

# Management of Lhok Bubon Coastal Ecotourism Integrating Local Wisdom and Coastal Conservation Principles Area

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**Abstrak:** Penelitian ini bertujuan untuk menganalisis daya tampung dan kesesuaian pariwisata Lhok Bubon berbasis ekowisata berkelanjutan dan kearifan lokal Aceh. Pendekatan penelitian bersifat sekuensial, dimulai dengan analisis kuantitatif dan kemudian diperdalam secara kualitatif. Berdasarkan luas area 120 ha, kapasitas maksimum area tersebut mencapai 20.700 orang pengunjung per hari dengan dua siklus kunjungan. Analisis kesesuaian pariwisata bahari menghasilkan skor 500 katagori sesuai. Parameter pendukung meliputi kedalaman berkatagori sangat sesuai, sumber air tawar pantai berpasir, dan tutupan lahan terbuka juga memiliki katagori sangat sesuai, material dasar substrat pasir karang memiliki katagori sesuai. Kendala ditemukan pada kejernihan udara kurang sesuai, Untuk snorkeling dan menyelam, sebagian besar parameter fisik gelombang, kecepatan arus, pH, salinitas, serta kecerahan air berada dalam kategori S1 (Sangat Sesuai), kecuali keanekaragaman terumbu karang (<25%) yang berada dalam kategori N (Tidak Sesuai). Secara keseluruhan, Pantai Lhok Bubon layak dikembangkan sebagai habitat ekowisata, tetapi dengan membantu restorasi terumbu karang, fasilitas, dan penguatan nilai-nilai lokal, kebaruan dalam penelitian ini adalah integrasi daya dukung, kesesuaian pariwisata, dan kearifan lokal Aceh, di samping juga menerapkan pendekatan sekuensial kuantitatif-kualitatif dalam penilaian ekowisata pantai.

**Kata kunci:** Ekowisata; Lhok Bubon; Kearifan Lokal; Konservasi Pesisir

## Abstract:

This study aims to analyze the capacity and balance of Lhok Bubon tourism based on sustainable ecotourism and Acehnese local wisdom. The research approach is sequential, starting with quantitative analysis and then deepened qualitatively. Based on an area of 120 hectares, the maximum capacity of the area reaches 20,700 visitors per day with two visit cycles. The marine tourism suitability analysis produces a score of 500 in the suitable category. Supporting parameters include depth in the very suitable category, freshwater sources of sandy beaches, and open land cover also have a very suitable category, the basic material of the coral sand substrate has a suitable category. Constraints found in air clarity are less suitable. For snorkeling and diving, most physical parameters of waves, current speed, pH, salinity, and air clarity are in the S1 (Very Suitable) category, except for coral reef diversity (<25%) which is in the N (Not Suitable) category. Overall, Lhok Bubon Beach is worthy of being developed as an ecotourism habitat, but by helping with coral reef restoration, facilities, and strengthening local values, the novelty in this research is the integration of carrying capacity, tourism

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suitability, and local wisdom of Aceh, in addition to the quantitative-qualitative sequential approach in assessing coastal ecotourism.

**Keyword:** Coastal Conservation; Ecotourism; Lhok Bubon; Local Wisdom

## 1. Introduction

Lhok Bubon Beach in Samatiga District, West Aceh Regency, is developing as a tourist village with basic facilities such as a parking area, prayer room, food stalls, and family recreation areas. According to Jadesta data, supporting tourism facilities are available, although there are no accommodations yet. With its potential natural resources, infrastructure support, and community economic involvement, this area has become a strategic coastal tourism destination in West Aceh, providing direct benefits through traditional culinary businesses such as Acehnese noodles, Acehnese *rujak* (rice cake), grilled fish, and local coffee.

Ecotourism is a concept that emphasizes the development of nature- and culture-based tourism, increasing environmental awareness, and conserving local resources by minimizing negative impacts and maximizing benefits for the community. Globally, tourism also plays a role as a social, cultural, and economic phenomenon that supports the preservation of the environment and local traditions [1][2].

There has been a shift in orientation from mass tourism to more specialized international tourism, marked by a decline in interest in traditional cultural tourism and an increased focus on the tourism experience itself. This shift has contributed to the annual increase in the number of international tourists visiting Aceh [3].

Tourism is seen as a path to development because it is a source of foreign exchange and contributes to GDP and job creation [4]. However, without adequate management and conservation, tourism can have a negative impact on the environment. This situation gave rise to the concept of sustainable tourism known as ecotourism, which began to gain global attention in 1831 through activities to protect important natural areas [5].

The implementation of ecotourism has the potential to increase anthropogenic pressures, necessitating conservation measures to maintain

biodiversity and biodiversity [6]. Conservation encompasses not only ecological aspects but also socio-political, economic, legal, cultural, aesthetic, and spiritual dimensions [7].

Ecotourism promotes sustainable tourism through responsible travel that minimizes environmental impacts and supports local communities [8], as well as emphasis on biodiversity conservation, cultural heritage, education, and empowerment [9]. This concept is gaining increasing attention due to its potential to protect the environment while improving community livelihoods [10]. Through stakeholder engagement, ecotourism supports environmental conservation and extinction [11], while also encouraging economic growth, poverty reduction, entrepreneurial opportunities, local investment, and preventing overexploitation of natural resources [12].

Conservation-based tourism activities, including ecotourism, provide socio-economic benefits while supporting conservation and development goals [13]. As “responsible travel to natural areas that conserves the environment and improves the well-being of local communities” [14], ecotourism offers a pragmatic compromise between conservation and sustainable development, providing economic incentives for environmental stewardship.

Ecotourism has the potential to impact environmental, social, cultural, and economic aspects and can be a protectionist alternative to conservation if managed equitably without overexploitation [15]. However, its optimization requires a combination of methods appropriate to the ecological characteristics of the area, taking into account differences in conditions, landscapes, local information, and social and cultural norms [16].

The complexity and beauty of coastal areas make them popular ecotourism destinations for tourists and researchers, with significant potential for coastal and small island development [17]. Ecotourism can provide economic benefits while achieving conservation goals through the integration of three main pillars: ecosystem and biodiversity protection, socio-cultural aspects, and economic benefits for communities aligned with local values and beliefs [18]. Furthermore, ecotourism implements strategies for waste

reduction, energy efficiency, and biodiversity conservation to create a harmonious relationship between tourists and the environment [19].

Lhok Bubon Beach in West Aceh Regency is characterized by a diverse coastal landscape with diverse marine and terrestrial habitats [20], plays a role in supporting livelihoods through fisheries and agriculture, and has the potential for sustainable tourism. However, this area is experiencing degradation due to population growth, urbanization, high resource demand, and suboptimal ecotourism management, which threatens biodiversity and community well-being, particularly in areas near urban centers [21].

Coastal and marine areas are highly vulnerable to pollution from various sources. According to [22], marine pollution is a global problem that transcends national and regional boundaries, encompassing land, sea, and the atmosphere, including sewage, wastewater, oil spills, and industrial activities. Land-based sources such as agricultural runoff, plastic waste, and industrial discharges account for approximately 80% of marine pollution, contaminating coastal and marine ecosystems.

Because marine and estuarine ecosystems are vulnerable to both natural changes and human activities, sustainable management is essential to maintain their sustainability. Pollution not only damages ecosystems but also threatens the well-being of fishing communities and coastal communities that depend on marine resources [22].

## **2. Research Method**

This study employed a mixed-methods approach with a Gampongin exploratory sequential design, consisting of two stages. In the first stage, quantitative data were collected and analyzed. In the second stage, the quantitative data results were used to plan qualitative data collection. The first stage began with data collection on carrying capacity using the following formula:

- a. Physical Carrying Capacity (PCC) with a modified formula as follows:

$$PCC = A \times 1/B \times Rf [23].$$

Information: A = The area used for tourism; B = The area required for a tourist to travel and still achieve satisfaction; Rf = Rotation factor

- b. Real Carrying Capacity (RCC). with a modified formula as follows:  $RCC = PCC \times (100 - Cf) / 100$  [23].

As for calculating the correction factor (Cf), it is obtained by using the following formula:  $Cf = Mi / Mt \times 100\%$

Information: Mi = Variable magnitude limits; Mt = The total variable limit is 65 for the Slope Correction Factor [24].

- c. Effective Carrying Capacity (ECC) with a modified formula as follows:  $ECC = RCC \times \text{correction factor (MC)}$  [23].

MC (*Management Capacity*) is the number of area management officers;  $MC = Rn / Rt \times 100\%$ . Information: RCC = Real Carrying Capacity; Rn = active resources on site; Rt = the number of fixed resources of the manager

A natural resource suitability analysis was used to develop a conceptual model for managing Bubon Beach as an ecotourism area based on sharia and local wisdom [25]. The study population included local residents and tourists visiting on Sundays, with an estimated population of approximately 200 people. Based on the Harry King Nomogram with a 10% margin of error, the sample size was set at 23%, or 46 respondents, out of a total population of 200.

### 3. Results and Discussion

Carrying capacity research aims to assess an area's ability to accommodate tourism activities without damaging the environment or reducing the quality of the visitor experience. This analysis is crucial to ensure that area use remains within acceptable limits for the ecosystem, community, and infrastructure. By understanding environmental capacity quantitatively and qualitatively, tourism management can be directed sustainably. The findings presented cover physical, ecological, and social carrying capacities as a basis for area management decisions.

## a. Carrying capacity of the Lhok Bubon Tourist Beach area

### 1. Physical Carrying Capacity (PCC)

In calculating physical carrying capacity, it is necessary to understand a number of basic assumptions, including: (a) The coastal area of Lueng Gayo as a tourist area is 120 hectares or 1,200,000 m<sup>2</sup>. The space required for visitors to visit is approximately 60 m<sup>2</sup> [26]. (b) The duration required to complete one series of visits is 5 hours. (c) The area is open approximately 10 hours per day, from 8:00 a.m. to 6:00 p.m.

The carrying capacity calculation is as follows:

$$\begin{aligned} A &= 1,200,000 \text{ m}^2 \\ B &= 60 \text{ m}^2 \\ R_f &= 5 \\ PCC &= A \times 1/B \times R_f \\ &= 1,200,000 \times 1/60 \times 3 \\ &= 60,000 \end{aligned}$$

### 2. Real Carrying Capacity (RCC)

The correction factor (Cf) is obtained by considering variables obtained based on field data on slope classes in Lhok Bubon.

**Table 1.** Slope Class Correction Factor Index for Lhok Bubon

Class	Slope (%)	Classification	Area (%)	Score value	Slope index
I	0 - 8	Flat	100 %	20	20
II	> 8 - 15	Gently Sloping	0 %	40	0
III	> 15 - 25	Somewhat Steep	0 %	60	0
IV	> 25 - 45	Steep	0 %	80	0
V	> 45	Very Steep	0 %	100	0
Amount					20

Based on Decree of the Minister of Agriculture No. 837/KPTS/UM/11/1980.

The correction factor (Cf) is calculated by considering variables obtained based on field data on slope classes in the Lhok Bubon tourist area using the following formula:  $Cf = M_i/M_t \times 100\%$

Where:  $M_i$  = Variable magnitude limit

$M_t$  = Total variable limit of 65 for the Slope Correction Factor (Muta'ali, 2012)

$$\begin{aligned} &= 20 / 65 \times 100\% \\ &= 30.77 \end{aligned}$$

The actual bearing capacity with the slope correction factor is:

$$\begin{aligned}
 RCC &= PCC \times ((100-Cf)/100) \\
 &= 60,000 \times (100-30.77/100) \\
 &= 60,000 \times (69.23/100) \\
 &= 11,000 \times 0.69 \\
 &= 41,400
 \end{aligned}$$

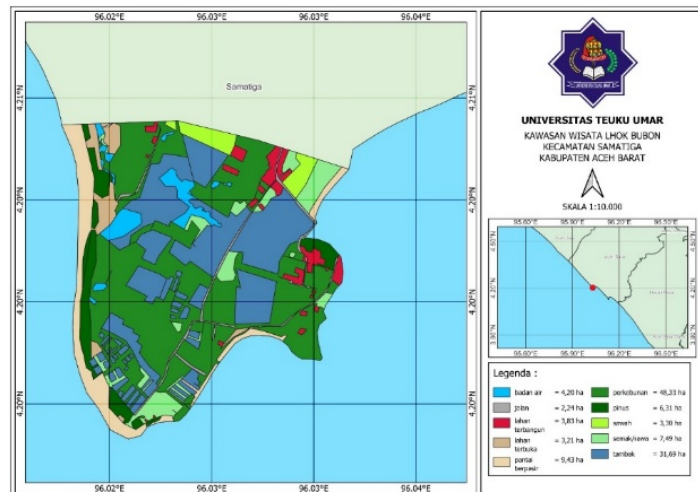


Figure 1. Destination development plan

### 3. Effective Carrying Capacity (ECC)

$$ECC = RCC \times \text{correction factor (MC)}$$

MC (Management Capacity) is the number of area management personnel.

$$MC \text{ (in \%)} = R_n/R_t \times 100\%$$

Where:

RCC = Actual Carrying Capacity

R<sub>n</sub> = active resources on site (15 people)

R<sub>t</sub> = number of permanent management resources (30 people)

$$MC = 15/30 \times 100\%$$

$$= 0.5 \times 100\%$$

$$= 50\%$$

$$ECC = 41,400 \times 0.5$$

$$= 20,700 \text{ people/day.}$$

The carrying capacity measurement of Lhok Bubon Beach was conducted to determine the safe limit for the number of visitors the area can accommodate. Based on a tourist area of 120 hectares, a visitor space requirement of 60 m<sup>2</sup> per person, and a visit duration of 5 hours per cycle, the Physical Carrying Capacity (PCC) is 60,000 people per day. This value is then

adjusted for the area's biophysical conditions, particularly the slope, which is entirely flat, with a total score of 20 out of a maximum of 65. The resulting correction factor is 30.77%, reducing the Real Carrying Capacity (RCC) to 41,400 people per day.

Furthermore, the area's management capacity, calculated based on the number of active staff, shows a Management Capacity (MC) of 50%, as only 15 of the 30 staff are available. After multiplying this by the RCC, the Effective Carrying Capacity (ECC) is 20,700 people per day. This figure represents the ideal number of visitors Lhok Bubon Beach can accommodate to ensure safe, comfortable, and sustainable tourism activities.

## b. Analysis of the suitability of the Lhon Bubon Tourism Area

Marine Tourism Suitability Analysis According to Maanema Site suitability analysis is a crucial step in determining the suitability of a water area for planned coastal resource utilization activities, such as mariculture, marine tourism, and coastal area development. This assessment is conducted by considering various biophysical parameters, including water depth, bottom material, current velocity, clarity, beach type, land cover, and distance to freshwater sources. The purpose of this analysis is to assess the level of site suitability based on field parameters, thus determining the suitability category (S1, S2, S3, or N) that reflects the area's potential utilization level.

Table 2. Marine Tourism Suitability

Parameter	Weight	S1 Very Appropriate	S2 Appropriate	S3 Less Appropriate	N Not Appropriate	Field Results
Water depth (m)	10	0-5 (18)	> 5-10 (4)	> 10-15 (2)	>15 (1)	0 s/d 3 meter
Basic Materials	8	Sand (16)	Sandy Coral (4)	Muddy sand (4)	Muddy coral (1)	Sandy coral
Current Velocity (m/sec)	6	0-0,17 (14)	> 0,17-0,34 (12)	>0,34-0,51 (2)	>0,51 (1)	0 s/d 0,3 m/sec
Water Clarity (m)	6	> 15-20 (10)	> 10-14 (4)	> 5-9 (2)	≥ 5 (1)	5 m
Beach Type	6	Sandy (14)	Sandy with a little cora (12)	Sandy with a little coral, steep (10)	Mud, coral, mangrove, steep (2)	Sandy with a little coral

Parameter	Weight	S1 Very Appropriate	S2 Appropriate	S3 Less Appropriate	N Not Appropriate	Field Results
Land cover	6	Open land (14)	Low scrub (12)	High scrub (10)	Mangroves, settlements, settlements (1)	Open land
Freshwater Distance (km)	6	< 0.5 (14)	> 0.5 - 1 (12)	> 1-2 (10)	> 2 (2)	< 0.5

Water depths of 0–3 m are classified as S1 (Very Suitable), making them ideal for aquaculture and coastal tourism due to easy access and minimized risk of strong currents. Sandy coral substrates are S2 (Suitable), providing sufficient stability for bottom organisms and lightweight construction, although pure sand is more optimal. Current velocities of 0–0.3 m/s also fall within the S2 (Suitable) category, supporting circulation and oxygen supply, although slower currents (S1) are better for stability. Water clarity at 5 m falls within the S3 (Less Suitable) category due to suspended particles or sediment that inhibit light penetration and potentially impact the underlying ecosystem.

A sandy beach with little coral is classified as S2 (Suitable), relatively stable and easily accessible, although coral restricts certain areas. Open land cover is S1 (Very Suitable), ensuring ecosystem preservation with minimal ecological disturbance. Distances to freshwater sources of <0.5 km also fall within the S1 (Very Suitable) category, supporting operational and technical needs.

**Table 3.** Feasibility Categories

Eligibility Category	Score	Field Score
S1 (very suitable)	544 – 704	
S2 (in accordance)	312 – 543	500
S3 (less appropriate)	144 – 311	
N (it is not in accordance with)	< 144	

Based on a total score of 500, the research site is categorized as S2 (Suitable). This means the area is quite suitable for use, but there are still several limiting factors, particularly in terms of water clarity and bottom material. Overall, the research site falls into the "S2 - Suitable" category, meaning the location is quite suitable for use with some technical adjustments. With proper

environmental management, this site's potential can be upgraded to S1 (Very Suitable) in the future.

**Table 4.** Suitability for Marine Tourism (Diving & Snorkeling) [27]

No	Parameter	Criteria	Measurement Results	Field Criteria
1	Diversity			
	Coral Reef Species	Very good (> 7), Good (5-6), Average (3-4) Not good (<4)	Not good	it is not in accordance with
	Uniqueness of the view	There is uniqueness	There is	very suitable
	Dangerous biota	None	None	very suitable
2	Geomorfologi			
	Slope (%)	< 15	2	very suitable
	Depth (m)	< 10	3	very suitable
3	Physical oceanography			
	Wave Height (cm)	< 70	30	very suitable
	Current Velocity (cm/sec)	< 40	30	very suitable
4	Water Quality			
	Acidity (pH)	6,5 - 8,5	6,5	very suitable
	Temperature	Experience	Experience	very suitable
	Salinity (ppt)	Experience sea water	Experience sea water	very suitable
	Translucency (m)	> 3	5	very suitable
	Ammonia (ppm)	< 0,5 ppm	0,1 (mg/L).	very suitable
	Nitrite	< 1 ppm	< 0,3 ppm	very suitable
5	Supporting Factors			
	Accessibility	Easy to Access	Easy to Access	very suitable

A site suitability assessment based on biophysical and oceanographic parameters was conducted to assess the potential and feasibility of coastal aquatic ecosystems, particularly those related to marine resource management, marine tourism, and coral reef ecosystem preservation. The assessment was conducted based on ecological suitability standards, which encompass aspects of biota diversity, coastal geomorphology, physical oceanographic characteristics, water quality, and supporting factors (accessibility).

a). Diversity Factor

Observations indicated that coral reef species diversity was in the poor category, thus classifying it as unsuitable (N). This indicates degradation of the coral ecosystem due to natural or anthropogenic factors such as sedimentation, destructive fishing activities, or tourism pressure. However, the unique underwater scenery and the absence of dangerous biota indicate that this area still has high aesthetic and safety value for marine tourism activities.

b). Geomorphological Factor

The geomorphological conditions are very favorable, with a low slope (2%) and a depth of only 3 meters, both of which are classified as Very Suitable (S1). The gentle topography facilitates access and reduces the risk of abrasion, while shallow depths support the growth of benthic biota and underwater tourism activities such as snorkeling or shallow diving.

c). Physical Oceanography

Measurements of a wave height of 30 cm and a current velocity of 30 cm/second indicate calm and stable conditions, ideal for shallow water activities. Moderate currents ensure the safety of human activities and the stability of the seabed ecosystem. Both parameters are categorized as Very Suitable (S1).

d). Water Quality Factors

All water quality parameters are categorized as Very Suitable (S1).

1) pH of 6.5 remains within the optimum range for marine life. 2) Natural temperature and salinity indicate no thermal disturbance or significant freshwater mixing. 3) A transparency of 5 meters indicates clear water and good light penetration for photosynthesis by benthic organisms. 4) Ammonia (0.1 mg/L) and nitrite (<0.3 mg/L) levels are well below thresholds that could harm aquatic biota. These conditions indicate waters with natural fertility and very low pollution levels.

e). Supporting Factors (Accessibility)

The accessibility factor is classified as Very Suitable (S1). The location is easily accessible by land and sea, which is an added value in the context of coastal tourism development or marine research.

f). Overall Feasibility Evaluation

In general, the evaluation results indicate that most parameters are considered Very Suitable (S1), with only one parameter-coral reef species diversity-categorized as Not Suitable (N). Therefore, the overall site condition remains categorized as "Suitable - S2," as the limiting factors are specific (biotic) and can be improved through coral ecosystem rehabilitation, such as replanting artificial reefs, limiting destructive activities, or managing conservation areas.

Based on the above situation, several future activities can be implemented to improve tourism activities at Lhok Bubon, including: Implementing a coral reef restoration program using transplantation or artificial modules; Implementing a seabed ecosystem protection zone to prevent further damage; and conducting routine monitoring of the physical and chemical parameters of the waters at least twice a year. And developing access to educational tourism using a sustainable ecotourism approach.

The research results indicate that Lhok Bubon Beach has strong potential as a local wisdom-based ecotourism area. Spatially, its strategic location and easy access support tourism development. The area's carrying capacity remains within safe limits, with relatively shallow, sandy, clear waters and minimal environmental risks, making it suitable for marine tourism. The commitment to ecotourism principles and the implementation of Islamic Sharia law are also considered positive, as they have created a safe, orderly, and culturally appropriate tourism environment for the Acehnese people.

However, the main challenges lie in limited management capacity, human resource professionalism, and the suboptimal utilization of marine tourism potential and the integration of local wisdom into tourist attractions. Supporting infrastructure and sharia tourism facilities also need to be improved

to comply with the provisions of the Aceh Qanun. Therefore, development strategies need to focus on strengthening human resources, developing cultural and marine tourism, improving infrastructure, and empowering the community in a sustainable manner so that Lhok Bubon Beach can develop into a leading, competitive and sustainable ecotourism destination.

#### **4. Conclusion**

Based on the research results, Lhok Bubon Beach has great potential to be developed as a sustainable sharia ecotourism area. Its high environmental capacity (20,700 people per day) and the results of the S2 (Suitable) land suitability analysis indicate the area's suitability for tourism activities. However, several inhibiting factors such as air clarity, sandy substrate, and low coral reef diversity require rehabilitation efforts. Tourism development has been proven to provide economic benefits to the community, while the integration of sharia principles and local wisdom is a strategic strength that supports a management model based on environmental intentions, religious values, and socio-cultural values. Therefore, the area's development needs to be directed at zoning, ecosystem rehabilitation, strengthening sharia infrastructure, and sustainable community empowerment.

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