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Potential Risks to the Environmental Sustainability of Ecotourism: A Visitor Satisfaction Perspective at Labuhan Mangrove Park

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Abstract
Ecotourism serves as a strategic approach to environmental conservation while simultaneously enhancing public awareness of sustainability. The Labuhan Mangrove Ecotourism Park in Bangkalan Regency represents a destination that integrates both educational and conservation values through the protection of its mangrove ecosystem. Tourist visitation data from 2022 to 2024 indicate a fluctuating yet stagnant trend. This condition raises concerns, considering that the destination possesses a strong ecological advantage in the form of a well-preserved mangrove ecosystem. The stagnation in visitor numbers not only reflects a possible gap between the available ecological attractions and the level of visitor satisfaction but also signals the potential emergence of environmental risks. This study aims to analyze the potential environmental risks affecting the sustainability of the ecotourism environment. The analytical method utilizes the Customer Satisfaction Index (CSI) to assess visitor satisfaction regarding environmental sustainability, complemented by a Gap Analysis to identify potential disparities that may contribute to environmental risks. The evaluated aspects include mangrove protection, biodiversity conservation, water clarity, and shoreline protection. The findings reveal that the mangrove protection aspect received the highest importance and satisfaction scores, whereas shoreline protection received the lowest scores. The overall CSI value reached 76.44%, indicating a very high level of visitor satisfaction. However, the most significant gaps identified in the analysis—particularly in shoreline and mangrove protection—serve as early indicators of potential environmental risks. These results demonstrate that the sustainability aspects of the destination have not yet fully aligned with visitors' expectations and present potential environmental risks. Therefore, improvements in infrastructure, environmental education programs, and public communication strategies are recommended to strengthen long-term environmental sustainability. This study makes an important contribution to the development of visitor experience–based environmental risk management strategies. It serves as a reference for destination managers and stakeholders in designing more sustainable and adaptive ecotourism initiatives in response to ongoing environmental challenges.

Keyword: Customer Satisfaction Index, Ecotourism, Satisfaction, Mangrove, Environment Risk

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1. INTRODUCTION

Sustainable tourism has become a central paradigm in global development, emphasizing a balance between economic, social, and environmental benefits to ensure the long-term viability of tourism destinations and the well-being of local communities(Giambona et al., 2024). This concept highlights tourism activities that are not only oriented toward increasing visitor numbers and revenue, but also toward conserving natural resources, empowering local communities, and ensuring long-term benefits. Ecotourism represents a concrete approach to achieving sustainable tourism by integrating responsible recreational activities with environmental education and conservation, focusing on minimizing negative impacts while generating benefits for both conservation and local communities through active stakeholder involvement in tourism management (Al Fajar et al., 2024; Kissinger et al., 2021; Zainal et al., 2024). The sustainability of nature-based tourism is dynamic and varies across development stages, from consolidation and growth to community engagement and multi-stakeholder collaboration involving government institutions and tourism industry actors (Kissinger et al., 2021; Lee & Jan, 2019; Li et al., 2024; Zhang & Deng, 2024). This perspective emphasizes that the primary goal of ecotourism is to strengthen environmental awareness, enhance visitors' understanding of the importance of nature conservation, and involve local communities in tourism management to improve economic well-being.

Mangroves are one of the coastal ecosystems that exhibit high levels of productivity and multidimensional functions, encompassing biological, ecological, physical, social, and economic aspects (Permana & Andhikawati, 2023). Mangrove ecotourism has the potential to be developed as an educational tourism facility that focuses on shaping human behavior to preserve the environment (Wahyuningsih, 2021). Mangrove ecotourism has the potential to be developed as an educational tourism facility that focuses on shaping human behavior in an effort to preserve the environment. The benefits of mangrove forests reduce the risk of waves, abrasion, and seawater intrusion, so that their existence not only plays a role as a support for the environmental balance, but also makes a real contribution to the welfare of coastal communities through the provision of natural resources and sustainable ecosystem services (Hartati et al., 2021; Nuranisa & Mulyanie, 2024; Utomo et al., 2024). Mangrove forests not only serve as natural fortresses that protect the coast, but also as a living space rich in meaning for humans. This proves that mangrove ecotourism not only provides recreational experiences but also educational facilities that encourage the formation of ecological awareness from an early age.

Labuhan Mangrove Park Ecotourism plays a crucial role in conserving the coastal ecosystem in Bangkalan Regency. This destination serves not only as a natural tourist attraction but also as a learning center for various groups, including students, researchers, and the general public who wish to learn more about the mangrove ecosystem. The educational programs offered, such as mangrove tours, tree planting activities, and discussions on the ecological benefits of mangroves, help visitors understand the vital role of mangrove forests in preventing erosion, providing habitat for animals, and sequestering carbon.

Data on tourist visits in the 2022–2024 period show a fluctuation in the tendency to stagnate (Badan Pusat Statistik, 2021, 2022, 2023, 2024, 2025). The stagnation in tourist visits to the Labuhan Village Mangrove Park suggests a mismatch between the quality of the ecological attractions and visitor satisfaction levels. This condition not only reflects a gap in the tourism experience but also signals potential environmental risks that can threaten the sustainability of ecotourism. The connection between environmental factors and risk is one of the important determinants in visitor preferences towards tourist destinations (Hayati & Purwoko, 2024).

The role of ecotourism also plays a significant role in shaping visitors' perceptions and satisfaction with sustainability. Consumer satisfaction can be understood as an evaluative response that arises when an individual compares their initial expectations with the actual performance of a product or

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service. The level of satisfaction will be achieved if the perceived performance is appropriate or even exceeds expectations, while dissatisfaction arises when the performance received is below expectations (Kotler, 2000). Consumer satisfaction represents the extent to which the experience meets the previously established subjective standards, making it an important indicator for assessing the quality of service and the success of a tourist destination.

The Customer Satisfaction Index (CSI) approach is used to analyze the level of visitor satisfaction with environmental sustainability aspects in mangrove ecotourism destinations. This approach measures satisfaction quantitatively by assessing the fit between visitors' expectations and the perceived performance of service attributes that are considered important to them. The smaller the difference between the two values, the higher the level of visitor satisfaction with the destination (Subramanian et al., 2014; Tao, 2014). The CSI method enables the description of the overall level of satisfaction and the relative contribution of each attribute to total satisfaction. The attributes measured include environmental sustainability dimensions such as the protection of mangrove plants, biodiversity conservation, water clarity, and coastal protection.

These four leading indicators serve as important benchmarks for assessing environmental sustainability in coastal ecotourism areas. The importance of protecting mangrove plants lies in their function as a natural barrier against abrasion and ocean waves, thereby maintaining the area optimally and increasing biodiversity and resilience to climate change (Dabalà et al., 2023; International Coral Reef Initiative, 2021). Mangrove ecosystems are an effective nature-based solution in reducing the impact of abrasion and maintaining the balance of the coastline (Lovelock et al., 2024). The clarity and quality of the waters reflect the health of the coastal ecosystem. Increased tourism activities, without sustainable management, can degrade water quality and accelerate the degradation of coastal environments (Kurniawan et al., 2023; Merlotto et al., 2025).

Visitors who see and experience genuine conservation efforts, such as mangrove rehabilitation or shoreline protection, tend to have a positive perception and feel more satisfied with their visit (Santiago et al., 2024). This is because tourists can feel that the activity has a positive impact on the environment, which increases the overall value of the experience. Visitors' perceptions of ecotourism and environmental sustainability play a crucial role in the success of ecotourism. This perception is influenced by a variety of factors, including the educational information provided, the facilities available, and the environmental impact felt during the visit (Angessa et al., 2022; Santiago et al., 2024). Visitors who receive accurate information about the importance of mangrove ecosystems and the ecological impact of tourism activities tend to have a more positive perception of sustainability. This positive perception is important because it can influence visitor attitudes and behaviors that are more environmentally responsible, such as maintaining cleanliness and avoiding damage to vegetation in ecotourism areas.

On the other hand, visitor satisfaction is a primary indicator for assessing the success of an ecotourism destination, particularly in the context of sustainability. Tourists who are satisfied with their natural tourism experience tend to support environmental conservation efforts and play a role in the sustainable management of the destination. The satisfaction of visitors is greatly influenced by the quality of service, natural beauty, and information provided regarding the ecological benefits of mangroves. Studies show that high satisfaction can increase visitor loyalty, which ultimately helps ecotourism destinations to gain greater public and financial support (Orden-Mejía et al., 2024; Thipsingh et al., 2022).

Weather changes, uncertain climates, and damage are among the risks that mangrove forests must face in their existence (Hindrayani et al., 2025). Human activities, such as land conversion, pollution, and the development of environmentally unfriendly tourism infrastructure, can threaten the sustainability of ecosystems. Habitat destruction and biodiversity degradation are real problems that

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have a direct impact on the ecological function of mangroves and the quality of the coastal environment. On the other hand, visitors to natural tourist destinations are now increasingly demanding experiences that are not only visually appealing but also consider environmental responsibility. Modern travelers tend to choose places that demonstrate a commitment to conservation and sustainable practices. Tourists who participate in ecotourism tend to have a higher awareness of environmental issues and become more conscious of the impact of their actions on the natural world (Negacz, 2021). Visitors are not only consumers, but also evaluators of the destination's environmental sustainability. This demand serves as an encouragement for ecotourism managers to prioritize environmental sustainability aspects as part of their efforts to enhance the quality of services and the attractiveness of destinations. The emphasis on sustainable management strategies is crucial in preventing environmental damage caused by mass tourism, particularly in vulnerable natural areas (Hall, 2019).

The gap between tourist perception and satisfaction with ecotourism is the beginning of the threat of environmental risks. Environmental values influence tourist satisfaction; therefore, satisfaction gaps that indicate negative values in environmental aspects reflect relatively low levels of satisfaction (Hanim et al., 2010; Xie et al., 2020). These environmental risks are directly related to visitor perception and satisfaction. Tourists tend to give a positive assessment of destinations that can maintain cleanliness, manage waste responsibly, preserve sensitive ecosystems, and comply with environmental carrying capacity limits (Santiago et al., 2024). It is also influenced by other factors such as education level and environmental awareness. Mondino & Beery (2019) Explains that the lack of environmental education can lead to negative perceptions of ecotourism, despite the formation of collaboration between stakeholders. Gap-based approaches can be analyzed through Gap Analysis to identify differences between respondents' expectations and perceptions. Gap Analysis is considered an effective method for assessing and improving service quality by understanding the difference between customer expectations and perceptions (Fontenot et al., 2005; Lin et al., 2009; Taplin, 2012). The results of this analysis can be the basis for quality improvement recommendations. This study advances ecotourism sustainability research by positioning visitor satisfaction gaps not merely as indicators of service quality, but as early warning signals of environmental risk. A visitor-experience–based risk detection framework is developed through the integration of the Customer Satisfaction Index (CSI) and Gap Analysis to assess the sustainability of mangrove ecotourism in ecologically vulnerable coastal areas.

This phenomenon is important to pay attention to because mangrove based ecotourism is highly dependent on the condition of the ecosystem, which must be maintained and function optimally. The decline in environmental quality will have a direct impact on tourists' experience and perception of destinations. Environmental risks that have the potential to arise include degradation of mangrove ecosystems, decline in biodiversity, deterioration of water quality, and weakening of the coastlines' natural buffering function(Hutasuhut et al., 2025). This risk not only reduces the ecological value of mangroves, but also has implications for decreasing tourist attractions and potentially worsening visitor satisfaction.

Studies on the sustainability of Labuhan Mangrove Ecotourism have so far focused more on conservation and community empowerment aspects. In contrast, environmental risk analysis based on the visitor satisfaction gap has not been widely studied. This research offers a sustainability perspective that combines satisfaction assessments with the identification of potential environmental risks. The purpose of this study is to measure the level of visitor satisfaction and identify the value gap as an early indicator of risks to environmental sustainability aspects, including the condition of mangrove ecosystems, biodiversity, water quality, and shoreline protection functions. This research is directed to identify the implications of environmental risks that have the potential to affect the sustainability of Mangrove Park Ecotourism in Labuhan Village, Bangkalan Regency. This research

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aims to formulate strategic recommendations for ecotourism management that not only focus on increasing visitor satisfaction but also emphasize the importance of environmental risk mitigation as a foundation for the sustainability of tourist destinations.

2. RESEARCH METHODS

The research was conducted in the Mangrove Park, Labuhan Village, Sepulu District, which is one of the mangrove-based ecotourism destinations with an important role in environmental conservation as well as a natural tourism attraction. The data population consists of tourist visitors, with a sample determined using the Accidental Sampling technique, based on the criteria of active visitors, and a total of 100 respondents. Accidental sampling was employed due to the absence of a defined sampling frame and the dynamic, non-scheduled nature of visitor arrivals. Tourists visit the destination randomly and cannot be predicted in advance, making probability-based sampling impractical. This technique is commonly used to capture the perceptions of active visitors who directly experience the environmental conditions and services of the destination. Consequently, the collected data reflect tourists' actual evaluations of the environmental sustainability of the ecotourism site. The analysis method used is a descriptive quantitative approach, utilizing the Customer Satisfaction Index (CSI) and Gap Analysis. The research instrument was designed based on four key indicators of environmental sustainability: the protection of mangrove plants, biodiversity, water clarity, and shoreline protection.

A sample size of 100 respondents was considered adequate because the Customer Satisfaction Index (CSI) and Gap Analysis are descriptive, index-based approaches aimed at producing stable mean values and perceptual weights, rather than inferential statistical estimates that require large samples. The research instrument was developed based on the main dimensions of environmental sustainability in mangrove ecotourism studies, including mangrove protection, biodiversity conservation, water clarity, and shoreline protection, which were adapted from the literature and contextualized to the specific characteristics of the Labuhan Mangrove Ecotourism Park. Although CSI and Gap Analysis are applied as aggregate perception indices, each questionnaire item was constructed consistently within the same conceptual framework, enabling reliable measurement of visitor satisfaction and perception gaps.

The measurement of the Customer Satisfaction Index (CSI) method is used to determine the overall level of visitor satisfaction by using an approach that considers the level of importance of each service quality attribute measured (Prihadi et al., 2021). The scale used ranges from one to four (very dissatisfied/important to very satisfied/important). The analysis stages include calculating the average interest and satisfaction score, determining the weight factor, assigning the weight score, and calculating the overall CSI index value. Calculation in the CSI method by determining the following values: (1)Calculating the Mean Importance Score (MIS) value is the value obtained from the average value of the interests of each customer ; (2)Determining the value of Weight Factors (WF) is the value obtained is the percentage of the MIS value per attribute to the total value of MIS of all attributes ; (3)Determining the Weight Score value (WS) is this value obtained by multiplying the WF value and the average value of customer satisfaction level ; (4)Determining the Total Weight (WT) value ; (5)Determining the Customer Satisfaction Index (CSI) value. The CSI value is then interpreted within the context of the satisfaction level, which has been established to determine the extent to which ecotourism management meets visitor expectations.

The Gap Analysis approach is used to examine the gap between the value of interest and satisfaction as an early indicator of potential environmental risks the difference between performance value and interest level. A comparison was made against the zero reference value as a benchmark for the balance between expectations and performance realization. If the value of the gap is positive, it

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indicates that the performance has exceeded the expected level of importance and can therefore be categorized as satisfactory. Conversely, a negative gap value indicates that performance has not met the expected level of importance, thus requiring intervention or managerial attention to improve service quality (Taplin, 2012). This identification is used to understand the implications of the sustainability of mangrove ecotourism, particularly in aspects that are of high importance but low satisfaction. This method not only assesses existing conditions but also provides an overview of potential risks that can threaten the sustainability of mangrove ecosystems as well as tourist experiences.

3. RESULTS AND DISCUSSION

Labuhan Mangrove Park is an educational ecotourism area located in Labuhan Village, Sepulu District, Bangkalan Regency, East Java. This area is one of the leading destinations on the north coast of Madura, combining ecosystem conservation, environmental education, and community empowerment along the coast. Geographically, this location is about 30 kilometers from the center of Bangkalan City. The park area is 0.39 km² (approximately 55% of the sub district area), with a coastal mangrove forest coverage of 130,038.62 m². This destination boasts several superior values, reflected in its wealth of attractions and facilities, including a panoramic view of the white sandy coast, a mangrove forest ecosystem, floating houses, and a distinctive grooved wooden bridge that is a regional icon. The facility also features coral reef dioramas as educational media, wooden halls, seating facilities, and camping areas, as well as small and large boat fleets, homestay services, and educational and training activity packages, including mangrove planting programs. Visitors to the Mangrove Park are primarily groups of students, as well as institutions conducting research, comparative studies, and training.

The Mangrove Park Manager is a local organization, namely the “Payung Kuning” Tourism Awareness Group. This organization was established and inaugurated by the Bangkalan Regency Culture and Tourism Office in 2019 with 30 members of the local village community. The role of this group is responsible for planning, implementing, and maintaining all conservation, education, and tourism activities. The institutional structure of management is simple yet functional, consisting of Trustees, Advisors, Chairman, Vice Chairman, Secretary, and Treasurer. The core manager is also assisted by several sections, including Public Relations and Marketing, Security and Parking, Culinary/Home Industry, Homestay, Transportation and Tour Guides, Tourist Attractions, and Souvenir Crafts. All members of “Payung Kuning” Tourism Awareness Group work together in various functions, including Drivers, Promoters, planners, developers, Preservation and Conservation, Education and Training, as well as partnerships and promotions. This step aims to achieve a more effective and efficient management of Mangrove Park tourism, ensuring a positive impact on visitor experience and satisfaction.

Visitor Satisfaction with Environmental Sustainability

Visitor satisfaction with the sustainability aspect of the destination environment is evident in the results of the Customer Satisfaction Index (CSI). The research on the environmental sustainability dimension in the Labuhan Mangrove Park ecotourism area yielded a CSI value of 76.44%, which falls within the "Very Satisfied" category. This shows that, in general, visitors have a high level of satisfaction with the environmental sustainability aspects managed by ecotourism managers. This value also reflects that the implementation of conservation and environmental protection programs has been effective and in accordance with visitor expectations. Environmental managers in the Labuhan Mangrove Park ecotourism area are effective in creating a balance between conservation functions and tourist attractions. This achievement indicates that most visitors consider environmental management to be able to meet their expectations for the sustainability of the

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destination. These results also reinforce the view that the success of ecotourism depends not only on natural attractions but also on the extent to which managers can maintain ecosystem sustainability through consistent and educational conservation practices.

The aspect of mangrove plant protection showed the highest achievement in the analysis of visitor satisfaction, with an average value of 3.16 and a weight factor of 25.76%. The "Very Satisfied" value reflects the empirical experience of tourists in the ecotourism area, particularly in relation to their perception of the effectiveness of mangrove vegetation management as part of environmental conservation and sustainability efforts. The value of the weight factor in this indicator indicates that visitors prioritize the protection aspect of mangrove plants the most, compared to other indicators. This suggests that the existence and management of mangrove vegetation are primary factors in shaping overall environmental satisfaction. A weight score value of 0.814 indicates a significant actual contribution of this indicator to the total satisfaction index (CSI). The higher the weight score, the greater the attribute's influence on the aggregate satisfaction of visitors. These results confirm that mangrove protection plays a dominant role in determining the level of environmental satisfaction and is a top priority in the management of sustainable ecotourism in the Labuhan Mangrove Park. Visitors assessed that the mangrove vegetation conservation efforts in the area have been well-managed. The high satisfaction value in the mangrove plant protection indicator confirms the importance of mangrove vegetation as a symbol of the success of coastal conservation. Regular mangrove planting programs, mangrove adoption activities by tourists, and the involvement of local communities in maintaining the area are key factors that contribute to a positive perception among visitors.

The high level of visitor satisfaction with mangrove protection indicates that mangroves are perceived as a core ecological component of the Labuhan Mangrove Park. Mangrove vegetation is not merely viewed as a landscape feature, but as a natural coastal buffer that maintains ecosystem stability and supports the sustainability of ecotourism. However, the presence of a gap between perceived importance and satisfaction suggests the existence of ecological pressure that is not yet fully apparent. Although conservation efforts are evaluated positively, visitors' expectations regarding the quality and extent of mangrove protection remain higher than the conditions they observe in the field. This implies that current mangrove management capacity may not yet be sufficient to keep pace with the increasing pressures associated with tourism activities.

The water clarity indicator obtained a satisfaction score of 3.05. The value of satisfaction describes the direct experience of tourists in the field. The results showed "Very Satisfied", especially in assessing the condition of the waters in the ecotourism area of the Labuhan Mangrove Park. The positive perception of water clarity indicates that visitors believe the quality of the aquatic environment has been well managed. However, there is still room for improvement in terms of cleanliness and supervision of water tourism activities. The weight factor value of 24.78% indicates that the cleanliness and clarity of the waters are included in the third main priority. The visual and ecological aspects of water clarity have a psychological impact on comfort, aesthetic impressions, and the overall perception of environmental quality. A weight score of 0.755 indicates the real contribution of this indicator to the CSI index. This value indicates that the clarity of the waters has a substantial influence on the formation of the perception of aggregate satisfaction. However, it is not as large as the indicator of mangrove protection. Water quality management, particularly in terms of cleanliness, waste control, and education on environmentally friendly behavior, needs to be continually improved so that the sustainability of ecotourism areas is maintained and visitor satisfaction levels can continue to increase. This value reflects efforts to maintain the quality of the aquatic ecosystem, as the cleanliness and water quality around the ecotourism area are relatively good; however, there is potential for improvement in waste management and tourism activities.

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Visitor satisfaction with water clarity indicates that visual water quality and cleanliness play an important role in shaping comfort and aesthetic impressions during visits to the Labuhan Mangrove Park. Clear water is perceived as a direct indicator of a healthy and well-managed environment. High satisfaction in this dimension suggests that visitors perceive the condition of coastal waters as supportive of both recreational activities and environmental learning, thereby reinforcing the destination's image as a relatively clean and environmentally friendly coastal ecotourism site.

The biodiversity protection indicator shows a satisfaction value of 3.05. The satisfaction value describes the tourists' experience of the ecosystem conditions and species diversity in the Labuhan Mangrove Park area. Visitors assessed that efforts to preserve coastal flora and fauna, including mangrove species, waterbirds, and marine life, had been carried out effectively, providing educational and recreational experiences during the visit. The weight factor value of 24.94% indicates that biodiversity protection is the second priority in the eyes of visitors, nearly comparable to the aspect of water clarity. This position highlights that biodiversity is a crucial component in shaping the ecological value and attractiveness of ecotourism destinations. A weight score of 0.760 indicates that the success of maintaining ecosystem balance and conserving species has a direct impact on the aggregate satisfaction level. Preserved biodiversity not only enhances the quality of the tourist experience but also strengthens the image of Labuhan Mangrove Park as a conservation-oriented ecotourism destination focused on environmental education and natural resource conservation. Efforts to preserve marine and mangrove life have had a positive impact on the tourist experience. Biodiversity protection indicators play an important role in maintaining the visual and biological attractiveness of ecotourism areas.

Visitor satisfaction with shoreline protection is relatively lower than for other environmental sustainability indicators, suggesting that this dimension is perceived as the most sensitive element of the ecotourism experience at the Labuhan Mangrove Park. The shoreline plays a critical role in shaping visitors' visual impressions, sense of safety, and overall comfort during coastal activities. Lower satisfaction in this dimension indicates that visitors perceive limitations in the quality of coastal protection, including erosion control, beach cleanliness, and the organization of coastal spaces. Although the destination is generally viewed as attractive and enjoyable, the coastal zone has not yet fully met visitor expectations regarding environmental quality and management standards.

The coastline protection indicator obtained an average satisfaction score of 2.98, the lowest among all indicators. Lower satisfaction scores still indicate that visitors are feeling "Satisfied". This figure shows that, although visitors assess the area as still being in good condition, there is a perception that the physical management of the coast is not entirely optimal. A weight factor value of 24.52% indicates that visitors consider shoreline protection an important aspect in assessing environmental sustainability. However, the attention given to this aspect is not proportional to the level of satisfaction obtained. A weight score of 0.730 indicates that, although its contribution to CSI is quite significant, this indicator has the least influence among other aspects. These results indicate that although the condition of the coastline is still in the good category, visitors assess the need for improvement in terms of arrangement and maintenance of coastal areas, such as abrasion control, cleanliness of the coastal area, and supporting facilities for environmentally friendly tourism activities. Findings on the aspect of shoreline protection reveal potential areas that need attention. There are limitations in the management of coastal areas, both in terms of cleanliness, security, and the provision of supporting facilities.

The achievement of the Mangrove Park environmental sustainability satisfaction category, which received an excellent response, was the result of coordination between the managers. The "Payung Kuning" Tourism Awareness Group applies the principle of "Tourism Awareness" and the values of "Sapta Pesona" to regional governance. "Payung Kuning" plays a role as a driver and agent of local community empowerment by carrying out cooperation activities to maintain the area's cleanliness,

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managing tourism facilities independently, and developing micro businesses based on local tourism potential. The educational role also encompasses counseling on the importance of mangrove ecosystems and the implementation of environmentally education based tourism. The conservation function is achieved through regular mangrove planting activities, coastal area cleanups, and the supervision of tourism activities to ensure alignment with the principles of ecosystem sustainability. Strategic partnerships are established with local governments, village owned enterprises, universities, and the private sector to enhance institutional capacity, develop entrepreneurial skills, and expand destination promotion networks. Efforts to promote and develop tourism potential are carried out through the use of social media such as Instagram. The function of supervision and governance of the area is consistently implemented to ensure the comfort and safety of visitors. Supervision focuses on managing waste disposal, controlling tourist activities, and utilizing conservation areas in accordance with applicable regulations. The overall role of The “Payung Kuning” Tourism Awareness Group contributes significantly to maintaining a balance between the economic interests of tourism and the ecological sustainability of coastal areas.

These results reinforce the theory that visitor satisfaction levels are formed from the correspondence between expectations for environmental sustainability and the actual performance of tourist area management. If environmental management, mangrove conservation, and the provision of educational facilities can meet or exceed visitor expectations, the level of satisfaction will increase significantly. This condition not only reflects the success of destination management but also has implications for increasing loyalty, a positive image of the region, and the long-term sustainability of ecotourism.

Potential Environmental Risks of Gap Impact

The relationship between environmental sustainability indicators and satisfaction interest gaps reflects a direct correlation between physical quality and tourist perception. The existence of a gap in the value of interest and visitor satisfaction indicates the existence of potential environmental risks in the Labuhan Mangrove Park. The highest importance value was found in the protection of mangrove plants (3.57), followed by the protection of biodiversity (3.45), the clarity of waters (3.43), and the protection of coastlines (3.40). The average value of visitor interest (3.46) is higher compared to the average satisfaction score (3.05). The average gap value is at 0.41 which indicates that there are visitor expectations for environmental conditions that have not been fully met. Visitors tend to judge destinations with effective environmental sustainability to be managed responsibly and environmentally friendly. The mismatch between expectations and actual experiences reflects the potential imbalance in ecotourism management, which can have an impact on the ecological, social, and reputational aspects of the destination.

The "Shoreline Protection" indicator shows the highest gap with a value of 0.42. This value indicates that visitors place the aspect of shoreline protection as a priority for implementation that is not optimal in the field. In the context of environmental sustainability, this gap has the potential to be a risk signal in the form of shoreline degradation due to erosion and abrasion. The imbalance between the use of tourist and conservation areas causes ecological pressures that can threaten the stability of coastal ecosystems such as land constriction and loss of protective vegetation such as mangroves, making beaches increasingly vulnerable to further damage. This disturbance reduces the quality of marine life habitats, damages tourism infrastructure, and reduces the aesthetic value of the landscape.

Labuhan Mangrove Park has gradually built abrasion resistant fences along the coastline as a measure to protect coastal areas in 2023. This structure, made of limestone reinforced with iron wire, measures approximately 40 cm in height and extends along the beach's contour. Although the fence

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serves as a wave barrier to prevent land erosion, the sandy area inside the fence is maintained, allowing visitors to enjoy sand play activities and experience the beach atmosphere directly.

The gap value of 0.41 in the "Mangrove Plant Protection" indicator illustrates the difference between visitors' expectations and satisfaction with the sustainability of mangrove vegetation. This gap can reflect the lack of optimal vegetation rehabilitation activities or limited supervision of the use of mangrove areas for tourism activities. From an environmental risk management perspective, this condition has the potential to pose long-term ecological risks in the form of reduced vegetation cover and reduced carrying capacity of the ecosystem. Educational activities have been carried out periodically with routine socialization about the benefits of mangroves for village sustainability. Environmental education is strengthened through activities to introduce mangrove types to local school students and students, accompanied by training on how to identify species in the field. Information about the rules of the area is also conveyed through appeal boards installed in tourist areas.

Conservation activities are also realized through environmental rehabilitation in the form of planting sea cypress trees and mangroves regularly along two kilometers of coastline. The planting aims to prevent abrasion and maintain the stability of the coastal ecosystem. Restoration of cypress trees is carried out periodically every November as a form of continuous maintenance of coastal vegetation. Tien et al. (2024) emphasizing the importance of maintaining a balance between coastal, marine, and island ecosystems with ecosystem restoration and preservation of local culture. The Bangkalan Regency Tourism and Culture Office has consistently provided training every year since 2018 as a form of support for community capacity building in ecotourism management.

The indicator "Biodiversity Protection" has a gap value of 0.40, illustrating an imbalance in the conservation of flora and fauna. This gap can be caused by the limitation of interpretive information at tourist sites. A decrease in the quality of biodiversity can have an impact on reducing the uniqueness of the destination and reducing the overall satisfaction of the tourist experience. The biodiversity in this region consists of sea spruce, the dominance of various types of mangroves, various types of fish, one of which is gelodok, water birds such as egret and crane. There is also a coral reef and seagrass transplant program as a strategy to restore aquatic ecosystems as well as support for the sustainability of marine biological resources. This activity not only functions ecologically, but is also developed into an educational tour that provides visitors with a hands-on experience of the importance of marine conservation. The program includes planting about 80 coral reefs that function as habitats for fish and other marine life, as well as being used wisely by fishermen for sustainable fisheries activities such as squid fishing.

On the conservation side, managers have implemented a ban on the use of fishing gear that is not environmentally friendly, marked by the existence of information boards in several coastal locations. The community plays an active role in preserving mangrove forests and coral reefs as part of efforts to maintain the balance of marine ecosystems. The local community also developed the cultivation of soka crabs, the cultivation of California papaya, mango, annual fruit crops and sea cypress as productive economic activities while supporting the stability of the coastal environment.

The "water clarity indicator" shows the lowest gap value of 0.38, which illustrates that this aspect is relatively less environmental risk based on visitor perceptions. The value of the gap indicates that visitors assess that the condition of the waters in the tourist area is still in the better category compared to other indicators. Visitors assess destinations with clean and pollution-free water as well-managed areas, but on the contrary, waters that appear cloudy or polluted cause a negative perception of management effectiveness and sustainability commitment of managers. The gap that still arises even though it is relatively low indicates the potential risk of water pollution due to tourism activities, garbage disposal, or domestic waste around the area. These risks can develop into long-

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term ecological damage, such as a decline in the quality of aquatic biota habitats, eutrophication, and reduced function of coastal ecosystems as natural buffers. From an environmental risk management perspective, water clarity can be used as an early detection parameter to identify trends in ecosystem degradation before it reaches a critical stage.

Potential sources of pollution can come from tourist activities such as garbage disposal, boat movement, and household waste around coastal areas. The results of field observations strengthened the findings by showing that the water quality in the Mangrove Park tourist area in general is still relatively good, characterized by the absence of an oil layer on the water surface and no smell that interferes with tourist activities. In terms of cleanliness, garbage bin facilities have been available at a number of points, but garbage is still found scattered and floating in several areas of water, reflecting that the waste management system has not been implemented optimally. The area manager has also not implemented a separation system between organic and non organic waste, so the waste treatment process has not fully followed the principles of sustainable environmental management. Final waste disposal site facilities for toilet waste such as sanitary pads, tissues, and diapers are not yet available, and some waste is still destroyed through the open burning process. Nevertheless, the installation of notice boards regarding the obligation to dispose of waste in its place at various strategic points shows the awareness and initial commitment of managers to environmental cleanliness practices.

Labuhan Village has implemented the Climate Village Program initiated by the Ministry of Environment and Forestry as a form of commitment to mitigating climate change and strengthening environmental resilience. The actions implemented in the form of "Energy" and "Environment" programs are the installation of solar panels and mangrove conservation. In fact, tourism awareness groups has carried out activities that are oriented towards environmental sustainability but have not been maximized. In the aspect of environmental sustainability, destination managers together with tourism awareness groups have carried out various community based conservation efforts oriented towards the protection of coastal ecosystems.

The participation of the people of Labuhan Village can be seen from their direct involvement as a tourist area manager. Community-based economic activities also develop through soka crab catering businesses and mangrove processing such as coffee and mangrove urap managed by local women's groups. These activities not only support the improvement of the family economy, but also strengthen the social and ecological sustainability value of mangrove ecotourism in Labuhan Village. This is in line with Research Hidayati et al. (2023) That when nature conservation is maintained, tourist facilities are improved, local guides are empowered, and community-based rules are enforced, then ecotourism not only protects the environment, but also prospers the community.

The pattern of expectation performance gaps across the four indicators indicates that the Labuhan Mangrove Ecotourism Park is exposed to structural, ecological, and operational environmental risks. The largest gaps in shoreline and mangrove protection highlight priority risks to coastal stability and core ecosystem resilience, while gaps in biodiversity and water clarity reflect pressures on habitat quality and pollution control. These findings call for a risk-based management approach. Shoreline and mangrove protection should be prioritized through strengthened erosion-control structures, vegetation restoration, and the regulation of visitor activities in sensitive zones. Biodiversity protection requires improved habitat zoning, environmental interpretation, and enforcement, whereas water quality management should focus on waste segregation, proper disposal systems, and regular water-quality monitoring. Using visitor perception gaps as an early warning tool enables adaptive and targeted interventions to safeguard the long-term sustainability of mangrove ecotourism.

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4. CONCLUSION

Environmental sustainability at the Labuhan Mangrove Ecotourism Park is perceived by visitors as satisfactory. However, the gap between perceived importance and satisfaction indicates the presence of significant environmental risks. The most critical risks are concentrated in shoreline and mangrove protection, which function as the primary structural buffers of the coastal ecosystem. Gaps in biodiversity and water clarity reflect additional ecological and operational pressures that, if left unmanaged, may reduce the area's carrying capacity in the long term. These findings confirm that visitor satisfaction gaps can serve as an effective early warning system for detecting environmental risks in mangrove ecotourism destinations. Accordingly, destination management should adopt a risk-based approach that prioritizes strengthened shoreline protection and mangrove rehabilitation, habitat zoning and monitoring to safeguard biodiversity, and improved waste management and water-quality surveillance. Improvements in supporting infrastructure, strengthened environmental education programs, and more strategic public communication are recommended to enhance long-term environmental sustainability. The implementation of these measures will enhance ecological resilience and support the long-term sustainability of mangrove ecotourism.

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