



Baron Coastal Management Strategy in Efforts to Realize Sustainable Ecotourism-Based Coastal Management

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Abstract: Baron Beach is one of the main coastal tourist destinations in Gunungkidul Regency, which, since its early development, has functioned as a center for tourism and local fishing activities. The high intensity of tourist visits can put pressure on the coastal environment if a sustainable management system does not balance it. This study aims to formulate a sustainable ecotourism-based coastal management strategy for Baron Beach by integrating environmental conservation, local community empowerment, environmentally friendly infrastructure development, tourist education, and monitoring and evaluation, all grounded in the area's carrying capacity. The research methods included field observations, structured interviews with managers and local communities, and the distribution of questionnaires to tourists. Environmental quality analysis was conducted by measuring Total Suspended Solids (TSS), pH, Dissolved Oxygen (DO), and Biological Oxygen Demand (BOD) in accordance with APHA (2023) standards. Management strategies were formulated using SWOT analysis and prioritized using the Analytic Hierarchy Process (AHP). The results of the study indicate that the water quality of Baron Beach still meets the quality standards for

pH, DO, and BOD, but the TSS value is very high and has the potential to degrade the coastal ecosystem. The involvement of the local community in tourism activities is relatively high, but there is still a need to increase capacity and strengthen environmental education. The SWOT-AHP analysis results indicate that the Strengths-Opportunities (S-O) strategy is a top priority in the management of Baron Beach. This study emphasizes the importance of implementing ecotourism-based coastal management supported by a sustainable monitoring and evaluation system to maintain a balance between environmental conservation and community welfare.

Keywords: Baron Beach, Coastal Management, Sustainable Ecotourism, Carrying Capacity, SWOT-AHP

Introduction

Coastal areas provide ecosystem services that are ecologically, socially and economically important, and are the center of livelihoods and tourism for local communities. However, the intensification of human activities such as coastal tourism can place significant pressure on coastal ecosystems and the services they provide, thereby increasing the socio-ecological vulnerability of these areas ([Baltranaitė et al., 2025](#); [Lazzari et al., 2021](#); [Shampa et al., 2023](#)). Beach tourism growth that is not accompanied by carrying-capacity-based management often leads to ecological pressure and coastal environmental degradation, including declining water quality, habitat destruction, and conflicts over

resource use among local communities ([Baloch et al., 2023](#); [Baltranaitė et al., 2025](#); [Nunes et al., 2020](#)). Baron Beach is one of the iconic beaches in Gunungkidul Regency, which the local government has developed as a leading tourist destination since its inception. Based on the 2014–2025 Gunungkidul Regency Tourism Development Master Plan, Baron Beach has been designated as a Strategic Tourism Area II (KSP II) with functions as a center for coastal nature tourism, family recreation, coastal education, and seafood cuisine. The uniqueness of Baron Beach lies in the presence of an underground river that flows directly into the sea, the activities at the Fish Auction Site (TPI), and the area's important role as a source of livelihood for the people of Kemadang Village.



Figure 1. Baron Beach Fish Auction Site (TPI)

Source: Author, 2025

As the number of tourist visits increases, Baron Beach faces various management challenges, particularly related to pressure on the coastal environment. Recent studies show that beach tourist destinations that experience intensified tourist activity tend to face increased water turbidity, coastal waste accumulation, and changes in beach morphology due to abrasion and sedimentation. Pressure on the coastal environment due to intensified tourist visits has been documented in various studies. The decline in marine water quality, especially during peak visitation periods, is a tangible impact of rapidly developing marine tourism ([Briciu, 2023](#); [Kurniawan et al., 2023](#)). Other impacts include the accumulation of rubbish on the coastline and perceived water contamination by local communities. ([Navarro, 2019](#)), as well as morphological changes to the coastline through abrasion, which affects the stability and function of coastal ecosystems ([Mayendri & Mussadun, 2022](#)). Furthermore, the relationship between tourism activities and water quality has been demonstrated in studies conducted in various locations in Indonesia, reinforcing the role of tourism pressure on coastal environmental degradation ([Nuzula et al., 2017](#)).

The management of the southern coast of Java, particularly Baron Beach, is becoming increasingly complex due to coastal morphological dynamics influenced by Indian Ocean

waves and the pressure of tourist visits. To address this, a sustainable ecotourism approach is considered strategic, emphasizing the conservation of natural resources, the empowerment of local communities, and the educational value of tourism management ([Kiswanto & Rudi Susanto, 2020](#); [Pratiwi et al., 2020](#); [Widiastuti Sri Lestari, 2017](#)). However, the implementation of the ecotourism concept at Baron Beach has not been fully integrated with a monitoring and evaluation system based on environmental and social data. Given these conditions, this research is important for formulating a sustainable ecotourism-based coastal management strategy for Baron Beach that is directly linked to the results of the thesis research, including analysis of environmental quality, tourism carrying capacity, tourist perceptions, and local community involvement. This research is expected to contribute scientifically and practically to coastal management in Gunungkidul Regency.

This study distinguishes itself from previous research by addressing the lack of integration between qualitative and quantitative approaches in the formulation of coastal management strategies. Recent studies on coastal and sustainable tourism management have predominantly applied either qualitative strategic tools or quantitative decision-making methods independently, resulting in limited analytical depth and weak prioritization frameworks. For instance, research by [Baloch et al. \(2023\)](#) highlights the importance of sustainability frameworks in tourism development, but does not provide a structured mechanism for prioritizing strategies. Similarly, studies on coastal vulnerability and tourism impacts emphasize environmental pressures but do not integrate decision-support tools for strategy selection ([Shampa et al., 2023](#)). In contrast, this study integrates SWOT analysis with the Analytical Hierarchy Process (AHP) to bridge this methodological gap by combining systematic identification of internal–external factors with quantitative prioritization of strategies. Furthermore, this research adopts a sustainability-oriented framework that explicitly incorporates the environmental, social, and economic dimensions into coastal management planning. This integrated approach provides a more comprehensive and decision-oriented model, particularly relevant for complex coastal systems where multiple stakeholders and dynamic environmental conditions interact.

Methods

This study uses a descriptive approach that combines quantitative and qualitative methods. The research location is in the Baron Beach Tourist Area, Kemadang Village, Tanjungsari Subdistrict, Gunungkidul Regency. Geographically, Baron Beach is situated at coordinates 8°07'42.5" N 110°32'55.0" E.

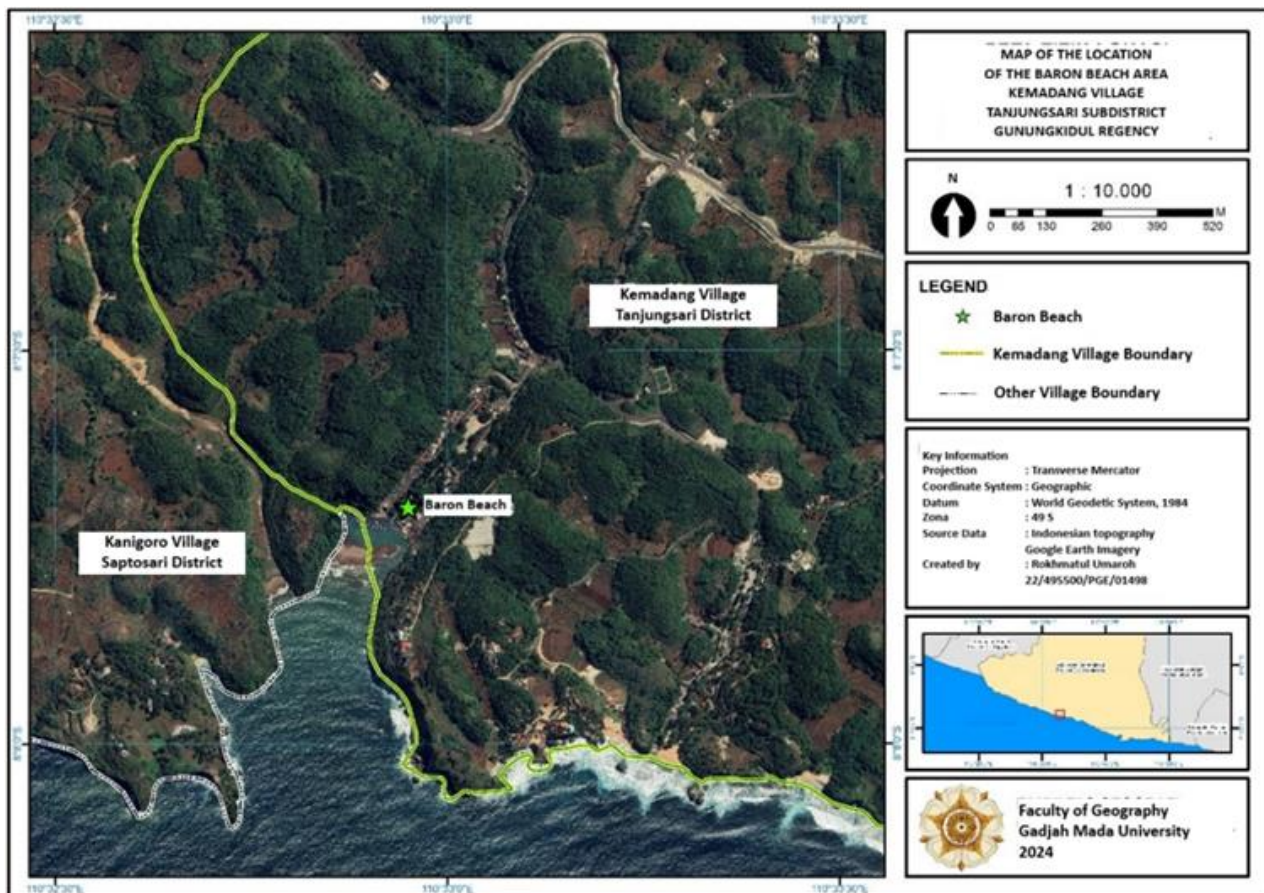


Figure 2. Map of The Location of The Baron Beach Area as a Research Location

Data collection was carried out through field observations, structured interviews, and the distribution of questionnaires to tourists. Environmental data were obtained by sampling seawater in May and August, then analyzed in the laboratory using the Standard Methods for the Examination of Water and Wastewater. The parameters analyzed included Total Suspended Solids (TSS), pH, Dissolved Oxygen (DO), and Biological Oxygen Demand (BOD). The test results were compared with applicable environmental quality standards.

Socio-economic data were obtained through interviews with tourism area managers, members of the Tourism Awareness Group (Pokdarwis), and local businesses, as well as questionnaires to tourists to determine their perceptions, preferences, and level of satisfaction with the management of Baron Beach. The tourism carrying capacity analysis included calculations of physical carrying capacity (PCC), real carrying capacity (RCC), and effective carrying capacity (ECC) based on the approach. [Cifuentes \(1992\)](#) which has been widely applied in studies of sustainable coastal tourism ([Maryono, 2019](#); [Siswanto et al., 2025](#)). The management strategy was formulated using SWOT analysis to identify strengths, weaknesses, opportunities, and threats. Subsequently, strategy priorities were determined using the Analytic Hierarchy Process (AHP) to obtain the most effective and applicable management strategy.

The Analytical Hierarchy Process (AHP) is widely recognized as an effective multi-criteria decision-making method for complex environmental and coastal management problems, as it enables the systematic evaluation of alternatives through pairwise comparisons and the assignment of priorities. Recent studies demonstrate that AHP is particularly useful in tourism and environmental planning due to its ability to incorporate both quantitative data and expert judgment in structured decision-making processes (Long et al., 2022; Xu & Li, 2025). Specifically, Xu and Li (2025) emphasize that AHP enhances decision accuracy by structuring complex environmental problems into hierarchical models, allowing consistent evaluation of competing criteria and improving the reliability of expert-based assessments. In the context of coastal management, where decisions involve trade-offs between ecological preservation, economic development, and social interests, AHP provides a transparent and consistent framework for determining priority strategies. Meanwhile, SWOT analysis supports the sustainability framework by systematically identifying internal strengths and weaknesses, as well as external opportunities and threats, which are critical in evaluating environmental, social, and economic dimensions of coastal systems. The integration of SWOT and AHP enhances analytical robustness by linking strategic analysis with quantitative prioritization, ensuring that selected strategies are not only relevant but also feasible and sustainable. This combined approach has been increasingly recommended in recent sustainability studies as a comprehensive tool for strategic environmental planning (Xu & Li, 2025).

Results and Discussion

A. Coastal Conditions at Baron Beach (TSS, Abrasion, and Pocket Beach Dynamics)

The results of seawater quality testing show that the Power of Hydrogen (pH), Dissolved Oxygen (DO), and Biological Oxygen Demand (BOD) values are within the standard range for seawater quality and support the sustainability of the aquatic ecosystem. The pH of seawater samples taken at Baron Beach was 7.67 ± 0.28 , as measured using the APHA 4500-H⁺ test method, 24th edition: 2023. The pH value, which tends to be neutral to slightly alkaline, indicates that the water is relatively stable chemically, while the DO = 8.85 ± 0.02 mg/L (APHA 4500-O.B test 24rd:2023) is classified as excellent (green zone). This value indicates that the water has dissolved oxygen levels that are highly conducive to aquatic life, a healthy aquatic ecosystem, and minimal risk of oxygen depletion. A high DO value indicates that the water has an adequate oxygen supply for marine life.

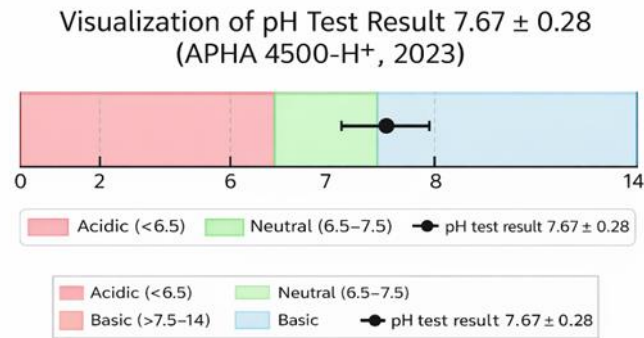


Figure 3. Visualization of pH Test Results at Baron Beach
Source: Visualization by Researchers with AI Assistance, 2025

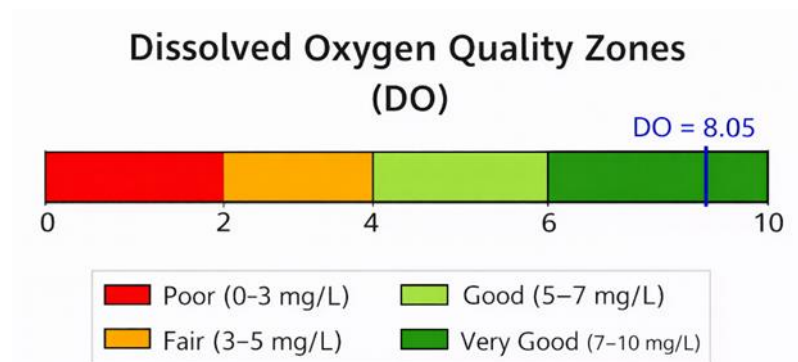


Figure 4. Dissolved Oxygen (DO) Quality Zone
Source: Visualization by Researchers with AI Assistance, 2025

BOD = 2.81 ± 0.10 mg/L (APHA 5210-B, 24rd:2023). A value of 2.81 mg/L indicates that the water requires only a small amount of oxygen to break down organic matter → low organic pollution load. The measurement tolerance of ± 0.10 indicates the method's accuracy, so the results range from 2.71 to 2.91 mg/L. According to water quality classification: 1) < 3 mg/L → relatively clean water, good quality, 2) 3–6 mg/L → moderate quality, beginning signs of organic pollution, 3) > 6 mg/L → poor quality, indication of high pollution. Therefore, the BOD result of 2.81 ± 0.10 mg/L falls within the good water category, indicating low organic pollution and safety for aquatic life. The Biological Oxygen Demand (BOD) result = 2.81 ± 0.10 mg/L (APHA 5210-B 24rd:2023) falls into the good category (< 3 mg/L). This means that the oxygen requirement to break down organic matter is low, so the water is classified as clean, with minimal organic pollution, and supports aquatic organism life. Low BOD values indicate a relatively small organic pollution load and minimal pressure from domestic waste and fishing activities.

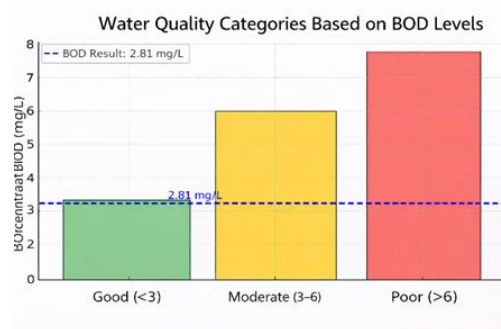


Figure 5. Water Quality Categories Based on BOD Levels

Source: Visualization by Researchers with AI Assistance, 2025

A TSS value of 202 ± 5.80 mg/L indicates that the water is very turbid and of poor quality when compared to drinking water, river water, and seawater standards. Potential impacts: 1) Reduced light penetration → disruption of biota photosynthesis, 2) Clogging of fish gills → reduction in dissolved oxygen, 3) Sedimentation into mud → destruction of aquatic habitats. It is evident that the TSS levels from the test far exceed all thresholds, including those for drinking water (50 mg/L), Class II rivers (50 mg/L), marine waters for biota (20 mg/L), and aquaculture (80 mg/L). However, the very high Total Suspended Solids (TSS) value indicates significant water turbidity and is a key indicator of environmental pressure on Baron Beach. In terms of coastal geomorphology, the high TSS cannot be separated from the character of Baron Beach as a narrow bay beach (pocket beach) flanked by steep karst cliffs. This morphological shape focuses the energy of Indian Ocean waves on certain coastal zones. At the same time, sediment supply from the mainland, via underground river flows and surface runoff, accumulates in the bay waters. High TSS concentrations directly impact coastal abrasion processes. Excessive suspended particles reduce the penetration of sunlight into the water column, disrupt the stability of the benthic ecosystem, and affect coastal sediment characteristics. Therefore, in the long term, these conditions have the potential to accelerate the degradation of the gytja zone and reinforce the dominance of abrasion over accretion.

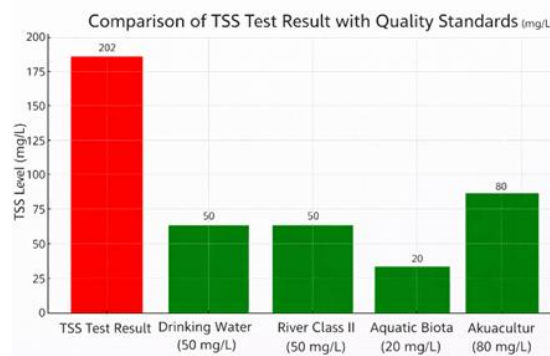


Figure 6. Comparison of TSS Test Results with Quality Standards (mg/L)

Source: Visualization by Researchers with AI Assistance, 2025

Research on the west coast of England revealed that a series of storms with extreme waves during the winter of 2013/14 caused a significant increase in wave energy, driving sediment transport beyond the intertidal zone and drastically increasing coastal erosion. These conditions were particularly pronounced on high-wave-energy beaches with limited sediment recovery capacity. Although the research [Masselink et al. \(2016\)](#) was conducted in the United Kingdom, its morphodynamic principles are highly relevant to other high-energy coasts, including the southern coast of Java (e.g., Baron Beach), where Indian Ocean waves deliver significant wave energy, resulting in similar erosional conditions. [Masselink et al. \(2016\)](#) emphasizes that on high-wave-energy coasts, increased suspended sediment and extreme wave events can accelerate coastal erosion, especially in coastal systems with low sediment recovery capacity. These findings are consistent with coastal geomorphological studies, which report that narrow bay beaches with an unbalanced sediment supply tend to experience chronic abrasion when wave energy is more dominant than sedimentation.

The dynamics of abrasion and accretion at Baron Beach are also influenced by the characteristics of karst rocks that limit lateral sediment mobility. In open beach systems, sediment redistribution along the coastline (longshore sediment transport) allows for a balance between abrasion and accretion. However, in pocket beach systems such as Baron Beach, this process is very limited, so sediment loss from extreme waves or storms is not easily replaced. This condition is in line with the concept of a closed sediment budget on narrow bay beaches, where an imbalance between sediment supply and loss is the main factor causing chronic abrasion. This condition explains the research findings that, during certain periods, abrasion at Baron Beach is more pronounced than accretion ([Carvalho & Woodroffe, 2023](#)).

Human activities, particularly tourism and fishing, contribute to these geomorphological pressures. Increased tourist visits contribute to the physical disturbance of coastal zones. In contrast, activities in river basins draining into coastal areas can increase the supply of fine sediment to coastal waters. The combination of natural pressures and anthropogenic activities is a major factor in the increase in TSS and environmental degradation in coastal tourist destinations. Increased anthropogenic pressure from coastal tourism activities contributes to increased water turbidity (TSS) and various forms of environmental degradation, including coastal erosion and loss of marine biota habitat. These pressures call for more holistic coastal management that focuses not only on coastal zone management but also on upstream catchment areas and on regulating tourism activities in sensitive zones to maintain the sustainability of ecotourism ([Serio et al., 2025](#)). In the context of ecotourism-based coastal management, this condition emphasizes the importance of a coastal geomorphological approach in area planning. TSS control can be

achieved not only through coastal area management, but also includes management of upstream catchment areas and regulation of tourism activities in sensitive zones. Integrating an understanding of pocket beach dynamics, abrasion, and water quality is essential to maintaining the sustainability of Baron Beach as an ecotourism destination.

B. Vegetation and Biodiversity

Observations show that coastal vegetation at Baron Beach is dominated by shade trees that serve to enhance tourist comfort and provide green open spaces. The shade trees at Baron Beach comprise a diverse range of tree species, totaling 197 trees. The types of trees at Baron Beach include 63 banyan trees, 37 nyamplong trees, 7 waru trees, 18 munggur trees, 14 coconut trees, 11 angšana trees, 8 Jarak trees, 8 Pule trees, 7 Cemara trees, 7 Jambe trees, 6 Tanjung trees, 4 Klapon trees, 3 Keben trees, 2 Mango trees and 2 Sawo Kecil trees. The trees' age range is 1 to 35 years. Pokdarwis Baron Indah planted the trees at Baron Beach to provide shade and coolness in the tourist area, supply oxygen, and provide green open space. In addition to these objectives, the trees at Baron Beach also have the potential to be developed for agro-educational tourism in introducing various tree species ([Fadirubun et al., 2023](#)). However, there is no mangrove vegetation, which plays an important role in protecting the coast from abrasion and improving water quality.



Figure 7. Several Types of Trees in the Baron Beach Area

Source: Researcher Documentation, 2025

KELOMPOK SADAR WISATA (POKDARWIS) BARON INDAH												
PANTAI BARON DESA KEMADANG, KECAMATAN TANJUNG SARI, KABUPATEN GUNUNGKIDUL, DAERAH ISTIMEWA YOGYAKARTA												
DAFTAR JENIS POHON PERINDANG												
No	NAMA POHON	JUMLAH POHON BERDASARKAN UMUR										JML
		1-5 TH	6-10 TH	11-15 TH	16-20 TH	21-25 TH	26-30 TH	31-35 TH				
1	MUNGGUR		2	5			5					15
2	BERINGIN	13	25	11	3	11						63
3	WARU		5	2								7
4	ANGSANA		1			10						11
5	KELAPA				14							14
6	TANJUNG			2		4						6
7	NYAMPLONG	12	7	8		10						37
8	CEMARA	2	2	3								7
9	KEBEN	3										3
10	KLAPON			4								4
11	JARAK	8	2	2								12
12	MANGGA		2									2
13	SAWO KECIK			2								2
14	JAMBE			7								7
15	PULE	8	1			1						10
	JUMLAH	40	47	60	10	26						197

Figure 8. List of Shady Tree Species on Baron Beach

Source: Researcher Documentation, 2025

The diversity of the fauna at Baron Beach is based on the various fish species caught by Baron Beach fishermen. These types of fish include pomfret, mackerel, tuna, and snapper. In addition, there are other marine products such as squid, shrimp, lobster, and crab. All of these types are examples of the wealth of marine resources available. Baron Beach fishermen are committed to protecting sea turtles, as their numbers are dwindling. The diversity of marine fauna at Baron Beach reflects the abundant potential of Indonesia's marine resources, highlighting the importance of conservation and sustainable aquatic management to optimize their utilization. Analysis of this diversity can also provide valuable insights into local ecosystems and the importance of environmental sustainability in supporting diverse marine life. This certainly requires increasing fishermen's capacity to improve their catches and educating them to preserve the ecosystem by avoiding prohibited forms in exploitation. The diversity of marine fauna, especially fish caught by fishermen, indicates a high potential for marine resources that needs to be managed sustainably.

C. Empowerment of Local Communities

Community empowerment in Baron Beach is assessed based on its economic development, which is quite good. According to research conducted by [Wibowo \(2021\)](#), the Baron Beach area has a significant annual economic value of Rp560,182,653,564.00. In addition, there is also an increase in the number of customers, reaching £282,531.00 per individual. This indicates the area's great economic potential and appeal to individuals and tourists. This amount can be used to maintain the economic and environmental sustainability of the Baron Beach Area if it is managed properly. The large economic value generated by the Baron Beach Tourist Area is inseparable from the involvement of 542 local community members, including business actors and tourism managers who are members of the Baron Indah Tourism Awareness Group, who are native residents of Kemadang Village, Tanjungsari District.

Some forms of community involvement in Kemadang Village include fruit vendors, raw and cooked fish vendors, souvenir vendors, mosque caretakers, fishermen, SAR teams, food stall and restaurant owners, photography service providers, beach crossing service providers, cleaning staff, and others. However, there is an evaluation of community skill development in the Baron Beach area, namely the need to increase the frequency and variety of training and skills development for the local community. Basically, the Gunungkidul Regency Tourism Office provides training every two years, including financial administration, tsunami simulation, and tourism product diversification. Therefore, as a suggestion, public speaking training and fluency in communicating in an international language, in this case English, are needed to attract foreign tourists to return to Baron Beach.

Active participation of local communities in ecotourism management not only enriches the tourist experience but also increases economic capacity and environmental conservation. Studies in coastal areas show that local communities tend to support and be directly involved in ecotourism development to encourage nature conservation and improve economic welfare ([Irmawati & Hasnawati, 2024](#); [Pineda et al., 2023](#)). Furthermore, systematic research shows that community participation in all stages of planning, implementation, and utilization of ecotourism is a key element of sustainable tourism ([Muda, 2025](#)). The involvement of the local community in Baron Beach tourism activities is relatively high, with various businesses managed by residents of Kemadang Village. However, interviews show that community income has declined since the COVID-19 pandemic, necessitating strategies to strengthen capacity and diversify tourism businesses.

D. Environmentally Friendly Infrastructure and Tourist Education

Tourist education is an important aspect of sustainable ecotourism development, as it raises awareness and encourages tourists to engage in environmentally friendly practices, thereby helping to reduce the negative impact of tourism activities. Research shows that environmental education programs for tourists can increase tourist responsibility towards natural resource conservation and sustainable practices at tourist destinations ([Šimková et al., 2023](#)). In addition, infrastructure indicators that support environmental management—such as waste management facilities and educational information—correlate with more sustainable tourism policies ([Muhamad et al., 2025](#)). Infrastructure barriers in many destinations, including suboptimal waste management and a lack of educational facilities, pose challenges that must be overcome in order to achieve truly sustainable ecotourism ([Garg, 2024](#); [Wahyuni et al., 2024](#)).

During the researcher's observations, questionnaire distribution, and interviews with tourists, it was found that there were no environmental education programs specifically designed for tourists. The results of the questionnaires and interviews with tourists showed that 45 of 80 tourists supported environmental education and conservation programs designed for tourists. Enthusiasm for environmental education programs needs to be maintained and conveyed to the Gunungkidul Regency Tourism Office so that it can be realized in the near future. Currently, the program is only implemented for the people of Kemadang Village who are involved in the tourism sector and support the management of the Baron Beach tourist area. This is because they are the ones who are closest to the tourist area in their daily lives and can immediately monitor for anything inappropriate. Tourist awareness of the importance of conservation is quite good, with 46 out of 80 tourists agreeing and supporting conservation in tourist areas. This must be maintained by regularly providing tourists with information and knowledge, or by creating an annual agenda once

or twice a year on the conservation of the Baron Beach area, involving managers, local communities, and Baron Beach tourists.

E. Monitoring and Evaluation of Management

Based on the researcher's analysis and carrying capacity estimates from previous studies, the data show that in 2015-2024, the physical carrying capacity (PCC) of Baron Beach was 3,285,000 tourists per year, and the real carrying capacity (RCC) was 2,010,420 tourists per year. The effective carrying capacity (ECC) of Baron Beach is 1,608,336 per year. The comparison of the number of tourists with the carrying capacity of Baron Beach shows a significant increase until 2016–2017, then a significant decrease in 2019–2021. Several factors, including tourism area management, the Covid-19 pandemic, changes in tourist preferences, and environmental impacts, influence this. The slight increase in 2022–2023 and the decline in 2024 may be due to weather factors and tourist visitation patterns. These changes confirm that tourist numbers fluctuate and that carrying capacity management remains necessary. If tourist numbers continue to increase and exceed the carrying capacity, there could be negative impacts on the environment and the quality of tourism at Baron Beach.

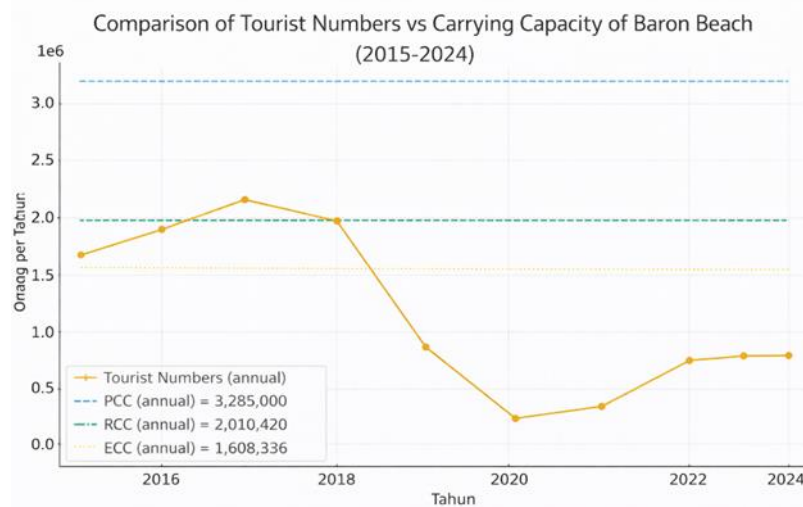


Figure 9. Comparison of Tourist Numbers and Carrying Capacity at Baron Beach 2015-2024

Source: Visualization by researchers with AI assistance, 2025

Carrying capacity is very important for setting limits on tourist numbers to ensure tourism remains sustainable and does not damage the beach ecosystem. Monitoring results for tourist numbers show fluctuating visitation trends over 2015–2024, with a significant decline during the pandemic. A comparison of tourist numbers with the area's carrying capacity shows that tourist visits remain below the effective carrying capacity, but further

controls are needed to prevent future environmental pressure. Tourist satisfaction with the management of Baron Beach is relatively high, indicating the area's potential for further sustainable development.

F. Ecotourism-Based Coastal Management Strategy

The results of the SWOT analysis combined with the Analytic Hierarchy Process (AHP) approach provide a more comprehensive picture of the direction of sustainable ecotourism-based coastal management at Baron Beach. This approach allows for the integration of the bio-physical conditions of the environment, the socio-economic dynamics of the community, and the preferences and perceptions of tourists, which were analyzed in the previous sub-section. The Strengths–Opportunities (S–O) strategy is the highest priority because Baron Beach has internal strengths in including unique natural attractions, the presence of underground rivers, traditional fishing activities, and a relatively high level of local community involvement. This approach is in line with the tourism system innovation framework, which emphasizes the use of local strengths as the basis for sustainable destination development. The utilization of local potential, both natural resources and community culture, has been proven to increase the competitiveness of sustainable tourism destinations ([Haukeland et al., 2023](#)). These internal strengths are in line with external opportunities in the form of increasing tourist interest in nature tourism and environmental education-based tourism, which encourages the development of forms of experiential tourism (nature-based and experiential tourism) ([Mishra, 2025](#)). The development of educational ecotourism packages that integrate beach tourism, coastal ecosystem education, and local cultural activities is considered effective in improving the quality of the tourist experience while strengthening tourists' environmental awareness and behavior ([Liu et al., 2024](#); [Manggaprouw et al., 2025](#)). This strength is in line with external opportunities in the form of increasing tourist interest in nature tourism and environmentally-based educational tourism. The development of educational ecotourism packages that integrate beach tourism, coastal ecosystem education, and local cultural activities is considered likely to improve the quality of the tourist experience while strengthening conservation awareness. The implementation of ecotourism that prioritizes environmental education has proven to play an important role in maintaining the sustainability of coastal destinations by increasing ecological awareness, shaping responsible tourism behavior, and strengthening efforts to conserve natural and local cultural resources ([Armayadi et al., 2025](#); [Nasution et al., 2025](#); [Rahmanda et al., 2024](#); [Sumarmi et al., 2023](#)).

The Weakness–Opportunity (W–O) strategy ranks second in priority. It focuses on efforts to minimize internal weaknesses, particularly limitations in environmentally friendly infrastructure and a lack of tourist education programs. This strategy is in line with

the findings. [Mauliyanti et al. \(2024\)](#) and [Shahparan & Odilov \(2024\)](#) which emphasizes that the improvement of local human resources and adequate infrastructure support largely determines the success of community-based ecotourism. Improving the capacity of local communities through training in tour guiding, waste management, and foreign-language communication is a strategic step towards utilizing opportunities for ecotourism development. Research [Mauliyanti et al. \(2024\)](#) and [Sulistyo et al. \(2024\)](#) shows that increasing the capacity of local human resources is a key factor in the success of community-based ecotourism development, as training, skill development, and local awareness have been proven to strengthen participation and the sustainable management of tourist destinations. The Strengths–Weaknesses (S–T) strategy aims to leverage Baron Beach's internal strengths to address external threats, including competition among coastal tourist destinations in Gunungkidul Regency and the potential for environmental degradation due to climate change and oceanographic dynamics in the Indian Ocean. Optimizing the appeal of local nature and culture and strengthening partnerships with conservation agencies and universities are important steps in maintaining the area's competitiveness and sustainability. The Weakness–Threats (W–T) strategy is a defensive strategy that aims to minimize weaknesses and avoid threats. This strategy includes stricter regulations on tourism activities that could damage the environment, increased surveillance of coastal areas, and control of unofficial business activities. Although it is the last priority, this strategy remains important as a preventive measure to maintain the stability of the management of the Baron Beach tourist area.

Table 1. Integrated SWOT–AHP Results, Priority Weights, and Strategic Implications

SWOT Strategy	Priority Rank	Approx. Weight*	Key Strategy Focus	Strategic Implications
S–O (Strength–Opportunity)	1 (Highest)	0.40–0.45	Development of ecotourism based on natural uniqueness, underground rivers, traditional fishing, and strong community involvement	Indicates a proactive strategy that leverages internal strengths to capture growing demand for nature-based and experiential tourism. Supports the development of educational ecotourism packages integrating coastal ecosystems and local culture, enhancing tourist experience and environmental awareness
W–O (Weakness–Opportunity)	2	0.25–0.30	Improvement of eco-friendly infrastructure and strengthening community capacity (training, education programs)	Reflects an adaptive strategy focused on overcoming internal limitations to maximize opportunities. Emphasizes human resource development , environmental education, and infrastructure improvement to support sustainable tourism
S–T (Strength–Threat)	3	0.15–0.20	Utilization of natural and cultural strengths to	Represents a competitive strategy that uses local advantages to mitigate

SWOT Strategy	Priority Rank	Approx. Weight*	Key Strategy Focus	Strategic Implications
			face competition and environmental threats	risks such as destination competition and climate change impacts. Encourages collaboration with institutions and conservation agencies
W-T (Weakness-Threat)	4 (Lowest)	0.10–0.15	Strengthening the regulation, monitoring, and control of tourism activities	Indicates a defensive strategy aimed at minimizing risks through stricter environmental regulations, supervision, and control of unsustainable practices to maintain long-term stability

The integrated SWOT–AHP results presented in **Table 1**. indicate that the Strength–Opportunity (S–O) strategy has the highest priority weight, suggesting that sustainable coastal management at Baron Beach should adopt a proactive approach by leveraging internal strengths to capitalize on external opportunities. The dominance of S–O strategies reflects the importance of optimizing natural resources and community participation in developing ecotourism-based destinations. Meanwhile, W–O strategies emphasize the need to improve infrastructure and human resource capacity, highlighting that internal limitations must be addressed to utilize tourism potential fully. The S–T and W–T strategies, although lower in priority, remain essential for ensuring long-term sustainability by mitigating environmental risks and strengthening governance systems. This integrated framework provides a clear and structured basis for decision-making in sustainable coastal management.

G. Integration of Monitoring and Evaluation Based on Carrying Capacity

Monitoring and evaluation are key elements in ensuring the sustainability of ecotourism-based coastal management. The results of the study show that the number of tourists visiting Baron Beach in the 2015–2024 period is still below the effective carrying capacity of the area. However, sharp fluctuations in visitor numbers, particularly before and after the Covid-19 pandemic, underscore the need for an adaptive, sustainable monitoring system. Integrating visitor data with carrying capacity analysis results (PCC, RCC, and ECC) provides a scientific basis for determining visitor limits. This approach is important to prevent overuse of the area, which can accelerate environmental degradation, particularly increased water turbidity and coastal abrasion. Coastal tourism management research shows that exceeding an area's environmental carrying capacity can negatively impact the ecosystem and the tourist experience, leading to declines in water quality and socio-environmental conflicts ([Aguilar Calderón et al., 2025](#); [Long et al., 2022](#)). An integrated

environmental carrying capacity assessment framework is essential for sustainable planning and monitoring of coastal destinations, including periodic evaluation of physical conditions, water quality, and coastal dynamics (Xu & Li, 2025). The high TSS values found in this study indicate the need for special attention to watershed management that flows into Baron Beach and to human activities in the coastal area. Periodic evaluation of environmental conditions can form the basis for decision-making in the management of tourist areas. In addition to environmental aspects, monitoring and evaluation also need to cover social and economic aspects, such as tourist satisfaction levels and local community welfare. The questionnaire results show that most tourists are satisfied with the management of Baron Beach, but still expect improvements in cleanliness, facilities, and environmental education programs. These findings emphasize the importance of continuous evaluation to improve the quality of tourism destination management.

H. Implications of Sustainable Coastal Management

Based on the study results, the management of Baron Beach for sustainable ecotourism requires synergy among the local government, area managers, local communities, and tourists. The ecotourism-based approach not only functions as an environmental conservation strategy but also as an instrument for sustainable local economic development. The policy implications of this research include strengthening coastal management regulations based on carrying capacity, developing environmentally friendly infrastructure, and integrating environmental education programs into tourism activities. In addition, the results of this study can serve as a reference for the management of other coastal tourist destinations in southern Java with similar environmental and socio-economic characteristics.

Conclusion

This study demonstrates that integrating SWOT and AHP provides a structured and reliable framework for determining priority strategies in sustainable coastal management. The findings suggest that strategies that optimize internal strengths while addressing external opportunities offer the most effective pathway to enhancing coastal resilience and sustainability. From a strategic perspective, the results highlight the importance of adaptive and integrated management approaches that balance environmental conservation, socio-economic development, and institutional capacity. This implies that policymakers should adopt participatory and data-driven approaches in coastal planning to ensure long-term sustainability.

However, this study has several limitations. The reliance on expert judgment in AHP introduces a degree of subjectivity in determining priority weights. Additionally, the study is geographically limited, which may restrict the generalizability of the findings to other coastal regions. Future research should incorporate more quantitative spatial data, engage a broader range of stakeholders, and conduct comparative studies across diverse coastal environments to enhance the model's robustness and applicability. This study contributes to the development of an integrated decision-support framework that can be adapted for coastal management in other regions facing similar environmental and socio-economic challenges.

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