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Preliminary Study on Willingness to Pay for Adaptive Management in Komodo National Park: A Contingent Valuation Approach

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***Abstract*—Komodo National Park (KNP), a UNESCO World Heritage Site, faces significant environmental challenges due to increasing tourism, climate change, and resource management issues. This preliminary study employs the Contingent Valuation Method (CVM) to estimate visitors' willingness to pay (WTP) for adaptive management initiatives aimed at preserving the park's unique biodiversity and ecological health. Conducted in Labuan Bajo, the main gateway to KNP, the study involved 50 respondents who were surveyed on their WTP for improved environmental quality and management. The binary logistic regression analysis revealed that higher income levels and gender significantly influence WTP, with higher income individuals and males being more likely to contribute financially. Marital status showed a negative association with WTP, suggesting that married individuals may have financial constraints. The study highlights the importance of understanding sociodemographic factors to design effective funding strategies for conservation. The findings underscore the need for targeted communication and engagement strategies to increase financial support for adaptive management. These insights will inform policy and management strategies to ensure the long-term sustainability of KNP.**

Keywords— Komodo National Park, adaptive management, willingness to pay, contingent valuation method, environmental conservation, tourism impact, binary logistic regression

I. INTRODUCTION

Komodo National Park (KNP), a UNESCO World Heritage Site located in Indonesia, is renowned for its unique biodiversity, including the iconic Komodo dragon and rich marine ecosystems. As one of the most significant conservation areas globally, KNP faces various environmental challenges, particularly those related to increasing tourism, climate change, and inadequate resource management [1]. Effective management strategies are essential to preserve the park's ecological integrity and sustain its biodiversity [2], [3]. One such strategy is adaptive management, a dynamic approach that adjusts policies and practices in response to changing environmental conditions and new scientific knowledge [4], [5], [6].

Tourism is a crucial economic driver for the region, with Labuan Bajo serving as the main gateway to the park. The influx of tourists has both positive and negative impacts on the park's environment [7], [8]. On one hand, tourism generates significant revenue that can support conservation efforts. On the other hand, it leads to environmental degradation, pollution, and resource depletion if not managed sustainably. Understanding visitors' willingness to pay (WTP) for adaptive management initiatives is vital for developing effective funding mechanisms and ensuring the long-term sustainability of conservation efforts [9]. The Contingent Valuation Method (CVM) is a widely used economic tool for estimating the value that individuals place on non-market goods, such as environmental conservation [10], [11]. CVM involves directly asking individuals their willingness to pay for specific environmental services or improvements, providing a monetary measure of the benefits derived from these services. This method is particularly useful in the context of KNP, where traditional market transactions do not capture the full value of the park's ecological and cultural significance.

Previous studies have demonstrated the utility of CVM in various conservation contexts [12], [13], [14]. For example, Eregae et al. highlighted the effectiveness of CVM in valuing public goods and services, including environmental conservation [15]. Similarly, studies by Aseres and Sira have shown that understanding public preferences and WTP can guide the design of sustainable funding mechanisms for protected areas [16]. These studies underscore the importance of incorporating economic valuation into conservation planning to ensure that financial resources are allocated efficiently and equitably.

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This preliminary study aims to estimate the WTP of visitors for adaptive management of KNP using CVM. By understanding the factors that influence WTP, such as income, education, and environmental awareness, this study seeks to provide insights into the economic value that visitors place on maintaining and improving the park's environmental quality. The findings will inform the development of targeted funding strategies and policy interventions to support the park's adaptive management framework. The study focuses on Labuan Bajo, the primary entry point to KNP, which attracts a diverse group of tourists from different regions and countries. The sociodemographic characteristics of these visitors, including their income levels, education, and environmental attitudes, play a crucial role in shaping their WTP. This information is essential for identifying potential funding sources and designing effective communication and engagement strategies to garner support for conservation efforts.

Adaptive management in KNP involves continuous monitoring, evaluation, and adjustment of management practices based on scientific data and stakeholder feedback [17]. It requires substantial financial resources to implement, making it imperative to explore various funding mechanisms. Visitor contributions, as indicated by their WTP, can provide a sustainable source of funding, complementing government and international support. The preliminary nature of this study allows for the identification of key trends and the establishment of a baseline for future research. It also provides an opportunity to refine the survey instruments and methodologies for broader application in subsequent studies. By leveraging the insights gained from this preliminary analysis, future research can build on these findings to develop more comprehensive and robust economic valuations of KNP's adaptive management needs.

II. Literature Review

The Contingent Valuation Method (CVM) is a widely recognized tool in environmental economics, particularly in valuing non-market goods and services such as those provided by marine protected areas (MPAs) [18], [19]. CVM involves directly asking individuals their willingness to pay (WTP) for specific environmental services or improvements, providing a monetary measure of the benefits derived from these services. This method has gained prominence in the valuation of marine protected area tourism because it helps to quantify the economic value of the environmental and ecological benefits that MPAs provide, which are often not captured by traditional market transactions. Marine protected areas are critical for conserving marine biodiversity, maintaining ecosystem services, and supporting sustainable fisheries and tourism. However, the management and conservation of MPAs often require significant financial resources [20]. Funding these efforts is a considerable challenge, particularly in regions where financial resources are limited.

The application of CVM in marine protected area tourism has been the focus of numerous studies across the globe. For example, studies conducted in the Philippines, which hosts several MPAs, have utilized CVM to estimate the WTP of respondents for the conservation of these areas [21], [22], [23]. In one such study, visitors to the Tubbataha Reefs Natural Park, a UNESCO World Heritage site [24], were surveyed to determine their WTP for conservation efforts. The findings revealed that tourists were willing to pay significant amounts to ensure the preservation of the park's unique marine biodiversity. These funds could potentially support the management and operational costs of the park, highlighting the utility of CVM in bridging the financial gap in conservation efforts).

Moreover, CVM studies have been instrumental in policy formulation and management decisions regarding MPAs [25], [26]. By quantifying the economic value that individuals place on conservation, policymakers can make informed decisions about resource allocation and the design of funding mechanisms. For example, a study in the Galápagos Islands used CVM to assess the WTP of tourists for the conservation of the islands' marine environment [27], [28]. The results were used to inform the setting of entrance fees, ensuring that they reflected the true value that visitors place on the natural environment while also providing a sustainable source of revenue for conservation efforts.

Environmental awareness and the perceived importance of conservation are also critical determinants of WTP [29], [30]. Tourists who are more aware of environmental issues and the role of MPAs in preserving marine biodiversity are generally more willing to contribute financially to conservation efforts. This finding highlights the importance of raising awareness about the environmental benefits of MPAs as a means of increasing financial support for their management. Furthermore, the use of CVM in marine protected area tourism is not without challenges. One of the main criticisms of CVM is the potential for hypothetical bias, where respondents may overstate their WTP in a survey setting compared to what they would pay in a real-world scenario. To mitigate this, researchers have employed various techniques, such as providing detailed information about the environmental issues being valued and using follow-up questions to confirm respondents stated WTP. Additionally, the design of the survey instrument, including the wording of questions and the presentation of information, can significantly influence the results, necessitating careful attention to survey design in CVM studies [31], [32].

III. Method

A. Study Area and Population

This preliminary study was conducted in Labuan Bajo, a gateway town to the Komodo National Park in Indonesia (Figure 1). The primary focus was on visitors to the Komodo Marine Protected Area (MPA), a critical region within the park known for its rich biodiversity and significant ecological value. Labuan Bajo, located on the western tip of Flores Island, is a bustling tourist hub that attracts visitors from all over the world, primarily due to its proximity to the Komodo National Park. Komodo National Park is renowned for its unique wildlife, including the iconic Komodo dragon, as well as its pristine marine environments. The park is a UNESCO World Heritage Site and a critical area for conservation efforts in Indonesia. The MPA within the park includes

coral reefs, mangroves, and seagrass beds that support a diverse array of marine life. The influx of tourists to this area necessitates effective management strategies to balance ecological preservation with sustainable tourism.

A total of 50 respondents participated in this study, aligning with recommendations from other research that suggest a minimum sample size of 50 for preliminary studies to ensure adequate representation and reliability of results [6], [33], [34], [35]. The sociodemographic profile of the visitors, as detailed in Table 1, includes a diverse range of variables such as gender, origin, income, age, marital status, highest education, and occupation. This diversity is crucial for capturing a comprehensive understanding of the visitor demographics and their potential willingness to pay (WTP) for adaptive management initiatives in the park.

B. Survey Design

The Contingent Valuation Method (CVM) was utilized to estimate how much visitors would be willing to pay (WTP) for adaptive management efforts at Komodo National Park. This approach is particularly effective for assigning monetary value to non-market resources like environmental conservation by directly asking individuals how much they would be willing to contribute for specific benefits or improvements. The survey was carefully crafted to capture the economic value that visitors assign to maintaining and enhancing the park's environmental quality and management. To ensure thorough data collection, the survey included both structured questions, which provided quantitative data, and open-ended questions, which offered qualitative insights into visitors' perceptions and valuations of the park's conservation needs.

The survey was organized into three primary sections. The first section gathered basic demographic information about the respondents, including gender, origin, income, age, marital status, education level, and occupation. This demographic data is essential for understanding the visitors' backgrounds and how these factors may influence their willingness to pay. The second section focused on the visitors' experiences and activities in Komodo National Park, collecting information about the duration and frequency of their visits, the specific attractions they visited, and their overall experience. This information is crucial for understanding the context of their valuation and experiences in the park.

The third and most significant section sought to determine respondents' willingness to pay for adaptive management initiatives. A hypothetical scenario was presented, outlining the current challenges faced by Komodo National Park, including environmental degradation, climate change impacts, and the need for improved management practices. Respondents were then asked if they would be willing to contribute to a proposed adaptive management fund to address these challenges. The willingness to pay question was presented in an open-ended format, allowing respondents to specify the maximum amount they would be willing to pay without being constrained by predefined categories or ranges.

Data collection was carried out in person by trained enumerators at strategic locations in Labuan Bajo, including the entrance to Komodo National Park, popular tourist sites, and accommodation facilities. This method ensured a diverse and representative sample of visitors. The collected data were subsequently analyzed using descriptive statistics to summarize the demographic characteristics of the respondents and their willingness to pay. Additionally, regression analysis was performed to identify the factors that influence willingness to pay, such as income, education level, and frequency of visits. The mean and median willingness to pay values were calculated to estimate the economic value that visitors place on adaptive management efforts at Komodo National Park.

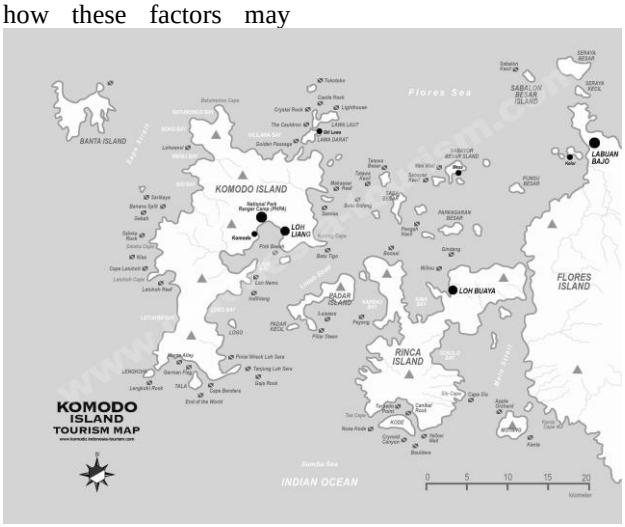

Figure. 1. Study location [36]

C. Data Analysis

The collected data were analyzed using descriptive statistics and a binary logistic regression model to assess the factors influencing visitors' willingness to pay (WTP) for adaptive management of Komodo National Park. Descriptive statistics were used to summarize the sociodemographic characteristics of the respondents and their stated WTP. This provided an overview of the demographic profile of the visitors, including variables

such as gender, origin, income, age, marital status, highest education level, and occupation.

To further understand the determinants of WTP, a binary logistic regression model was employed. In this model, the dependent variable was binary, indicating whether a respondent was willing to pay (1) or not willing to pay (0) for the adaptive management initiatives. The independent variables included income, education level, frequency of visits, gender, age, and marital status. The binary regression model helped to identify the likelihood of a respondent's willingness to pay based on their sociodemographic characteristics. The regression coefficients indicated the strength and direction of the relationship between each independent variable and the probability of WTP. A positive coefficient suggested that an increase in the independent variable increased the probability of WTP, while a negative coefficient indicated the opposite.

The mean and median WTP values were calculated to provide an estimate of the economic value that visitors place on the adaptive management of Komodo National Park. The mean WTP represents the average amount visitors are willing to pay, while the median WTP indicates the central tendency of the distribution.

The binary regression analysis revealed significant factors influencing WTP. Higher income levels and more frequent visits were positively associated with a greater likelihood of WTP. Education level also played a significant role, with higher educational attainment correlating with increased WTP. Gender and age showed varying impacts, with some demographic groups demonstrating a higher propensity to support conservation efforts financially.

IV. Results and Discussion

A. Respondent

Table 1 presents the sociodemographic characteristics of the visitors who participated in the preliminary study at Komodo National Park. The survey included 50 respondents, providing a comprehensive overview of their background. The table details various variables such as gender, origin, income, age, marital status, highest education level, and occupation. In terms of gender, the sample was fairly balanced with 48.3% female and 51.7% male respondents. The majority of visitors originated from Java Island and its surrounding areas, comprising 63.8% of the sample, followed by a notable 15.5% from the Nusa Tenggara Islands. There was also representation from other Indonesian regions, including Sumatra, Kalimantan, Sulawesi, and Bali, as well as international visitors accounting for 8.6%. Income distribution among respondents varied, with 46.6% earning more than IDR 6,300,000 monthly, while smaller proportions fell into lower income brackets.

TABLE 1.
SOCIODEMOGRAPHIC OF VISITOR

Variable	Number	%
Gender		
Female	28	48.3
Male	30	51.7
Origin		
Java Island and surrounding areas	37	63.8
Sumatra Island and surrounding areas	4	6.9
Kalimantan Island	1	1.7
Sulawesi Island and surrounding areas	1	1.7
Bali Island	1	1.7
Nusa Tenggara Islands and surrounding areas	9	15.5
International	5	8.6
Income (monthly)		
< IDR 2,100,000	6	10.3
IDR 2,100,001 – IDR 4,200,000	5	8.6
IDR 4,200,001 – IDR 6,300,000	20	34.5
> IDR 6,300,000	27	46.6
Age		
18 – 30 years	38	65.5
31 – 40 years	9	15.5
41 – 50 years	5	8.6
> 50 years	6	10.3
Marital Status		
Single	36	62.1
Married	22	37.9
Highest Education		
High School	10	17.2
Associate/bachelor’s degree	42	72.4
Master's Degree	6	10.3
Occupation		
Student	6	10.3
Government/Private Employee	8	13.8
Entrepreneur	6	10.3
Private Sector Employee	23	39.7
Housewife	1	1.7
Profession (Doctor, Lawyer, etc.)	2	3.4
Others	12	20.7

The age range of the visitors indicated a predominantly young demographic, with 65.5% aged between 18 to 30 years. Marital status showed that 62.1% of the respondents were single, whereas 37.9% were married. Regarding education, a significant majority of 72.4% held an associate or bachelor's degree, with 17.2% having completed high school, and 10.3% possessing a master's degree. The occupations of the visitors were diverse, with the largest group being private sector employees at 39.7%, followed by various other professional and non-professional roles.

B. Contingent Valuation

Figure 2 illustrates the distribution of respondents' bids for their willingness to pay (WTP) for adaptive management of Komodo National Park, presented in a Pareto chart and accompanied by a regression curve. The x-axis represents the bid ranges, while the y-axis shows the total number of respondents for each bid range. The chart reveals that the majority of respondents, approximately 50, were willing to pay up to IDR 1,000,000. As the bid amounts increase, the number of respondents willing to pay decreases sharply. For instance, there were significantly fewer respondents willing to pay between IDR 1,000,001 and IDR 2,000,000, and even fewer in the higher bid ranges of IDR 2,000,001 to IDR 3,000,000 and IDR 3,000,001 to IDR 4,000,000.

The regression curve fitted to the data, represented by the equation $y=114.04e^{-1.34x}$ with an R^2 value of 0.9752, indicates a strong negative exponential relationship between the bid amounts and the number of respondents willing to pay those amounts. This high R value suggests that the regression model explains a substantial proportion of the variance in the data, demonstrating a clear trend where higher bid amounts correspond to fewer willing respondents. The negative exponential relationship observed in the regression suggests an application of the economic law of diminishing marginal utility. This law posits that as the quantity of a good, consumed increases, the additional satisfaction (utility) gained from consuming each additional unit decreases. In the context of this study, it implies that as the bid amount for adaptive management increases, the additional utility or value perceived by the respondents decreases, resulting in fewer respondents willing to pay the higher amounts. This economic principle underscores the importance of setting realistic and acceptable bid amounts for funding conservation efforts. By understanding the diminishing willingness to pay at higher amounts, policymakers and park managers can design more effective and widely acceptable funding strategies that align with the visitors' economic valuations and perceptions of utility.

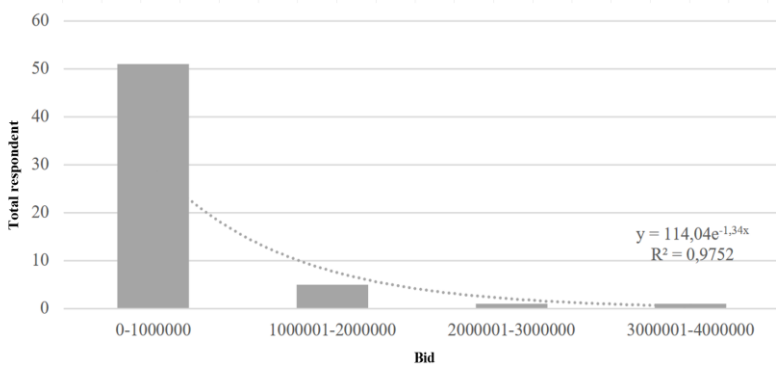

Figure 2. Pareto and regression model for WTP

Table 3 presents the coding used for the binary logistic regression model, detailing how the variables were parameterized for analysis. Income levels were categorized into four groups: less than IDR 2,100,000, between IDR 2,100,001 and IDR 4,200,000, between IDR 4,200,001 and IDR 6,300,000, and greater than IDR 6,300,000. Each category was assigned a specific binary code for inclusion in the regression model. For instance, respondents with an income of less than IDR 2,100,000 were coded as 1 1 0, while those with an income greater than IDR 6,300,000 were coded as 0 1 0. Marital status was divided into two categories: married and single. Married respondents were coded as 1, while single respondents were coded as 0. Similarly, gender was categorized into male and female, with males coded as 1 and females as 0. This coding scheme is essential for the binary logistic regression model as it transforms categorical data into a format suitable for statistical analysis, allowing the model to estimate the influence of these variables on the respondents' willingness to pay for adaptive management of Komodo National Park.

TABLE 2.
CODING FOR BINARY LOGISTIC MODEL

Variables		N	Parameter coding		
			1	1	1
Income (monthly)	< IDR 2,100,000	6	1	0	0
	> IDR 6,300,000	27	0	1	0
	IDR 2,100,001 – IDR 4,200,000	5	0	0	1
	IDR 4,200,001 – IDR 6,300,000	20	0	0	0
Marital Status	Married	22	1		
	Single	36	0		
Gender	Male	30	1		
	Female	28	0		

Table 4 displays the results of the binary logistic regression model analyzing the factors influencing visitors' WTP for adaptive management of Komodo National Park. The regression model incorporates various income categories, gender, and marital status as predictors. Model properties indicate a -2 Log likelihood of 59.319, Cox & Snell R Square of 0.301, and Nagelkerke R Square of 0.403, demonstrating the model explains a substantial portion of the variance in WTP. The overall percentage correctly predicted by the model was 77.6%, indicating a good fit. For income, respondents earning less than IDR 2,100,000 had a coefficient (B) of -0.046 with a standard error of 1.143, indicating no significant effect on WTP (p = 0.968). In contrast, respondents earning more than IDR 6,300,000 had a positive coefficient of 1.469 with a standard error of 0.692, showing a significant positive effect on WTP (p = 0.034) and an odds ratio (Exp(B)) of 4.345, suggesting these respondents are over four times more likely to be willing to pay. For the income category IDR 2,100,001 to IDR 4,200,000, the coefficient was -20.543 with an extremely large standard error, resulting in a non-significant effect on WTP (p = 0.999). This category appears to be an outlier and may require further investigation.

Gender showed a positive effect on WTP, with males (coded as 1) having a coefficient of 1.385 and a standard error of 0.790. The effect was near the threshold of significance (p = 0.080), with an odds ratio of 3.994, indicating males are nearly four times more likely to be willing to pay compared to females. Marital status also significantly influenced WTP, with married respondents (coded as 1) having a coefficient of -1.860 and a standard error of 0.780, indicating a significant negative effect on WTP (p = 0.017). The odds ratio of 0.156 suggests that married respondents are less likely to be willing to pay.

TABLE 3.
MODEL BINARY FOR WILLINGNESS TO PAY

Variables in the Equation	B	S.E.	Wald	df	Sig.	Exp(B)
Income (per month)			5.233	3	0.155	
Income (per month) (1 for < IDR 2,100,000)	-0.046	1.143	0.002	1	0.968	0.955
Income (per month) (1 for > IDR 6,300,000)	1.469	0.692	4.501	1	0.034	4.345
Income (per month) (1 for IDR 2,100,001 – IDR 4,200,000)	-20.543	16695.474	0.000	1	0.999	0.000
Gender (1 for male)	1.385	0.790	3.072	1	0.080	3.994
Marital Status (1 for married)	-1.860	0.780	5.688	1	0.017	0.156
Constant	-0.758	0.592	1.640	1	0.200	0.468
Model Properties						
-2 Log likelihood			59.319			
Cox & Snell R Square			0.301			
Nagelkerke R Square			0.403			
Overall Percentage			77.6			

C. Discussion and Future Studies

The findings from this preliminary study provide significant insights into the factors influencing visitors' WTP for the adaptive management of Komodo National Park. The use of binary logistic regression has highlighted the critical sociodemographic determinants, including income, gender, and marital status, that affect WTP. One of the most salient findings is the strong positive effect of higher income on WTP. Respondents earning more than IDR 6,300,000 per month are significantly more likely to be willing to pay for adaptive management initiatives, as evidenced by the positive coefficient and the high odds ratio. This result aligns with economic theories suggesting that individuals with higher disposable incomes are more likely to contribute to non-essential expenditures [33], [37], [38], [39], such as environmental conservation. Conversely, the lack of significant effect in other income categories, particularly the anomalous results for the IDR 2,100,001 to IDR 4,200,000 group, indicates potential issues in data reliability or the need for larger sample sizes to capture variability more accurately.

Gender differences also play a crucial role in determining WTP, with males showing a higher propensity to pay compared to females. This finding is consistent with some studies in environmental economics that have noted gender differences in environmental concern and behavior, often influenced by social and cultural norms [40], [41]. However, it contrasts with other studies where females have shown higher environmental concern and WTP [42]. The near-threshold significance suggests that this factor should be examined further with a larger sample to confirm its robustness. Marital status emerged as a significant negative predictor of WTP, with married respondents less likely to be willing to pay for adaptive management.

The overall model fit, with a Nagelkerke R Square of 0.403, indicates that the logistic regression model explains a substantial portion of the variance in WTP, suggesting that the identified sociodemographic factors are important determinants. However, the model also leaves a considerable portion unexplained, indicating the presence of other influential factors not captured in this study. These could include personal values, environmental awareness, previous experiences with conservation efforts, or perceptions of the park's management effectiveness.

Building on the insights from this preliminary study, future research should aim to address several key areas to enhance understanding and inform policy and management strategies for Komodo National Park. Firstly, expanding the sample size beyond 50 respondents is crucial to improve the reliability and generalizability of the findings. A larger sample would help to validate the observed trends and allow for more

nuanced analysis, particularly in understanding the anomalous results within specific income categories.

Future studies should incorporate additional variables that may influence WTP. These could include environmental attitudes, knowledge about conservation issues, satisfaction with park management, and the perceived benefits of adaptive management measures. Including such variables would provide a more comprehensive model of WTP determinants and help identify leverage points for increasing public support for conservation efforts. Longitudinal studies could offer valuable insights into how WTP evolves over time, particularly in response to changes in economic conditions, environmental policies, or personal experiences. Longitudinal data would help to understand the stability of WTP and the factors that may influence its change, thereby informing adaptive management strategies that can sustain financial support from visitors [43], [44].

Additionally, comparative studies involving other national parks or MPAs in Indonesia and other countries could contextualize the findings within a broader framework. Understanding how participation for conservation efforts varies across different contexts can highlight unique challenges and opportunities, facilitating the transfer of successful strategies and best practices [45]. Engaging in qualitative research, such as in-depth interviews or focus groups, could complement quantitative findings by exploring the underlying reasons behind visitors' willingness or unwillingness to pay. Qualitative insights can reveal personal motivations, concerns, and suggestions for improving conservation efforts, providing richer context and actionable recommendations for park managers. Exploring the impact of educational campaigns and awareness programs on WTP would be beneficial. Assessing how information dissemination and public engagement initiatives influence visitors' valuation of conservation efforts can guide the development of effective communication strategies to boost financial support for adaptive management (Jacobson, 2009).

V. Conclusion

This preliminary study provides valuable insights into the factors influencing visitors' willingness to pay (WTP) for the adaptive management of Komodo National Park. The binary logistic regression analysis revealed that higher income levels and gender significantly influence WTP, with higher income individuals and males being more likely to contribute financially. Additionally, marital status showed a negative association with WTP, suggesting that married individuals may have financial constraints that reduce their ability to pay for conservation efforts. The study highlights the importance of understanding the sociodemographic characteristics of visitors to design effective funding strategies for conservation initiatives. The strong positive effect of higher income on WTP underscores the need to target wealthier individuals for fundraising efforts, while the observed gender differences suggest that tailored communication strategies could be beneficial in increasing contributions from both males and females. The negative impact of marital status on WTP indicates that conservation funding strategies might need to consider the financial burdens faced by married individuals.

These findings contribute to the growing body of literature on environmental economics and the valuation of non-market resources. They underscore the necessity for comprehensive and targeted approaches to mobilize financial support for conservation. Expanding the sample size and incorporating additional variables in future studies will provide a more nuanced understanding of the factors influencing WTP and enhance the generalizability of the results.

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