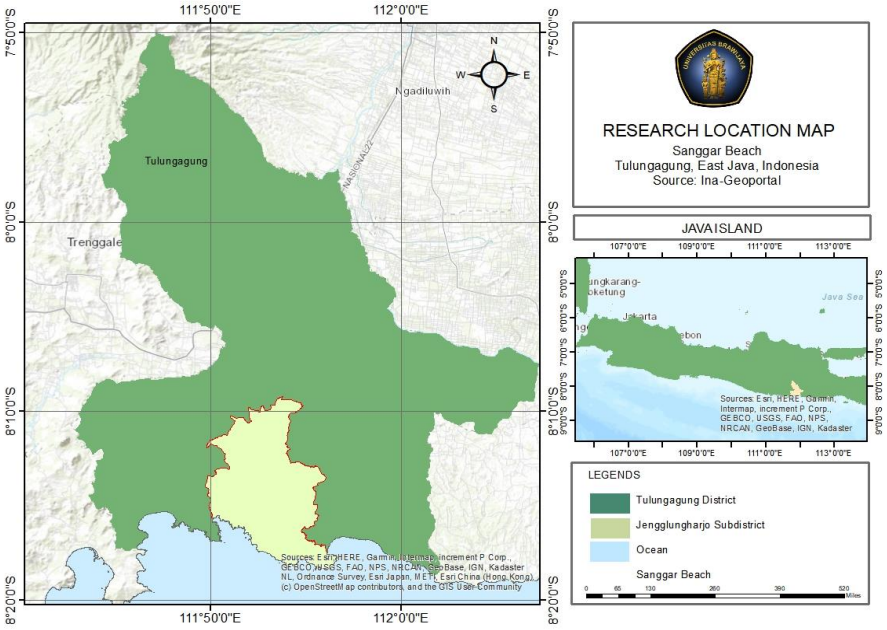

Figure 1. Research Map Location, Sanggar Beach, Tulungagung Regency. Source: Research (2025).

2.2. Research Method

2.2.1. Data Collection

Data collection was conducted through structured interviews and distributing questionnaires to tourists visiting the ecotourism locations studied. The technique used was purposive sampling to select respondents who met certain criteria, namely tourists who had experience in ecotourism activities and were relevant to the research objectives, namely tourists who had visited Sanggar Beach, Tulungagung. Another criterias is that tourists are aged >15 years or who can fill out and understand the questionnaire well so that the calculation of the results is not too biased. The total sample to be interviewed and filled out the questionnaire was 30 people in accordance with statistical rules because the initial population size is not known with certainty. This number of samples is said to be sufficient and in accordance with statistical rules which state that the minimum number of samples that can explain the population is 30 (Memon et al., 2020). This is also in accordance with Ahmed (2024) research, which states that purposive sampling is a non-probability sampling method, meaning it does not involve randomization. Therefore, not all subjects in the population have the same or known probability of selection. Furthermore, this technique is used when researchers cannot reach the entire population or when resources and time are limited.

2.2.2. Data Analysis

The data analysis used is quantitative and descriptive analysis. Quantitative analysis through multiple linear regression and calculation of consumer surplus using Ms. Excel and SPSS 23. In addition, tourist data analysis was carried out by grouping based on decision tree criteria and principal component analysis (PCA) analysis using Orange Software. Analysis by explaining the results of the research general conclusions obtained by researchers based on the results of the study on the sample. Economic and social characteristics are presented in the results to translate tourist responses to the main valuation questions (Muharram, 2010). Factors that influence tourist visits are analyzed using multiple linear regression (Adrianto, 2006). The variables considered to influence the number of tourist visits to Sanggar Beach are travel costs, gender, age, income, education and distance. The form of the equation is as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + ei \quad (1)$$

Measurement of economic value is estimated from consumer surplus using the travel cost method. The stages of the calculation analysis are as follows:

a. Estimating the demand function
b. Natural logarithm function transformation (Ln)
c. Determining the consumer surplus value and the economic value of tourism

Then, the calculation of consumer surplus is estimated based on the area under the demand curve, which is calculated through the following steps:

a. Calculating the area of different values under the demand curve: $U = (\frac{b0}{b1+1}) \times (RQ)^{b1+1}$

b. Calculating the average travel cost limit value: $P = \frac{RQ}{a}^{1/b1}$

c. Calculating the area of the curve below the limit price: R = P × RQ

d. Calculating the consumer surplus value CS = U – R

e. Calculation of economic value EV = CS × ∑total population

3. Results and Discussion

3.1. Results

3.1.1. Tourist Characteristic in Sanggar Beach

Sanggar Beach is one of the turtle nesting beaches on the southern coast of Tulungagung Regency. This situation has encouraged local communities to pay attention to the turtle hatchery, both as an environmental conservation effort and as an ecotourism attraction. Sanggar Beach has the potential to attract tourists since 2022. Besides its tranquil nature, Sanggar Beach is also attractive for its beauty and private nature. During certain seasons, tourists can participate in ecotourism activities such as releasing baby turtles. Although not yet well-known, visitors are recorded not only as local but also as inter-regional tourists. The characteristics of tourists at Sanggar Beach are shown in a decision tree visualization that can explain the conditions of tourists who come. A decision tree model was developed to analyze the relationship between variables that influence the final outcome (satisfaction or preference score). The tree was constructed based on a sample of 30 respondents and grouped the data using four main variables, namely travel costs, age, education, and income (**Figure 2**).

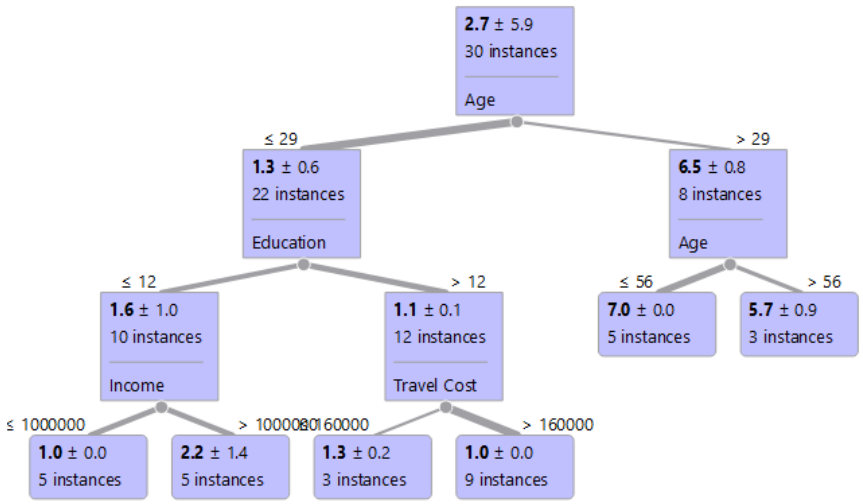

Figure 2. Decision-tree model illustrating the hierarchical effects of age, education, income, and travel cost on the predicted response variable for 30 respondents. Source: Research (2025).

The results of the decision tree show that the root node divides based on age, distinguishing tourists aged 29 years or younger from those over 29 years of age. This initial division resulted in a significant difference in the average score, with younger tourists (≤29 years) having a lower average score (mean = 1.3 ± 0.6), while older tourists (>29 years) had a much higher average score (mean = 6.5 ± 0.8). This shows that age is the main variable affecting tourism demand. For tourists aged 29 years or younger, the next most important factor is education. Those with ≤12 years of education (representing secondary education and below) tend to score slightly higher (average = 1.6) than those with >12 years of education or a bachelor's degree (average = 1.1), indicating a possible inverse relationship between education and the target variable in this tourists subgroup in influencing tourism demand. This figure demonstrates that age is the most influential explanatory factor, as respondents above 29 years have markedly higher predicted values than younger respondents

The subsequent breakdown based on income and travel expenses shows further differences. Tourists with low education (≤12 years of education) and those with an income of ≤1,000,000.00 had the lowest scores (mean = 1.0), while those with an income above this threshold but below 1,600,000 had higher mean scores (mean = 2.2). This indicates a moderate positive relationship between income and outcomes, although the variance is quite significant (±1.4). For tourists with a high level of education (>12 years), travel costs are a distinguishing factor. Those who spend more than 160,000 consistently report the lowest scores (average = 1.0). Meanwhile, those who spend less show slightly higher scores (average = 1.3), indicating that cost sensitivity plays a role in shaping the results for this group of tourists. Conversely, in the subgroup of tourists aged over 29, age remains the main distinguishing factor. Tourists aged ≤56 years showed perfect satisfaction scores (mean = 7.0), while those aged over 56 years showed slightly lower but still high scores (mean = 5.7 ± 0.9). The pattern shows a strong positive relationship between increasing age and higher satisfaction levels, with a slight decline after age 56. These results are worthy of further evaluation in a larger sample considering that the sample in this study is quite limited.

3.1.2. Travel Cost Analysis

Travel costs in this study are the total costs incurred by respondents during the trip from the starting location to the Sanggar Beach and then back to the original location. The total cost consists of transportation costs, consumption costs, parking costs and others (**Figure 3**).

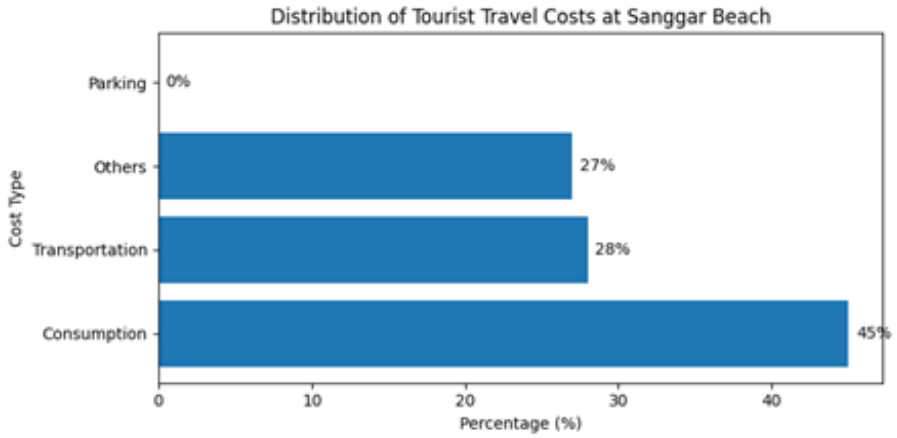

Figure 3. Percentage distribution of tourist travel cost components at Sanggar Beach. Source: Research (2025).

The figure presents how total visitor spending is allocated among consumption, transportation, other expenses, and parking. Most visitors spend the most on consumption while in the Sanggar Beach tourist area or 45%. Then 28% of it is transportation costs

followed by other costs of 27% and finally parking costs of 0%. Although some tourists do not spend the same amount. At Sanggar Beach there is a stall that provides consumption for visitors to Sanggar Beach. Drink prices start from IDR 5,000.00 and food starts from IDR 10,000.00. If many tourists come from Tulungagung City itself so that they do not require large transportation costs, then the largest expense should be consumption. Parking fees at Sanggar Beach are not charged. Most tourists come with groups/families. Other costs here include accommodation and motorbike rental. While mat rental and entrance tickets are free of charge as long as visitors buy food and drinks beforehand.

3.1.3. Tourism Demand Model

Based on the previous travel cost analysis, a regression analysis was conducted to determine the variables that affect the level of tourist visits to Sanggar Beach. The variables analyzed include travel costs, gender, age, income, education and distance from home (**Table 1**).

Table 1. Summary statistics of the regression model used to explain the variation in the dependent variable based on 30 observations.

Model Summary	
Regression Statistics	Summary
Multiple R	0.90
R Square	0.80
Adjusted R Square	0.75
Standard Error	0.42
Observations	30

The table reports the model fit indicators, including Multiple R, R Square, Adjusted R Square, and Standard Error.

The results of the multiple linear regression analysis show that the R square (R^2) value is 0.90. The Adjusted R square value of 0.80. The number of respondent samples is 30 people with a standard error of 0.42 or 42%. The model or equation for Sanggar Beach tourism demand based on the variables considered to influence it is shown in **Table 2**.

Table 2. Estimated regression coefficients for factors associated with the level of visits.

Coefficients[a]						
Model		B	Std. Error	Standardized Coefficients Beta	*t*	Sig.
	1	1.1590	2.8817	0.4022	0.402	0.6913
Intercept	1	0.0037	0.1487	-0.2250	0.050	0.9803
Travel Cost		-0.3015	0.2489	-1.2069	1.206	0.2397
Age	1	0.6705	0.3288	2.0394	2.034	0.0500
Income	1	0.1466	0.1747	0.8391	0.891	0.4097
Education	1	-0.5611	0.4851	-1.1568	0.252	0.2592
Distance	1	-0.3070	0.1918	-1.6005	0.123	0.1231

a Dependent Variable: Level of Visits

The table summarizes the direction, magnitude, and statistical significance of the relationships between travel cost, age, income, education, distance, and the dependent variable. The key message highlighted by this table is that age shows the most prominent positive contribution to the model and is the closest to statistical significance, whereas the other variables do not show statistically significant effects at the conventional level.

The resulting Sanggar Beach tourism demand equation is as follows:

$$Y = 1.1590 – 0.0037c – 0.3015g + 0.6705a + 0.1466i – 0.5611e – 0.3070d$$

The variables used in this analysis are defined as follows: **Y** represents the number of visits (times); **c** denotes travel cost (rupiahs); **g** refers to gender, expressed as a dummy variable (1 = male, 2 = female); **a** indicates age (years); **i** represents income (rupiahs); **e** denotes education level (years); and **d** indicates the distance from home to the study location (kilometers).

The level of visits if there is no influence from the variables that have been determined has a constant value of 1.1590. The coefficient value of the travel cost variable is -0.0037, meaning that every increase in travel costs by one unit will decrease the level of visits by 0.0037 and vice versa. The coefficient value of the gender variable is -0.3015, meaning that every increase in gender by one unit will decrease the level of visits by 0.3015 and vice versa. The regression analysis of the gender variable uses a dummy variable where 1: male and 2: female. So male visitors will visit Sanggar Beach more than female visitors. The coefficient value of the age variable is 0.6705, meaning that every increase in age by one unit will increase the level of visits by 0.6705 and vice versa. The coefficient value of the income variable is 0.1466, meaning that every increase in age by one unit will increase the level of visits by 0.1466 and vice versa. The coefficient value of the education variable is -0.5611, meaning that every increase in the level of education by one unit will decrease the level of visits by 0.5611 and vice versa. The higher the level of education, for example at the S1 level (12 years), the lower the level of visits to Sanggar Beach. The coefficient value of the home distance variable is -0.3070, meaning that every increase in the distance from home by one unit will decrease the level of visits by 0.3070 and vice versa.

3.1.4. Principal Component Analysis

Figure 4 illustrates the scree plot of the proportion of variance explained by each principal component (red line) alongside the cumulative variance explained (green line).

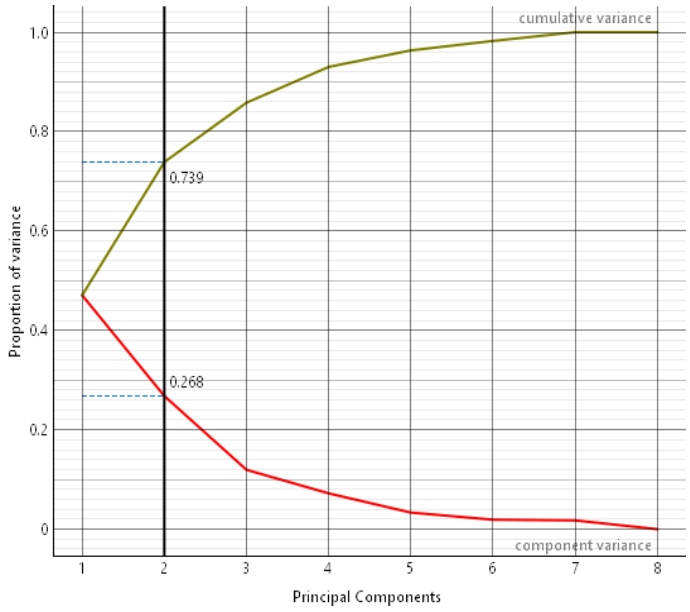

Figure 4. Scree plot showing the proportion of variance explained by each principal component and the cumulative variance obtained from the principal component analysis (PCA). Source: Research (2025).

The red line represents the variance contributed by each individual component, while the green line indicates the cumulative variance across components. The main finding highlighted by this figure is that the first two principal components explain 73.9% of the total variance, indicating that these two components are sufficient to capture most of the information contained in the original variables. The first principal component (PC1/travel cost) accounts for approximately 46.9% of the total variance, while the second component (PC2/age) contributes a further 26.8%. Collectively, these two components capture approximately 73.9% of the total variance in the dataset.

3.1.5. Consumer Surplus Analysis

Consumer surplus analysis calculating the economic value of tourism resources is an estimate of the value calculation that has not been paid by tourists outside the total travel costs that they have spent while touring at a tourist location. The stages of calculating consumer surplus to estimate the total economic value of Sanggar Beach resources utilized for tourism activities are as follows:

a. Calculating the area of different values under the demand curve

b. The calculation of the U value (utility) is by calculating the area of value that is under the resulting demand curve (**Figure 5**). The U value is obtained by the following calculation: U = $(b_0/(b_1+1))$ x (RQ) b_1+1 = 65.1402

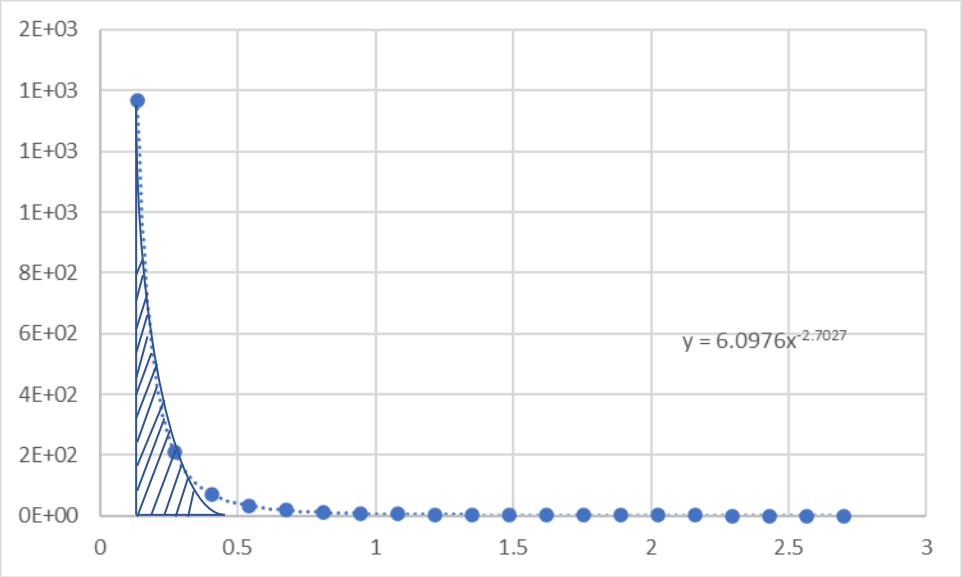

Figure 5. Consumer surplus curve estimated from the travel cost demand function for visits to Sanggar Beach. Source: Research (2025).

The figure shows the inverse relationship between travel cost and visitation demand, where the shaded area under the curve represents the estimated consumer surplus obtained by visitors. The main finding highlighted by this figure is that demand decreases sharply as travel cost increases, indicating that visitors are sensitive to higher travel expenses and that the economic benefit received by tourists is concentrated at relatively low travel costs.

c. Calculating the average travel cost limit value: $P = \left(\frac{RQ}{a}\right)^{1/b1}$ = 0.4162

d. Calculating the area of the curve below the limit price: R = P × RQ = 1.1237

e. Calculating the consumer surplus value CS = U – R = 64,016.5

Calculation of economic value NE = CS × ∑total population = 18,064,987,438.00 ~ Rp18,064,987,438.00.

3.2. Discussion

To begin the discussion regarding the economic value of coastal resources at Sanggar Beach, we start with an analysis of tourist characteristics. This is important considering the characteristics of tourists, which are then used in the analysis of tourism demand and consumer surplus. The analysis of tourist characteristics in this study was conducted using a decision tree. Decision tree analysis is used to analyze and explore factors that influence tourism behavior and demand. This method is used to identify different visitor segments based on important demographic and socio-economic variables (Tajtakova, 2009). Decision Trees systematically divide datasets based on attributes such as travel costs, age,

education, and income. This is useful for classifying tourist characteristics. This approach not only provides a hierarchy of the importance of these factors, but also facilitates policy recommendations that are expected to improve the tourist experience in ecotourism activities (Keller and Gauster, 2021). Among the many factors that influence tourism consumption behavior, age is a factor that can encompass all visitors and has clear characteristics that are consistent with tourism consumption behavior, which has the most significant influence (Chen and Pan, 2017). Overall, the decision tree shows age as the main predictor, followed by education, income, and travel costs in shaping the outcome variable. These results indicate the complex behavior of tourist subgroups, especially among young tourists, where socioeconomic factors such as income and travel costs significantly influence responses. Phan et al. (2025) says that in addition, the impact of travel-related and socio-economic factors on expenditure elasticity provides a holistic understanding of tourist behavior. In contrast, older individuals demonstrate consistently higher outcome levels regardless of economic variables, potentially indicating greater stability, satisfaction, or resilience with age. older individuals consistently demonstrate higher levels of outcomes regardless of economic variables, potentially indicating greater stability, satisfaction, or resilience as they age. The travel characteristics and motivations of seniors vary widely. These differences can be seen in the types of food, accommodations, purchasing behavior, and types of tourist attractions and entertainment (Alen et al., 2016).

The study used the travel cost method, which is a method used to assume the value of a tourist attraction by considering the aspect of travel costs incurred by each visitor (Adrianto, 2006). Most visitors spend the most on consumption while in the Sanggar Beach tourist area or 45%. In general, the total travel costs of Sanggar Beach tourists are not too large. This condition will usually be in line with the conditions and popularity of tourist locations that have not yet developed greatly (Woo, 2019). Based on the previous travel cost analysis, a regression analysis was conducted to determine the variables that affect the level of tourist visits to Sanggar Beach. The results of the multiple linear regression analysis show that the R square (R^2) value is 0.90. This value indicates that the model or equation obtained is trusted within 90%. The Adjusted R square value of 0.80 indicates that the model or equation obtained is able to explain field conditions by 80%, the remaining 20% is explained by other variables outside those studied. The number of respondent samples is 30 people with a standard error of 0.42 or 42%. The coefficient of determination (R^2) value, which represents the amount of variance in an endogenous construct explained by all related variables, indicates the combined effect of the exogenous latent variables. An R2 value exceeding 0.67 (0.90) indicates a high level of predictive accuracy (Sukrana et al., 2025).

The demand model for Sanggar Beach marine tourism shows that the number of visits is influenced by travel costs, gender, age, education, income and distance from home. The variable that significantly affects the level of visits is age where the p-value is <0.0500. This means that this variable significantly influences the decision to visit Sanggar Beach tourists. In addition, the level of visits can also be influenced by gender, origin and travel time but it is very dependent on the location of each tourist destination and the condition of the tourists (Mazaya et al., 2023).

Then, to find out the most influential parameters, a PCA analysis was carried out. The Principal Component Analysis (PCA) was conducted to reduce the dimensionality of the dataset while preserving as much variance as possible (Greenacre et al., 2022). This substantial proportion indicates that the first two principal components adequately represent the underlying data structure, justifying their selection for dimensionality reduction and subsequent analysis. This means that travel cost and age are likely the two original features contributing the most variance, even though they are not statistically significant. Beyond the second principal component, each additional component contributes only marginally to the overall variance, with diminishing returns. The third and fourth components explain much smaller amounts of variance (approximately 12% and 6%, respectively), and the cumulative variance curve begins to flatten. The elbow illustrates the boundary of the two principal components used in further analysis (Cattell, 2010). In summary, the PCA results show that the two main components, namely age and income, sufficiently explain 74% of the total variance. This reduction not only simplifies the data

structure but also mitigates noise, potentially improving the performance and interpretability of subsequent analytical models (Acharya and Analytics, 2024).

Consumer surplus analysis is an economic approach to describe the indirect economic value of the resources that utilized as a tourism destination. The consumer surplus value of Sanggar Beach tourists is IDR 64,016.00 per individual tourist. Based on Indonesian Central Bureau of Statistics (BPS) data 2025, the total number of tourists to Tulungagung Regency was 1,763,718, with 16% visiting beaches across 25 destinations. Based on this calculation, the estimated economic value of Sanggar Beach is IDR 18,064,987,438.00 per year. This value is used as an approach to estimate the indirect economic value of the use of ecosystem services as a tourist destination. The economic value of a resource analyzed based on tourism demand is indirectly related to the quantity and quality of the resource (Mazaya et al., 2019). By knowing the indirect economic value, management recommendations can be formulated. One of which is by considering the entrance fee to the area and the strategy for developing conservation-based tourism areas as well as calculating incentives for conservation efforts. The development of the tourism sector, especially marine tourism, is one of the leading maritime sectors in the national economy that needs to be developed (Leiwakabessy et al., 2024).

4. Conclusions

This study demonstrates the importance of estimating the indirect economic value of coastal resources as an indicator of ecotourism sustainability, using Sanggar Beach in Tulungagung as a case study. The results of the decision tree analysis show that age, education, income, and travel costs significantly affect visitor satisfaction and behavior. Older visitors tend to show higher levels of satisfaction. On the other hand, younger individuals are more sensitive to economic and educational factors, highlighting the need for targeted management strategies. Principal Component Analysis (PCA) shows that the first two principal components, namely age and income, capture more than 74% of the total variance. This reduction facilitates more efficient interpretation and informed policy decisions. Consumer surplus analysis yields an indirect economic value of IDR 64,016.00 per tourist, resulting in a total annual economic value of approximately IDR 18,064,987,438.00 per year. This value represents the non-market benefits obtained by tourists and reflects the potential of Sanggar Beach to contribute sustainably to the local economy. The value tends to be small because the utilization of Sanggar Beach has not been maximized. Overall, the study provides empirical evidence supporting the integration of economic valuation into coastal resource management. It underscores the necessity of balancing ecological preservation with economic utilization to achieve long-term ecotourism sustainability. The results are expected to inform local government policies and tourism development strategies that prioritize both conservation and community welfare.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the research, authorship, or publication of this article.

Acknowledgements

This research and publication were supported by Universitas of Brawijaya. The authors also express their gratitude to the parties who supported the success of this research.

AI Writing Statement

During the preparation of this work**,** the authors used ChatGPT 5.2 to paraphrase and proofread the sentences. After using this tool/service, the authors reviewed and edited the content as needed and takes full responsibility for the content of the publication.

References

Acharya, P. (2024). Principal Component Analysis (PCA) - An Efficient Way of Variable Reduction Method and its Application in Oncology Trials. Bengaluru, Indonesia: Ephicacy Lifescience Aalytics Pvt. Ltd.

Adrianto, L. (2006). *Introduction to Economic Assessment of Coastal and Marine Resources*. Bogor, Indonesia: Bogor Agricultural University

Ahmed, S.K. (2024). How to choose a sampling technique and determine sample size for research: A simplified guide for researchers. *Oral Oncology Reports*, *12*, 1-7. https://doi.org/10.1016/j.oor.2024.100662

Alen, E., Losada, N., & Dominguez, T. (2026). The impact of ageing on the tourism industry: an approach to the senior tourist profile. *Springer Science Business Media*, *127*, 303-322. https://doi.org/10.1007/s11205-015-0966-x

BPS (Indonesian Central Bureau of Statistics). **(**2025). *Tulungagung Regency in Figures*. 42

Campbell, L.M. (2008). Science, spectacle and speculation in the environment-society interface. *Environment and Planning A*, *40*(5), 1135-1152.

Cattell, R.B. (2010). The Scree Test for the Number of Factors*. Multivariate Behavioral Research, 1*(2), 245-276. https://doi.org/10.1207/s15327906mbr0102_10

Centeno, A.B. (2000). The Travel Cost Method Applied to the Valuation of the Historic and Cultural Heritage of the Castile-León Region of Spain*. 40th Congress of the European Regional Science Association.*

Elegbede, I.O., Kies, F., & Jolaosho, T.L. (2023). Marine and coastal resources. *Encyclopedia of Sustainable Management, 3*, 1-5. https://doi.org/10.1007/978-3-030-02006-4_304-2

Fahrizal, A., Kasnir, M., & Rauf, A.,S. (2025). Towards sustainable eco-mina tourism: biophysical characterization and development pathways of mangrove ecosystems in Sorong District, Southwest Papua, Indonesia. *Egyptian Journal of Aquatic Biology and Fisheries*, *29*(5), 235-253. https://doi.org/10.21608/ejabf.2025.417328.6475

Gómez-zapata, J.D., Herrero-prieto, L.C., & Alberto, J. (2025). A choice experiment economic valuation of cultural heritage tourism ecosystems. *Journal of Sustainable Tourism*, *33*(3), 591-612. https://doi.org/10.1080/09669582.2024.2382840

Iqbal, M., Education, G., & Medan, U.N. (2024). Conservation strategy and ecotourism impact counseling mangrove on the coastal mangrove beach of Nipah Village District Serdang Various Sumatera North. *International Journal of Social Science and Humanity*, *1*(4), 39-51. https://doi.org/10.62951/ijss.v1i4.150

Imran, Z., Ketjulan, R., & Masahiro, Y. (2025). Sustainable strategy on marine spatial planning of tiworo archipelagic. *Jurnal Ilmu dan Teknologi Kelautan Tropis*, *13*(3), 379-394. https://doi.org/10.29244/jitkt.v13i3.35311

Keller, K., & Gauster, J. (2021). P*olicy recommendations on ecotourism for the countries of the Danube region*. Budapets, Hungaria: Corvinus. https://doi.org/10.14267/978-963-503-892-3

Konwar, D., & Goswami, N. (2020). A travel cost estimation of consumer surplus in recreational visits: a count model approach*. Assam Economic Journal, 30*(2020), 1-14. https://ssrn.com/abstract=4250334

Koshy, N., Shuib, A., Ramachandran, S., & Afandi, S.H.M. (2019). Economic valuation using travel cost method (TCM) In Kilim Karst Geoforest Park, Langkawi, Malaysia*. Journal Of Tropical Forest Science, 31*(1), 78-89. https://doi.org/10.26525/jtfs2019.31.1.078089

Kurniati, R., Widjajanti, R., Dewi, S.P., & Syahri, E.K. (2024). Coastal area sustainability. *International Review for Spatial Planning and Sustainable Development, 12*(2), 293-317. https://doi.org/10.14246/irspsd.12.2_293

Leh, F.C., Mokhtar, F.Z., Rameli, N., & Ismail, K. (2018). Measuring recreational value using travel cost method (TCM): a number of issues and limitations. *International Journal of*

Academic Research in Business and Social Sciences, 8(10), 1381-1396. http://dx.doi.org/10.6007/IJARBSS/v8-i10/5306

Leiwakabessy, F., Kubangun, M.T., & Pattiasina, E.B. (2025). Analysis of water suitability for ecotourism development on several beaches in Morella Village, Central Maluku Regency, Maluku Province. *Jurnal Ilmu dan Teknologi Kelautan Tropis, 17*(2), 451-468. https://doi.org/10.29244/jitkt.v17i2.63710

Lubis, K.M., Imran, Z., Taryono, T., & Damar, A. (2025). Carbon sequestration estimation and economic valuation of *rhizophora apiculata* in the North Nias Marine Conservation Area. *Jurnal Ilmu dan Teknologi Kelautan Tropis, 17*(1), 64-72. https://doi.org/10.29244/jitkt.v17i1.57948

Loomis, J.B., & White, D.S. (1996). Economic benefits of rare and endangered species: Summary and meta-analysis. *Ecological Economics*, *18*(3), 197-206. https://doi.org/10.1016/0921-8009(96)00029-8

Greenacre, M., Groenen, P.J.F., Hastie, T., D'Enza, A.L., Markos, A., & Tuzhilina, E. (2022). Principal Component Analysis. *Nature Reviews Methods Primers*. 1. https://doi.org/10.1038/s43586-022-00184-w

Gutic, M.J. (2016). Sea turtle eco tourism brings economic benefit to community. *Marine Turtle Newspaper, 64*, 10-12. https://www.researchgate.net/publication/304251976_Sea_Turtle_Eco-Tourism_Brings_Economic_Benefit_to_Community

Mazaya, A.F.A., Masjhoer, J.M., & Pramesit, A.A. (2023). Tourism demand analysis for marine ecotourism management in Kukup Beach, Gunung Kidul, Yogyakarta. *Berkala Perikanan Terubuk*, *51*(3), 9.

Mazaya, A.F.A., Yulianda, F., & Taryono, T. (2019). Economic valuation of coral reef ecosystem for marine tourismin Karimunjawa National Park. *IOP Conference Series: Earth and Environmental Science*, *241*(1). https://doi.org/10.1088/1755-1315/241/1/012025

Meleddu, M. (2014). Tourism, residents' welfare and economic choice: A literature review. *Journal of Economic Surveys*, *28*(2), 376-399. https://doi.org/10.1111/joes.12013

Memon, M.A., Ting, H., Cheah, J.H., Ramayah, T., Chuah, F., & Cham, T.H. (2020). Sample size for survey research: review and recommendations. *Journal of Applied Structural Equation Modeling, 4*(2), 1-20. https://doi.org/10.47263/JASEM.4(2)01

Muharram, A. (2010). Utilization of coral reef resources for capture fisheries and tourism in Pasi Island, Selayar Islands Regency, South Sulawesi Province [*thesis*]. Bogor (ID): Bogor Agricultural University

Parsons, G.R. (2022). *University of Delaware Travel Cost Models*. *Springer Nature Link*. https://doi.org/10.1007/978-94-007-7104-8

Patil, S., & Pattanshetti, M. (2024). The role of ecotourism in sustainable development: a comprehensive systematic review. *Research Square*, 1, 1-18. https://doi.org/10.21203/rs.3.rs-4843585/v1

Phan, K.T., Chen, S.H., Pai, W.T., Lee, J.M., & Hsieh, C.J. (2025). How travel-related factors and the socioeconomic characteristics of tourists shape tourism demand? new evidence from the role of satisfaction. *Sage Journal, 1*, 1-26. https://doi.org/10.1177/21582440251335471

Tegar, D., & Gurning, R.O.S. (n.d.). Development of marine and coastal tourism based on blue economy. I*nternational Journal of Marine Engineering Innovation and Research*, *2* (2), 128-132. http://dx.doi.org/10.12962%2Fj25481479.v2i2.3650

Rahat, K.M.R., Amin, A., & Ahmed, T. (2024). Comparing tourists travel cost and consumer surplus to estimate the recreational values of Kuakata Sea Beach in Bangladesh. *Journal of Tourism & Hospitality*, *13*(1), 1-7.

Riadi, S., Susanti, A., & Arkham, M.N. (2024). The economic analysis of fisheries management of big pelagic fish in WPPNRI 715. *Jurnal Ilmu dan Teknologi Kelautan Tropis*, *16*(1), 37-46. https://doi.org/10.29244/jitkt.v16i1.41693

Rizal, A. (2018). Economic value estimation of mangrove ecosystems in Indonesia. *Biodiversity International Journal*, *2*(1), 98-100. DOI: 10.15406/bij.2018.02.00051

Sukrana, B., Hassan, S., Jui, F.I., Shakur, M.S., Debnath, B., & Bari, A.B.M.M. (2025). Investigating the Influence of the Push and Pull Factors in Eco-Resort Selection to Promote Sustainable Tourism in Bangladesh. *Sustainable Futures, 9,* 1-16. https://doi.org/10.1016/j.sftr.2025.100619

Tajtakova, M. (2009). Machine learning methods for the market segmentation of the performing arts audiences. *International Journal of Business Environment*, *2*(3), 356-374. https://doi.org/10.1504/IJBE.2009.023796

Tisdell, C.A., & Wilson, C. (2014). Wildlife-based tourism and increased support for nature conservation financially and otherwise: evidence from sea turtle ecotourism at Mon Repos. *Tourism Economics*, *7*(3), 2330249. https://doi.org/10.5367/000000001101297847

Torres, C., Hanley, N., Torres, C., & Hanley, N. (2016). *Management Perspective Economic Valuation of Coastal and Marine Ecosystem Services in the 21 st century: an overview from a management perspective*. Palma de Mallorca, Spanish: Universitat de les Illes Balears

Wijaya, G.A., Purwakanta, I.N., & Tantrawan, I.W. (2020). The Economic, Ecological, and Educational Benefits of Sea Turtle Conservation in North Bali Region. *Springers Nature*, *394*(2019), 113-118. https://doi.org/10.2991/assehr.k.200115.019

Woo, M. (2019). Determinant Factors of Tourist Expenses. *Journal of Travel Research*, *59*(2), 267-280. https://doi.org/10.1177/0047287519829257