Forest and Society
Vol. 9(2): 641-664, December 2025
10.24259/fs.v9i2.43851

REGULAR RESEARCH ARTICLE

How Much and Why? Conservation Behavior and Valuation in Katunggan Coastal Ecopark, Mindanao Island, Philippines

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RECEIVED 2025-04-22
ACCEPTED 2025-05-28

ABSTRACT

Mangrove forests are among the most productive and valuable ecosystems, providing critical services such as shoreline protection, fisheries support, and carbon sequestration. Despite their ecological and economic significance, mangrove forests continue to decline at an alarming rate due to land conversion for aquaculture, urban expansion, overharvesting, and climate-related impacts. Although national and community-based conservation programs exist in the Philippines, many of these efforts have struggled due to limited public participation and a lack of insight into how local communities perceive and value mangrove ecosystems. This study surveyed 503 residents living near the Katunggan Coastal Ecopark in Mindanao Island, Philippines, to examine how conservation attitudes, perceived threats, knowledge, utilization, and sociodemographic factors shape conservation action and willingness-to-pay (WTP) for mangrove protection. Respondents generally exhibited high knowledge of mangroves, with strong recognition of climate and human-induced threats, as well as high conservation attitudes and actions, and a low reliance on mangroves for their livelihood. Most expressed support for conservation through monetary contributions (82.4%), although some cited financial constraints, skepticism toward fund use, or preference for non-monetary participation. Structural equation modeling (SEM) revealed that perceived threat and conservation attitude significantly influenced conservation actions, while knowledge, conservation actions, monthly income, and sex at birth predicted WTP. The log-normal interval regression model estimated a mean annual WTP of USD 12.29 (₱703.53) and a median of USD 1.59 (₱91.01), indicating a right-skewed distribution. These findings offer critical insight into the cognitive and behavioral drivers of mangrove conservation support. They can inform inclusive, flexible payment mechanisms that ensure greater community participation in sustainable mangrove ecosystem management.

KEYWORDS

Community-based conservation; Environmental valuation; Mangrove conservation; Structural Equation Modelling (SEM); Mindanao; Philippines.

1. INTRODUCTION

The gradual loss of coastal ecosystems has become a pressing concern in recent decades, with mangrove forests being among the most threatened habitats globally (Polidoro et al., 2010; Ward et al., 2016). Mangroves, composed of salt-tolerant trees and shrubs, thrive along intertidal zones and provide a wide range of ecosystem services that benefit nature and people (Clough, 2013). These coastal forests function as natural buffers against storm surges (Seriño et al., 2017; Sarker et al., 2020) and coastal erosion (Van Hespen et al., 2023), serve as breeding grounds for marine life (Carugati et al., 2018), and support the livelihoods of countless coastal communities (Millenium Coastal Assessment, 2005). Despite their ecological and economic significance, mangrove forests continue to decline at an alarming rate due to land

conversion for aquaculture (Primavera 1995), urban expansion (Nyein et al., 2025), overharvesting, and climate-related impacts (Ottinger et al., 2016; Thomas et al., 2017; Nyangon et al., 2019). In Southeast Asia alone, nearly half of the original mangrove cover has been lost (Thomas et al., 2017). The Philippines, once home to approximately 320,000 ha of mangroves in the 1900s (Primavera, 1995), saw this area reduced to around 256,185 ha by 2000 (Long & Giri, 2011) and 240,824 ha in 2010 (Long et al., 2014) as determined through satellite-based assessments. In 2019, it was estimated to be at 227,808 ha (Neri et al., 2021). In contrast, the Department of Environment and Natural Resources-Forest Management Bureau (FMB-DENR) reported a higher estimate of 311,400 ha in 2020 (DENR-FMB, 2023).

Efforts to restore and conserve mangrove habitats in the Philippines have been implemented through national programs, such as the National Greening Program (NGP) (DENR Exec. Order No. 26, 2011), and community-based initiatives (Maliao & Polohan, 2008; Pacyao, 2025). However, many of these interventions have struggled due to limited public participation, insufficient scientific input, and weak long-term monitoring (Camacho et al., 2020). One of the key gaps in conservation planning lies in the limited understanding of how local communities perceive, value, and engage with these ecosystems (Primavera et al., 2011; López-Portillo et al., 2017). Recognizing and quantifying public support through behavioral and economic aspects is essential for designing effective and sustainable conservation strategies (Farley, 2010; Bennett, 2016; Gkargkavouzi & Halkos, 2024).

The Katunggan Coastal Ecopark in Barangay Tunguisa, Lebak, Sultan Kudarat, serves as a critical conservation site co-managed by the Department of Environment and Natural Resources (DENR) and the local government unit (LGU) of Lebak. A mangrove conservation effort exists in this area, reflecting the ecological importance and community involvement. However, ensuring the long-term sustainability of this initiative requires a deeper understanding of how the residents perceive, utilize, and value the mangrove forest. This study assesses and explores the interrelationships among the residents' conservation attitude toward mangrove forests, perceived threats to mangrove forests, knowledge about mangrove forests, utilization of mangrove forests in Katunggan Coastal Ecopark, conservation actions, and willingness to pay (WTP) to conserve mangrove forests. It also applies to the Contingent Valuation Method (CVM) to estimate the residents' mean and median annual WTP for implementing five (5) year projects and programs in the eco-park. The results of this study aim to provide evidence-based insights that can inform local policy development and strengthen community-driven conservation planning.

1.1 Theoretical framework

Latent variables such as conservation attitude toward mangrove forests, perceived threats to mangrove ecosystems, knowledge about mangroves, and utilization of mangrove forests were interrelated and jointly affected conservation support (Musa et al., 2020; Quevedo et al., 2020; Salampessy et al., 2021; Tahir, 2023; Dat et al., 2024; Savari et al., 2024).

Conservation attitude refers to the beliefs, feelings, and behavioral intention to protect and conserve the natural environment (Schultz et al., 2005) and is an important factor that affects actual conservation behaviors (Dat et al., 2024; Simpao & Yabut, 2022). Understanding conservation attitude is critical for conservation studies (De Vera et al., 2023, 2024; Limbaro et al., 2024). Studies have demonstrated this link in Southeast Asia. For instance, in Phu Long, Vietnam, attitude toward mangrove conservation significantly predicted the stronger intentions to act and pay for mangrove conservation (Dat et al., 2024). Similarly, in East Kalimantan, Indonesia,

positive conservation attitudes, although they vary among communities, were associated with higher participation and WTP on mangrove conservation programs (Tahir, 2023). Thus, this study hypothesized the following:

- H1: Conservation attitude towards mangrove forests is positively and significantly associated with conservation actions;
- H2: Conservation attitude towards mangrove forest is positively and significantly associated with willingness-to-pay for mangrove forest conservation.

Perceptions and knowledge are closely linked to conservation behavior (Quevedo et al., 2020; Salampessy et al., 2021). According to Rosenstock's Health Belief Model (1974), behavior is influenced by how individuals perceive a threat within a given context. This is supported by empirical evidence from studies in Southern Iran and Eastern Samar, Philippines, which found that high levels of perceived threats were associated with greater community participation in conservation activities such as mangrove planting and coastal clean-up (Quevedo et al., 2020; Savari et al., 2024). Furthermore, when communities understand mangrove forests' economic, ecological, and disaster risk reduction functions, they are more likely to support or contribute financially to conservation efforts, particularly in post-disaster settings (Quevedo et al., 2020).

Several Southeast Asian studies have also shown that higher environmental knowledge is associated with increased conservation actions and WTP (Carandang et al., 2013; Vo Trung et al., 2020; Firdaus, 2023; Dat et al., 2024). For example, in Xuan Thuy National Park, Vietnam, Vo Trung et al. (2020) highlighted that knowledge about mangrove ecosystems significantly and positively affected WTP; respondents with greater understanding were more likely to pay for their conservation. Similarly, in Bohol and Palawan, Philippines, Carandang et al. (2013) reported that providing new information about mangroves significantly increased WTP for ecosystem management. Thus, this study hypothesizes the following:

- H3: Perceived threats to mangrove forests are positively and significantly associated with conservation actions;
- H4: Perceived threats to mangrove forests are positively and significantly associated with willingness to pay for mangrove forest conservation;
- H5: Knowledge about mangrove forests is positively and significantly associated with conservation actions;
- H6: Knowledge about mangrove forests is positively and significantly associated with willingness to pay for mangrove forest conservation.

Several studies reveal that the more people use mangroves, the more they invest money, time, or labor. In Barangay Ipil, Zamboanga Sibugay, Philippines, people who rely on their livelihood from mangrove forests have shown a stronger motivation to support and contribute financially to mangrove conservation (Hernando et al., 2024). In Bohol and Palawan, Philippines, Carandang et al. (2013) showed that sites where residents earned high direct-use value from mangroves also posted a high mean of WTP and stronger support for mangrove conservation through labor contribution and maintenance of mangrove forests. A similar pattern was also shown in a coastal community in Marudu Bay, Sabah, Malaysia, in which residents expressed WTP for mangrove conservation due to their dependence on this ecosystem, and ensured that the younger generation could continuously enjoy the resources from the mangroves (Musa et al., 2020). Thus, this study hypothesizes the following:

- H7: Utilization of mangrove forests is positively and significantly associated with conservation actions;
- H8: Utilization of mangrove forest is positively and significantly associated with

willingness-to-pay for mangrove forest conservation.

Engaging in conservation activities has been positively linked to a willingness to pay for environmental conservation efforts (Lamsal et al., 2015; Vo Trung et al., 2020). In the context of mangrove conservation, studies have demonstrated that individuals who actively participate or express interest in conservation initiatives tend to assign a higher monetary value to this ecosystem (Carandang et al., 2013; Vo Trung et al., 2020). For instance, Xuan Thuy National Park, Vietnam, found that awareness of mangroves and interest in conservation activities positively impact WTP (Vo Trung et al., 2020). Thus, this study hypothesizes the following:

- H9: Conservation action is positively and significantly associated with willingness to pay for mangrove forest conservation.

Recent evidence has indicated that how people act and protect mangroves varies across socio-demographics, such as monthly income, sex at birth, educational attainment, and age. Studies conducted in the Philippines and other Southeast Asia countries demonstrated that households with higher disposable income would volunteer more labor and pledge larger cash amounts to conservation and rehabilitation funds (Musa et al., 2020; Vo Trung et al., 2020; Hernando et al., 2024; Al Furqon & Hak, 2025). Sex-linked tasks were also observed in the Philippines; men generally partake in physically demanding jobs, while women dominate nursery care of mangroves and monitoring (Creencia & Querijero, 2018; Cañada et al., 2022), which translates into different levels of WTP (Gagarin et al., 2022). Educational attainment is consistently a positive driver for conservation behavior (Tianyu & Meng, 2020; Firdaus et al., 2021; Hernando et al., 2024; Al Furqon & Hak, 2025), and in the Philippines, an additional year of schooling increases the probability of engaging in pro-environmental behaviors such as planting trees (Hoffmann & Muttarak, 2020). Although inconsistent across studies, age has been noted to have positive effects in supporting conservation actions and WTP for conservation in the Philippines (Tejada & Cauilan, 2019; Gagarin et al., 2022). Thus, this study hypothesizes the following:

- H10: Monthly income is positively and significantly associated with conservation actions;
- H11: Monthly income is positively and significantly associated with willingness to pay for mangrove forest conservation;
- H12: Sex at birth is positively and significantly associated with conservation actions;
- H13: Sex at birth is positively and significantly associated with willingness to pay for mangrove forest conservation;
- H14: Educational attainment is positively and significantly associated with conservation actions;
- H15: Educational attainment is positively and significantly associated with willingness to pay for mangrove forest conservation;
- H16: Age is positively and significantly associated with willingness to pay for mangrove forest conservation;
- H17: Age is positively and significantly associated with willingness to pay for mangrove forest conservation;

2. MATERIALS AND METHODS

2.1 Study area

This study was conducted in Lebak, Sultan Kudarat, Mindanao Island, Philippines (124.00376°, 6.68053°) (Figure 1). Lebak is a first-class municipality situated in the southern part of the country, facing the Celebes Sea. The area is characterized by nearly level to hilly and mountainous terrains, ideal for intensive rice and corn farming. As of

2020, the municipality had a population of 91,344 across 22,155 households, with an annual growth rate of 2.45% (Philippine Statistics Authority, 2020). The local economy primarily depends on fishing, farming, professional services, trade, and small businesses.

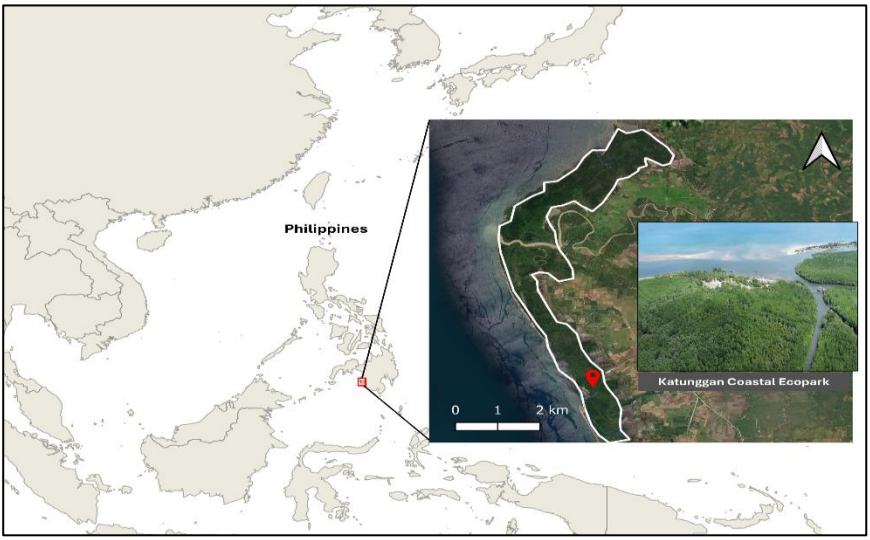

Figure 1. Map of mangrove forest in Katunggan Coastal Ecopark, Lebak, Sultan Kudarat (map generated from QGIS 3.42.1 by P.J. de Vera).

Located in Barangay Taguisa, the Katunggan Coastal Ecopark spans approximately 1,000 hectares of mangrove forest. It is co-managed by the Department of Environment and Natural Resources (DENR) and the Local Government Unit (LGU) of Lebak. According to Mangaoang and Flores (2019), the eco-park is home to twenty-nine (29) mangrove species belonging to 14 families. Among these, four (4) were identified as species of conservation concern; these are *Ceriops zippelliana* (Near Threatened-IUCN), *Avicennia rumphiana* (Vulnerable-IUCN), *Camptostemon philippinensis* (Endangered-IUCN), and *Pemphis acidula* (Threatened-DENR Administrative Order 2017-11) (Mangaoang & Flores, 2019). The presence of these at-risk species underscores the need to prioritize conservation and rehabilitation programs within the Katunggan Coastal Ecopark.

2.2 Sampling procedure

An in-person survey was conducted from October 2024 to February 2025. Before actual sampling, a pre-test was conducted on random people (n=30) to test the clarity and completion time of the survey questionnaire. It took an average of 35 to 40 minutes to finish the survey questionnaire. Communities near and within the Katunggan Coastal Ecopark, public markets, and areas within the municipality of Lebak were visited during the daytime (8:00 AM to 3:00 PM). Samples were collected by asking every fifth person who walked past the researcher (S.L.C.) and asked if they were a resident of the municipality of Lebak, Sultan Kudarat, and willing to partake in the survey (Vaske, 2008). In cases in which more than five (5) people passed before the completion of the survey, the first person who came across the researcher was invited to participate. A total of 503 responses were collected from 524 residents (95.99% response rate).

This study adheres to the ethical standards set by the Ethics Research Committee of MSU-Maguindanao, Philippines (OVCRE ERC form no. 05). Informed consent was

sought, and the participants' anonymity was maintained.

2.3 Survey questionnaire design

The survey questionnaire has three sections. The first section focused on the WTP questions. In the first step, the respondents were informed about the current status of the Katunggan Coastal Ecopark. A photograph of the eco-park was shown to further the respondents' insights into the mangrove forest's current conditions and to explain how further deterioration may reduce the ecosystem services it provides. It was also clarified that the area is co-managed by the DENR and the LGU of Lebak.

To introduce the WTP scenario, the researcher explained that conservation and rehabilitation projects would be pursued if at least 60% of households voted in favor through a referendum. Supporting this initiative would mean additional household expenditure in the form of an annual tax to be collected over the next five (5) years. Details on the proposed payment mechanism were also provided.

Respondents were then asked whether they would support a program to conserve and rehabilitate the mangrove forest in Katunggan Coastal Ecopark. A cheap talk script was included in the survey questionnaire to reduce hypothetical bias. This is to encourage the respondents to consider their choices seriously and respond as if they are committed to making real financial contributions (Cummings & Taylor, 1999). In addition, to help inform their decision, the researcher enumerated specific activities that would be carried out over the five years of implementation. The researcher employed a dichotomous-choice contingent valuation format to assess how much each respondent would pay annually to support the conservation program. For those who answered "no", follow-up questions were asked to indicate their reasons. Respondents who answered "yes" were presented with a range of contributions to choose as an annual payment (₱5.00- $0.09; ₱10.00-$0.17; ₱20.00-$0.35; ₱50.00-$0.87; ₱100.00-$1.75; ₱250.00-$4.37; ₱500.00-$8.74; ₱1,000.00-$17.47; ₱2,000.00-$34.94; ₱3,000.00-$52.41; ₱4,000.00-$69.88; ₱5,000.00-$87.35, US dollar equivalents were provided for the benefit of international readers, based on April 01, 2025 Philippine Peso (₱) and US Dollar ($) exchange rate)The respondents were then asked to indicate their certainty of paying each amount on a five-point multiple bounded scale (definitely yes; probably yes; not sure; probably no; definitely no). These amounts were selected initially based on the socio-economic status of the Philippines, following focus group discussions (FGDs) conducted among key community members before finalizing the survey questionnaire.

The second section of the questionnaire included items to measure six (6) latent variables. Conservation attitude toward mangrove forests was assessed using five (5) items to measure the ecological beliefs, personal values, and support for mangrove conservation of the respondents (see Table 2). Perceived threats to mangrove forests refer to awareness of environmental and governmental issues involving mangrove among the respondents, and this was measured through five (5) items (see Table 2). To assess the knowledge of the respondents about mangrove forests, five (5) factual items were used (see Table 2). Utilization of mangroves in Katunggan Coastal Ecopark was used to explore how the respondents personally benefit from mangroves using five (5) items (see Table 2). Four (4) items were used for conservation actions to investigate the proactive behavior and conservation policy support of the respondents (see Table 2). Willingness-to-pay to conserve mangrove forest was measured through four (4) items to assess the financial commitment of the respondents (see Table 2). Respondents rated the conservation attitude, perceived threats, knowledge, and willingness to pay on a 5-point scale (1 = strongly disagree to 5 = strongly agree). Utilization of mangroves in Katunggan Coastal Ecopark was rated from 1 (never) to 5 (always), while

conservation actions were rated from 1 (highly unlikely) to 5 (highly likely). All the items used to measure the latent variables were based on previously published studies (Carandang et al., 2013; Mangaoang & Flores, 2019; Tejada, 2019; Vo Trung et al., 2020; Alimbon & Manseguiao, 2021; Dat et al., 2024; Hernando et al., 2024; Limbaro et al., 2024). The third section addressed demographics, in which respondents were asked about their age, monthly income, educational attainment, and religion. Data was collected using the free, open-source platform KoboToolbox (Harvard Humanitarian Initiative, n.d.).

2.4 Data analysis

Factor analysis using the varimax rotation (eigenvalue criterion ≥ 1) was performed to determine whether the statements used to measure the latent variables grouped. The internal consistency, construct validity, and reliability were assessed using Cronbach's alpha ($\alpha \geq .80$), composite reliability (CR ≥ .60) (Hair et al., 2013), and convergent validity (Fornell & Locker, 1981). Structural equation modeling (SEM) using the maximum likelihood ratio was employed to assess the association of latent variables in the model. Several indices were used to determine the fitness of the model (acceptable if IFI ≥ .90; TLI ≥ .90; CFI ≥ .90; AGFI ≥ .80; RMSEA < .06-.08; SRMR ≤ .08) (Hu & Bentler, 1999; Hooper et al., 2008; Gefen et al., 2000). SEM was conducted using the *lavaan* (Rosseel, 2012) and *semTools* package (Jorgensen et al., 2025) in R (R Core Team, 2025).

The multi-bounded discrete choice data were analyzed with the interval model (Welsh & Poe, 1998). The "probably yes,"" definitely yes", and "probably yes" answers were recorded as "yes,", and "not sure," "probably no," and "definitely no" were recorded as "no." The data was transformed into dichotomous format (Hanemann et al., 1991; Broberg & Brännlund, 2008;). Only the latent variables and demographic variables that were significant based on SEM results in this study were included in the econometric regression model to estimate the mean and median annual WTP. The analysis was conducted using the *survreg* function from the survival package (Therneau, 2024) in R (R Core Team, 2025).

3. RESULTS

3.1 Sociodemographic profile

Table 1 presents the sociodemographic characteristics of the 503 respondents, classified by sex at birth. Male respondents were slightly older (M = 35.50 ± 9.614) and had a higher monthly income ($434.18 ± $323.11 (₱24,610.19±₱18,314.52)) compared to female respondents (M = 35.50±9.614; income $411.39±$376.48 (₱23,318.41±₱21,339.64)), however, the difference is not statistically significant (age F = 2.219, p = .137, η = 0.066; monthly income F = 0534, p = .465, η = 0.033). The majority of male (80.51%) and female (93.56%) respondents attained higher education, indicating a significant difference (X^2= 18.617, p = .000, V = 0.192), but the effect size is minimal. Regarding religion, no significant difference was found between the sexes at birth (X^2 = 7.102, p = .069, V = 0.199) despite males having a slightly higher representation across religious affiliations.

Table 1. Sociodemographic profile of the respondents classified by sex at birth (n=503).

Sociodemographic variables	Sex at Birth		Statistic X2 or *F*-value	*P*-value	Effect size *V* or η
	Male	Female			
Age (years old) (SD)	35.50 (9.614)	34.15 (10.647)	2.219	.137	.066
Monthly Income (SD)	USD 434.18;	USD 411.39;	.534	.465	.033

Sociodemographic variables	Sex at Birth		Statistic X2 or *F*-value	*p*-value	Effect size *V* or η
	Male	Female			
	₱24,610.19 (±USD 323.11; ₱18,314.52)	₱23,318.41 (±USD 376.48; ₱21,339.64)			
Education			18.617	.000	.192
Lower (elementary or junior high school degree graduate)	53	15			
Higher (senior high school, college, post-graduate studies, graduate)	219	218			
Religion			7.102	.069	.119
Islam (Muslim)	90	54			
Christianity	116	118			
Indigenous Religion	24	26			
Did not mention	42	35			

PHP 1.00 = USD 0.01747 based on April 01, 2025, exchange rate [Source: Bangko Sentral ng Pilipinas].

3.2 Latent variables and measurement indicators for mangrove forest conservation in Katunggan Coastal Ecopark

Respondents in this study showed positive attitudes towards the conservation of mangrove forests (M = 3.87-4.15) (Table 2). They strongly agreed that mangroves are essential for biodiversity (M = 4.15 ± 1.273), contribute to community well-being (M = 4.00 ± 1.235), and provide valuable ecosystem services such as fisheries and ecotourism (M = 3.96 ± 1.187). Moreover, they expressed personal support for mangrove conservation (M = 3.87 ± 1.145) and acknowledged a sense of responsibility in protecting these ecosystems (M = 3.87 ± 1.235). These findings suggest a strong awareness of conserving mangrove forests' ecological and practical benefits. All attitude items demonstrated high composite reliability (CR = .928), internal consistency (α = .930), and convergent validity (AVE = .729).

This study highly rated the perceived threats of mangrove forests (M = 3.84-4.10) (Table 2). Respondents recognized climate change (M = 4.10±1.302), illegal cutting (M = 3.98±1.260), and deforestation and loss of natural habitats (M = 3.95±1.193) as key threats to mangrove forests. They also identify low public awareness as a contributing factor to mangrove decline (M = 3.92 ± 1.203), while moderately believing that there is adequate enforcement of laws and regulations protecting mangrove forests (M = 3.84 ± 1.176). The mean high scores indicate the community is strongly aware of the environmental issues affecting mangrove decline and conservation. Moreover, the items for perceived threat exhibit high composite reliability (CR = .938), internal consistency (α = .938), and convergent validity (AVE = .756).

Most respondents scored high in knowledge about mangrove forests (M = 3.85-4.01) (Table 2). They recognized that mangrove forests act as barriers to natural hazards (M = 4.10 ± 1.224), mitigate climate change (M = 3.90 ± 1.261), and have the potential to boost ecotourism (M = 3.90 ± 1.261). The respondents are also familiar with environmental laws that protect mangroves in the country (M = 3.92 ± 1.202) and link the presence of mangrove forests to local fisheries (M = 3.85 ± 1.252). This indicates that respondents possess a high level of knowledge about the ecological, economic, and legal aspects of mangrove forests. High composite reliability (CR = .938), internal

consistency (α = .938), and convergent validity (AVE = .756) were also observed in the statements regarding knowledge about mangrove forests.

All the statements used to determine how the community utilizes the mangroves in Katunggan Coastal Ecopark also exceeded the threshold for reliability and validity (α=.899; CR=.897; AVE=.640). Results for this latent variable indicated generally low levels of mangrove utilization among respondents in the Katunggan Coastal Ecopark (M = 1.46-1.56) (Table 1). This only reflects the minimal dependence on mangroves for livelihood purposes such as fishing materials (M = 1.53 ± 0.905), charcoal (M = 1.46 ± 0.876), house furniture (M = 1.51 ± 0.899), and dyeing agents (M = 1.54 ± 0.885). Additionally, respondents do not perceive mangroves as an important source of income for local communities (M = 1.56 ± 0.955).

The items used to assess conservation actions demonstrated a high consistency and reliability (α = .921; CR = .921; AVE = .745). Most participants expressed support for programs that provide alternative livelihoods to communities near the Katungan Coastal Ecopark (M = 3.86 ± 1.236) and agreed to offer financial contributions for mangrove protection (M = 3.82 ± 1.232). Respondents also favored enforcing stricter regulations on mangrove tree cutting (M = 3.80 ± 1.212) and showed a willingness to participate in local community-based conservation initiatives (M = 3.78 ± 1.207). These results highlight a positive outlook toward active engagement in mangrove conservation in Katungan Coastal Ecopark.

Statements used to measure the willingness to pay to conserve mangrove forests exceeded the accepted threshold set for internal consistency and reliability (α = .918; CR = .919; AVE = .739). Overall, respondents demonstrated a moderate to high intention to financially support any programs or projects related to mangrove conservation (M = 3.79-4.12) (Table 1). They agreed to financially support mangrove forest conservation (M = 4.12 ± 1.259). Respondents also supported paying for mangrove forest conservation to reduce disaster risk (M = 3.89 ± 1.225) and recognized their contribution as a way to protect biodiversity (M = 3.79 ± 1.132). Additionally, they were willing to support payment schemes for mangrove forest conservation, especially if these were affordable (M = 3.84 ± 1.154).

Table 2. Descriptive statistics and reliability scores of latent variables (n=503).

Statements	Mean	SD	α	CR	AVE
Conservation Attitude toward Mangrove Forest			.930	.928	.729
Mangrove conservation is essential for maintaining biodiversity.	4.15	1.273			
Protecting mangroves contributes to the well-being of the community.	4.00	1.235			
I feel a personal responsibility to conserve mangrove forests in my area.	3.87	1.145			
Mangrove forests provide important services, such as fisheries and ecotourism.	3.96	1.187			
I like the idea of conserving mangrove forests	3.87	1.235			
Perceived Threat to Mangrove Forests			.938	.938	.756
Climate change causes extreme weather events and reduces the suitability of mangroves habitat.	4.10	1.302			
Illegal cutting reduces the number of mangrove species.	3.98	1.260			
Deforestation and loss of natural habitats are the major threats to the survival of mangrove species.	3.95	1.193			

Statements	Mean	SD	α	CR	AVE
Lack of public awareness about mangrove contributes to its decline.	3.92	1.203			
There is adequate enforcement of laws and regulations protecting the mangrove ecosystem.	3.84	1.176			
Knowledge about Mangrove Forests			.940	.940	.759
Mangrove forests act as natural barriers against coastal erosion.	4.01	1.224			
Mangrove forests help mitigate climate change by storing carbon.	3.90	1.261			
Mangrove forest supports local fisheries	3.85	1.252			
Mangrove forests can boost ecotourism.	3.90	1.219			
There are existing laws in the Philippines that protect mangrove forests.	3.92	1.202			
Utilization of Mangroves in Katunggan Coastal Ecopark			.899	.897	.640
I use mangroves as fishing material.	1.53	0.905			
I use mangroves as charcoal.	1.46	0.876			
I use mangroves as house furniture.	1.51	0.899			
I use mangroves as a dyeing agent.	1.54	0.885			
Mangroves are an important source of income for local people.	1.56	0.955			
Conservation Actions			.921	.921	.745
Offer money for the protection of mangroves in Katunggan Coastal Ecopark.	3.82	1.232			
Engage the local community in conservation efforts to promote the productivity of mangroves in Katunggan Coastal Ecopark.	3.78	1.207			
Support and enforce stricter cutting of mangrove trees.	3.80	1.212			
Support programs that provide alternative livelihoods to the community near Katunggan Coastal Ecopark.	3.86	1.236			
Willingness-to-Pay to Conserve Mangrove Forest			.918	.919	.739
I am willing to contribute financially to support mangrove forest conservation projects in Katunggan Coastal Ecopark.	4.12	1.259			
I am willing to pay for mangrove conservation in Katunggan Coastal Ecopark because it helps reduce disaster risk.	3.89	1.225			
My financial contribution to mangrove conservation in Katunggan Coastal Ecopark is a way to protect biodiversity.	3.79	1.132			
I will support payment schemes for mangrove conservation in Katunggan Coastal Ecopark if they are affordable.	3.84	1.154			

3.3 Factors influencing conservation and WTP

The final model shows a good fit to the data (IFI = .956; CFI = .953; TLI = .948; AGFI = .828; RMSEA = .056; SRMR = .064) (Figure 2). The model explained 89.7% of the variances in conservation actions and 91.4% of the willingness-to-pay (WTP) variance. Perceived threat (β= .523, p <.05) and conservation attitude (β= .307, p < .05) are

significant predictors of conservation actions ($p < .05$), Thus, accepting H1 and H3. While utilization of mangrove forest (β= .042, $p > .05$), knowledge (β= .140, $p > .05$), and demographics such as monthly income (β = .037, $p > .05$), sex at birth (β = -.011, $p > .05$), educational attainment (β= .026, $p > .05$), and age (β = .002, $p > .05$) did not significantly predict the conservation actions ($p > .05$). Thus, rejecting H5, H7, H9, H10, H12, H14, and H16.

WTP was significantly influenced by conservation actions (β = .189, $p < .05$), knowledge (β = .701, $p < .05$), monthly income (β = .044, $p < .05$), and sex at birth (β = -.067, $p < .05$). Thus, accepting H6, H9, H11, and H13. However, conservation attitude (β = -.036, $p > .05$), perceived threat (β = .133, $p > .05$), and utilization of mangrove forest (β = -.019, $p > .05$), educational attainment (β = .013, $p > .05$), and age (β = -.002, $p > .05$) did not significantly affect WTP. Thus, rejecting H2, H4, H8, H15, and H17.

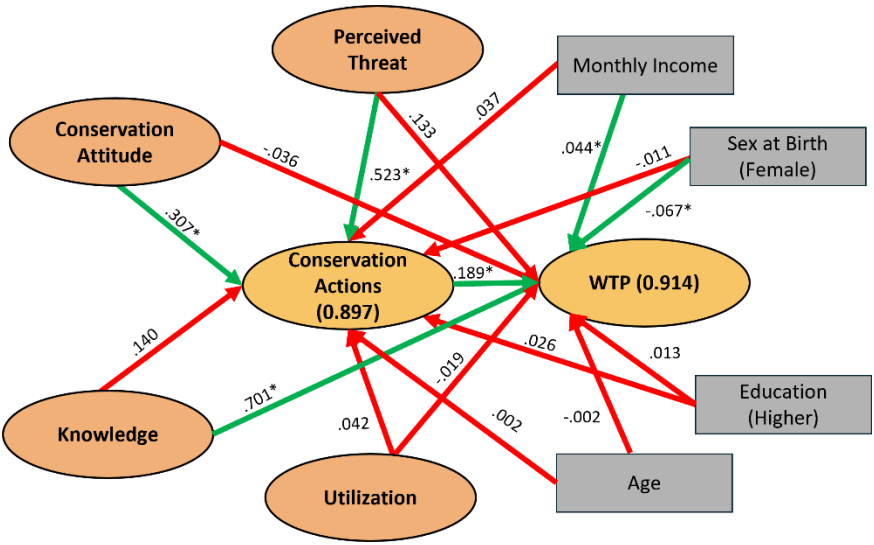

Figure 2. Structural equation model showing the relationships among demographics, attitude, perceived threat, knowledge, utilization, conservation actions, and willingness-to-pay (endogenous variables). Values adjacent to each line are standardized regression coefficients *(β)*. Green lines show statistically significant paths at $p < .05$, while red lines are non-significant at $p < .05$.

3.4 Community support and predictors of WTP

Most respondents (82.4%) supported conserving mangrove forests in Katunggan Coastal Ecopark through payment (Table 3). Among those who did not support the proposed payment, the most common reasons were disagreement with the proposed amount (6.3%), followed by low household income (4.4%). Some respondents preferred to contribute non-monetary (2.8%), while others cited a lack of trust in how funds would be used (2.0%). A few believed that conservation is solely the responsibility of the government (1.2%), and a small portion expressed no interest in mangrove conservation (1.0%).

Table 3. Support and stated reasons for non-supporting mangrove conservation in Katunggan Coastal Ecopark (n=503).

	Frequency	Percent (%)
Supports the conservation of Katungan Ecopark through payment	416	82.4
I disagree with the proposed payment	32	4.4

	Frequency	Percent (%)
My household income is low; I cannot afford the extra cost	22	3.6
I prefer to contribute in other ways than donating money	14	2.8
I do not believe that the donated funds will be used efficiently	10	2.0
The protection of the mangrove ecosystem is the government's responsibility	6	1.2
I am not interested in mangrove conservation	5	1.0

Respondents who reported engaging in more conservation-related actions were significantly more likely to express a higher willingness to pay (WTP) for mangrove forest conservation in Katunggan Coastal Ecopark ($\beta = 0.853$, $p < 0.001$). Monthly income was also a significant predictor of WTP ($\beta = 0.00001$, $p = 0.039$). Although the coefficient appears small, the log-transformed WTP increases slightly for every additional peso in monthly income. This means that individuals with higher income levels tend to show greater financial support for conservation efforts across larger income differences. In contrast, knowledge about mangroves ($\beta = 0.222$, $p = 0.156$) and sex at birth ($\beta = 0.143$, $p = 0.439$) did not significantly influence WTP. The overall model demonstrated a good fit, with the predictors collectively accounting for a significant portion of the variation in WTP (Wald χ^2 (4) = 35.96, $p < 0.001$) and an AIC of 2772.34.

Table 4. Results of the interval regression model using log-normal distribution for willingness-to-pay (n=503).

Variable	Coefficient	SE	z	p > z
Intercept	0.08772	0.37287	0.23525	0.81402
Sex at birth (Female)	0.14256	0.18409	0.77441	0.43869
Income	0.00001	0.00000	2.06095	0.03931
Knowledge	0.22238	0.15685	1.41774	0.15627
Conservation Actions	0.85300	0.15811	5.39501	0.00000
Log Likelihood (Null)	-1380.17			
AIC	2772.34			
Wald χ^2 (df=4)	35.96			
Model p-value	< .001			

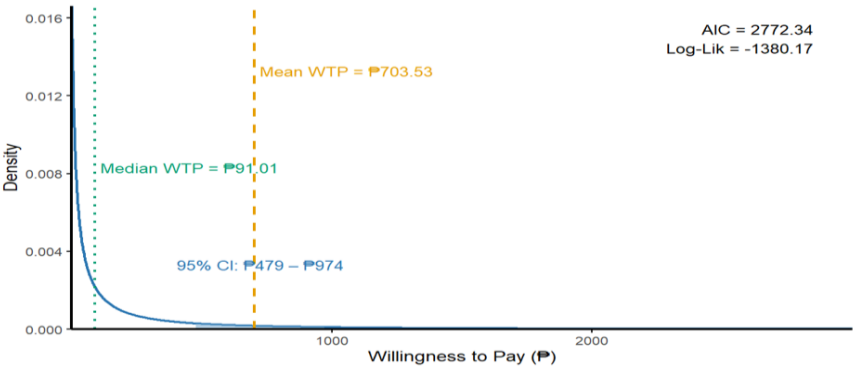

Figure 3. Median and mean willingness-to-pay (WTP) derived from the log-normal interval regression model (n=503).

The interval regression model yielded a mean annual WTP of USD 12.29 SE (95% CI: USD 8.37- USD 17.02) (₱703.53 (95% CI: ₱479-₱974) for mangrove conservation at Katunggan Coastal Ecopark (Figure 3). The median WTP was notably lower at USD 1.59 (₱91.01), indicating that only a few respondents are willing to contribute substantially more. The notable gap between the mean and median WTP indicates a right-skewed

distribution. This pattern is typical in environmental valuation studies and reflects the underlying differences in income, valuation priorities, and perceived benefits (Carson & Hanemann, 2005).

4. DISCUSSION

This study examined the behavioral, cognitive, and sociodemographic factors influencing the support for mangrove forest conservation in Katunggan Coastal Ecopark. Our results revealed that respondents have strong conservation attitudes, high knowledge about mangroves, familiarity with the threats facing mangrove forests, and generally low levels of direct resource utilization from mangrove forests in Katunggan Coastal Ecopark. A significant portion of the respondents (82.4%) supported mangrove forest conservation through financial contribution, with conservation actions and monthly income as significant predictors of WTP. SEM showed that perceived threat and conservation attitudes positively influenced conservation actions, while monthly income, sex at birth, knowledge, and conservation actions were significantly associated with WTP. The estimated mean annual WTP was USD 12.29 SE (95% CI: USD 8.37-USD 17.02) (₱703.53 (95% CI: ₱479-₱974) while the median WTP was USD 1.59 (₱91.01). Based on the mean WTP and the number of households, the total annual non-use value will be approximately USD 27,2301.33 (₱15,586,707.15).

4.1 Attitudes, knowledge, and actions towards mangrove conservation

Our findings revealed that most respondents generally held strong positive attitudes toward mangrove conservation, recognizing its importance in biodiversity, community, and ecosystem services it provides (Table 1). This pattern is similar to previous studies that even in communities with varying degrees of dependence on natural resources, they still express support for conservation, especially when they perceive direct or indirect benefits from its ecosystem services (Badola et al., 2012; Faccioli et al., 2020; Quevedo et al., 2020). In this study, participants agreed on the mangroves for fisheries and ecotourism and showed a sense of personal responsibility for mangrove protection. Similar results were observed in coastal areas in Phu Long and Xuan Thuy National Park, Red River Delta, Vietnam, and East Kalimantan, Indonesia, where a pro-conservation attitude is tied to the perceived benefit they can acquire from conserving mangrove forests (Nguyen et al.,2022; Tahir, 2023; Dat et al., 2024). Despite the low direct resource utilization of mangrove forests in Katunggan Coastal Ecopark, most respondents will still support any conservation programs. This only implies that the conservation attitudes among the respondents are shaped by the ecological importance of the mangrove forest rather than direct utilization.

Respondents in this study exhibited a high level of awareness regarding the various threats faced by mangrove forests, particularly climate change, illegal cutting, and deforestation (Table 1). These findings align with a study conducted in Eastern Samar, Philippines (Quevedo et al., 2020), in which communities residing near mangrove areas ranked natural disasters and human-induced threats such as illegal cutting and charcoal-making as the most concerning threats to mangrove forests. This only implies that the respondents have a better understanding of the natural and anthropogenic drivers of environmental degradation. This study also noted that the respondents moderately agree that there is adequate enforcement of laws and regulations protecting mangroves (Table 1). However, the lower mean score may suggest skepticism about the policy implementation. In Phu Long, Vietnam, perceived gaps in the enforcement of policies and regulations may contribute to the vulnerability of coastal communities dependent on mangrove forests (Dat et al., 2024). Future studies should explore the implementation of policies and regulations for mangrove

conservation in Katunggan Coastal Ecopark.

In terms of knowledge, most participants scored high on items measuring their understanding of the ecological and economic aspects of mangrove forests (Table 1). Respondents correctly identified that mangroves act as natural barriers against coastal erosion, contribute to climate change mitigation, support local fisheries, and have ecotourism potential. Similar findings were noted in the Philippines, Vietnam, and Malaysia, where knowledge of mangrove functions was positively associated with conservation support (Vo Trung et al., 2020; Ampaso et al., 2024; Dat et al., 2024). In contrast, responses to the utilization of mangrove forests in Katunggan Coastal Ecopark revealed that most respondents had limited direct dependence on mangrove resources for livelihood purposes, such as fishing materials, charcoal, house furniture, and dyeing agents (Table 1). This might be the case in the study area due to the management imposed by the DENR and LGU of Lebak. This pattern aligns with previous studies conducted in the Philippines that noted the declining utilization of mangroves in areas with diversified sources of livelihood or conservation restrictions (Quevedo et al., 2020; Alimbon & Manseguiao, 2021).

In this study, the respondents were also asked about their conservation actions and their willingness to contribute to mangrove conservation financially. Most respondents expressed support for community-based programs, stricter regulations for cutting mangroves, and promotion of alternative livelihoods to residents near the eco-park (Table 1). This level of engagement underscores that conservation is not merely seen as a government program but as a shared responsibility among the residents. Similar patterns were also observed in other countries in Southeast Asia. For instance, in Lampung Bay, Indonesia, fishers and shrimp farmers have medium to high perception levels regarding protecting, restoring, and conserving mangroves (Firdaus et al., 2021). In Eastern Samar, Philippines, local communities have relatively high participation in coastal management activities, including volunteering for mangrove planting, education and information campaigns, and ordinance formulation (Quevedo et al., 2020).

Regarding financial contribution, most respondents indicated they would be willing to support mangrove conservation through monetary means (Table 1 and Table 3). One of the motivations for this support is that most respondents believe that a healthy mangrove ecosystem plays a critical role in disaster prevention and biodiversity protection (Table 1). These findings align with the studies conducted in the Philippines and Vietnam, which found that people are more willing to pay when the benefits are associated with their safety and the conservation of their respective local ecosystems (Vo Trung et al., 2020; Gagarin et al., 2022; Dat et al., 2024;). Although the support for financial contribution is high, practical concerns such as the affordability of the payment schemes may influence their willingness to contribute (Table 3). The results showed that respondents do not only recognize the value of mangrove forests, but they are also willing to take both action and financial responsibility.

4.2 Predictors of conservation actions and WTP

Results of the SEM revealed that conservation attitudes and perceived threats were significant predictors of conservation actions (Figure 2). Respondents who strongly believed in the importance of mangroves and acknowledged their vulnerability brought by climate change and anthropogenic activities such as illegal cutting and deforestation were more likely to support conservation actions, including stricter regulations and alternative livelihoods. This result is consistent with other studies suggesting that environmental concern typically translates to proactive behaviors, especially when individuals perceive the natural ecosystems as under threat (Quevedo

et al., 2020; Savari et al., 2024). Interestingly, while knowledge was not a significant predictor of conservation actions in this study, it may still play a reinforcing role, as seen in other studies (Gagarin et al., 2022; Dat et al., 2024; Savari et al., 2024). The non-significant effects of socio-demographics such as sex at birth, monthly income, age, and education on conservation action suggest that behavior towards mangrove conservation may be shaped more by cognitive and emotional dimensions rather than by individual socio-economic status (Ruiz-Guevara et al., 2025).

In contrast, WTP was mostly strongly influenced by knowledge, followed by conservation actions, monthly income, and sex at birth (Figure 2). This suggests that individuals who understand mangrove forests' ecological, economic, and risk-mitigating roles are more inclined to support their conservation financially. These findings support earlier studies from Southeast Asia showing that public awareness of ecosystem services significantly boosts payment acceptance (Vo Trung et al., 2020; Gagarin et al., 2022; Dat et al., 2024). The significance of conservation actions in predicting WTP aligns with behavioral theory, which posits that people who are willing to engage in conservation behaviors are more likely to back up these actions with monetary contributions (Ajzen, 1991). Results also showed that males are more willing to pay compared to females. This gender difference may reflect varying perceptions of environmental responsibility or economic decision-making between the sexes; this observation is also noted in previous environmental valuation studies in the Philippines (Gagarin et al., 2022; Jaafar et al., 2024). Those with higher incomes were also more willing to contribute financially than those with lower incomes. This implies that economic capacity is critical in shaping WTP for mangrove conservation. Thus, future programs that require monetary contributions for mangrove conservation in Katunggan Coastal Ecopark should consider a flexible payment structure to avoid placing undue burden on economically disadvantaged residents (Acharya et al., 2021).

4.3 Support for mangrove conservation and WTP

A substantial majority of respondents expressed willingness to support mangrove conservation efforts through monetary contributions, with 82.4% stating that they would pay for the protection of Katunggan Coastal Ecopark (Table 3). This strong support aligns with the results of other studies, indicating that communities living near ecological hotspots often recognize the importance of conservation and express support for payment schemes (Firdaus et al., 2021; Gagarin et al., 2022; Dat et al., 2024). However, the results of this study must be interpreted in a broader context, particularly in relation to local welfare. Fishing and farming are the main livelihoods in the study area, and these sectors have the highest poverty rates in the country (fisherfolk: 30.6%; farmers: 30.6%) (Philippine Statistics Authority, 2023). Financial resources may be limited, and people may prioritize basic needs before environmental priorities (Drupp et al., 2024; Kassahun et al., 2020). Nonetheless, our results showed a strong relationship between monthly income and conservation actions as predictors of WTP, suggesting that when households are economically stable and actively engaged in conservation, they will be inclined to contribute financially.

Although the Philippines has existing policies for reforestation and coastal management, such as the National Greening Program and Executive Order No. 533 (adopting Integrated Coastal Management), local implementation often lacks sustainable funding (De Leon, n.d., ; Zech et al., 2023). Integrating payment for ecosystem services (PES) into local ordinances or protecting area management plans can translate residents' willingness to pay into an actual financial contribution (Pulhin et al., 2024; Ureta et al., 2021). However, PES integration should be integrated with sector-specific initiatives with sustainable mechanisms and riding on ongoing efforts

at the national level to be effective (Domingo et al., 2022).

Among those who opposed the payment schemes, common reasons include disagreement with the proposed amount (6.3%), financial limitations (4.4%), and a preference for non-monetary involvement (2.8%). Affordability and fairness of the payment schemes can influence participation in conservation initiatives (Palanca-Tan, 2020; Acharya et al., 2021). Camacho et al. (2020) indicated that a successful mangrove rehabilitation program should consider the involvement of the locals in planning and monitoring, in addition to program implementation. A smaller portion of the sample also expressed distrust of how the funds would be used or believed that conservation is solely the responsibility of the government. These results only reflect the lack of confidence of some residents in how the money will be managed, indicating a potential distrust between the public and the implementing bodies. Previous studies have shown that perceived institutional reliability affects public support for conservation programs (Allegretti, 2010; Bennett et al., 2019; Gorris & Koch, 2024). When residents doubt whether their contribution will be used efficiently, their willingness to contribute may decline regardless of their support and pro-conservation attitudes (Gagarin et al., 2022; Makwinja et al., 2019). Thus, implementing bodies of the conservation programs in Katungan Coastal Ecopark should prioritize transparent management of funding and community involvement in financial oversight (Susilo et al., 2017; Camacho et al., 2020).

Although this study focuses on the financial support of residents in the study area for mangrove forest conservation, a small proportion of the respondents (2.8%) preferred to contribute non-monetarily. This suggests that some respondents prefer direct engagement, such as volunteering or monitoring, which can be more accessible to them rather than making a financial contribution. Several studies have noted the non-monetary forms of involvement in mangrove conservation programs in the country (Carandang et al., 2013; Quevedo et al., 2020). These alternative forms to support mangrove conservation may not only foster stronger community cohesion, but also affect social capital and livelihoods (Valenzuela et al., 2020).

Results from the regression analysis further revealed that conservation actions were the most significant predictor of WTP (Table 4), underscoring the role of behavioral engagement in shaping conservation finance decisions. This finding supports the Theory of Planned Behavior, which asserts that behavioral intentions usually predict actual support behaviors such as financial contributions (Ajzen, 1991). Similar patterns were reported in other studies (Carandang et al., 2013; Lamsal et al., 2015; Tahir, 2023), where communities actively involved in conservation activities were more likely to offer financial support for continued efforts. Monthly income also showed a statistically positive significant relationship with WTP, implying that individuals with higher economic capacity tend to contribute more, consistent with other environmental valuation studies in mangrove conservation and rehabilitation in Southeast Asia countries (Vo Trung et al., 2020; Hernando et al., 2024; Al Furqon & Hak, 2025), but contrasting to the results of some studies conducted in the Philippines (Gagarin et al., 2022; Ampaso et al., 2024). This suggests that the income-WTP relationship in the Philippines is not always straightforward and highlights the need for a context-specific program design. Interestingly, neither sex at birth nor knowledge about mangroves significantly predicted the WTP in the final model. This contrasts with some previous studies (Vo Trung et al., 2020; Gagarin et al., 2022; Ampaso et al., 2024; Savari et al., 2024;), but supports the notion that knowledge alone may not directly affect financial behavior unless paired with prior engagement (Kollmuss & Agyeman, 2002; Wyss et al., 2022).

The mean annual WTP was USD 12.29 (₱703.53) per household, while the median WTP was much lower at USD 1.59 (₱91.01). This indicates a right-skewed distribution in which a small group of respondents indicates much higher WTP values than the majority (Carson & Hanemann, 2005). Such a pattern only reflects the heterogeneity in disposable income or perceived benefits acquired from mangrove forest conservation. Given this skew, future conservation programs should consider tiered contribution schemes (pay-what-you-can options) to maximize inclusivity while tapping into the higher potential of the wealthier segment in the community (Ting et al., 2021; De Lange et al., 2023). This aligns with Camacho et al. (2020), who emphasized that successful mangrove rehabilitation programs involve local communities in implementation planning, and monitoring, ensuring that financial mechanisms are participatory and sensitive to local socio-economic conditions.

5. CONCLUSION

The present study revealed that communities surrounding the Katunggan Coastal Ecopark generally held strong conservation attitudes and actions and high levels of ecological knowledge and awareness of threats to mangroves, while demonstrating relatively low direct utilization of mangrove resources. Despite sociodemographic differences, conservation behaviors were primarily driven by cognitive and affective dimensions, specifically, perceived threats and pro-conservation attitudes. Knowledge and conservation actions emerged as key factors influencing willingness to financially support mangrove conservation, alongside monthly income and sex at birth. This underscores the importance of behavioral engagement and awareness in shaping conservation financing, reflecting findings from other environmental valuation studies in Southeast Asia.

A large proportion of respondents in the study area expressed support for payment-based conservation schemes, which suggests a favorable environment for implementing community-based mangrove protection strategies at Katunggan Coastal Ecopark. However, the observed right-skewed distribution in WTP and the cited concerns over affordability, fund transparency, and government responsibility point to the need for more inclusive and context-sensitive approaches. Flexible payment structures, participatory governance, and targeted awareness campaigns may improve local participation and long-term sustainability of conservation efforts in Katunggan Coastal Ecopark.

This study provides practical insights to inform local policy and program design, particularly in integrating ecological knowledge and behavioral motivators into conservation planning. While the findings are specific to the Katunggan Coastal Ecopark in Mindanao Island, Philippines, they may be relevant to other coastal communities facing similar socio-ecological dynamics across the country. Future research should explore how socio-cultural contexts and perceptions of institutional trust influence conservation commitment and payment behavior across different settings.

Author Contributions: Sheenamae P. Loreno: Conceptualization, Fieldwork and Data collection, Formal analysis, Visualization, Writing-Original draft and Finalization; Peter Jan D. de Vera: Supervision, Conceptualization, Methodology, Writing–review & editing, Validation

Competing Interests: The authors declare no conflict of interest.

Acknowledgments: We thank the local communities of Lebak, Sultan Kudarat, Philippines, for allowing us to conduct this research. Special thanks to the LGU of Lebak and the Department of

Environment and Natural Resources (DENR) Region 12 for their invaluable support. Gratitude is also extended to Prof. Jayric F. Villareal and Prof. Rolly James F. Cheng for providing invaluable feedback on this manuscript.

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