

Integration of Ecological and Socio-Economic Aspects for Sustainable Management of Nambo Beach Tourism

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Abstract

Managing coastal tourist areas requires an approach that can integrate ecological and socio-economic aspects so that environmental quality and community welfare are maintained. This study aims to analyze the ecological and socio-economic conditions in the Nambo Beach Tourism Area, Kendari City, and to formulate sustainable management strategies through an integrative ecology–social approach. The research was conducted in October–November 2025 through field surveys, water quality measurements (temperature, pH, salinity, DO, BOD, TSS, TDS), vegetation cover analysis based on the 2024 SHP, observations, as well as interviews and questionnaires with the community. The results show that most water quality parameters still meet marine tourism standards, although there is pressure on the TSS value (96 mg/L) and indications of increasing organic material shown by the BOD value (3.70 mg/L). Coastal vegetation cover, including mangroves, still dominates with an area of 5,910 hectares. but it's starting to be pressured by increased tourism activities and development. On the socio-economic side, the community relies on income from tourism businesses, small trade, and transportation, but they face challenges such as low environmental awareness, limited public facilities, and suboptimal waste management. The integration of analyses using the ICM and SWOT approaches shows that Nambo Beach is in the aggressive strategy quadrant, meaning it has great potential for development.

Keywords: *ecological-social integration, water quality, nambo beach, sustainable management, kendari*

Abstrak

Pengelolaan kawasan wisata pesisir membutuhkan pendekatan yang mampu mengintegrasikan aspek ekologi dan sosial-ekonomi agar kualitas lingkungan dan kesejahteraan masyarakat tetap terjaga. Penelitian ini bertujuan menganalisis kondisi ekologis dan sosial-ekonomi di Kawasan Wisata Pantai Nambo, Kota Kendari, serta merumuskan strategi pengelolaan berkelanjutan melalui pendekatan integratif ekologi–sosial. Penelitian dilakukan pada Oktober–November 2025 melalui survei lapangan, pengukuran kualitas air (suhu, pH, salinitas, DO, BOD, TSS, TDS), analisis tutupan vegetasi berbasis SHP 2024, observasi, serta wawancara dan kuesioner kepada masyarakat. Hasil penelitian menunjukkan bahwa sebagian besar parameter kualitas air masih sesuai baku mutu wisata bahari, meskipun terdapat tekanan pada nilai TSS (96 mg/L) dan indikasi peningkatan bahan organik melalui nilai BOD (3,70 mg/L). Tutupan vegetasi pantai, termasuk mangrove, masih mendominasi dengan luas 5.910 hektare, tetapi mulai tertekan oleh peningkatan aktivitas wisata dan pembangunan. Dari sisi sosial-ekonomi, masyarakat menggantungkan pendapatan pada usaha wisata, perdagangan kecil, dan transportasi, namun menghadapi kendala berupa rendahnya kesadaran lingkungan, fasilitas umum yang terbatas, dan pengelolaan sampah yang belum optimal. Hasil integrasi analisis menggunakan pendekatan ICM dan SWOT menunjukkan bahwa Pantai Nambo berada pada kuadran strategi agresif, sehingga memiliki peluang besar untuk dikembangkan.

Kata Kunci: *integrasi ekologi-sosial, kualitas air, pantai nambo, pengelolaan berkelanjutan, kendari*

1. Introduction

Coastal areas are strategic spaces with interconnected ecological, social, and economic functions. In addition to being important habitats for various organisms, coastal areas provide ecosystem services that support people's lives, such as residential areas, fishery-based livelihoods, and tourist spots. However, the increased intensity of space use in recent decades has put significant pressure on the sustainability of Indonesia's coasts. Various studies show that uncontrolled growth in the tourism sector can lead to environmental degradation, such as water pollution, reduced vegetation cover, and increased ecological pressure on coastal ecosystems [1]. This situation also happens in Kendari City, especially at one of its top

spots, Nambo Beach. Nambo Beach has great tourism potential and is one of the main recreation destinations for locals and nearby communities. Tourism activities in the area provide economic benefits through opportunities in transportation, small trade, and tourism services. However, tourism growth that isn't managed sustainably brings threats to environmental quality. Research findings show that the surge in tourist visits contributes to increased waste production, declining water quality, and damage to coastal vegetation due to changes in land use and unorganized use of space [2].

This situation shows that the management of Nambo Beach tourism still faces challenges in balancing usage and conservation. More broadly, coastal management issues in Indonesia are not only related to ecological pressures but are also influenced by governance and socio-economic dynamics. Damage to coastal areas is influenced not only by ecological pressures but also by governance aspects. Weak policy integration, suboptimal coordination between institutions, and low community participation are major challenges in achieving sustainable coastal area management [3]. In the context of Nambo Beach, the socio-economic conditions of the community are closely linked to the ecological dynamics of the area. The people of Nambo Beach rely on tourism and the use of coastal resources for their livelihood. Therefore, raising community awareness through beach cleaning activities contributes to keeping the coastal environment clean and supports the sustainability of the conservation area. These activities not only increase people's understanding of the impact of waste on coastal ecosystems but also encourage active community participation in preserving the environment and enhancing the tourism appeal of the coastal area [4].

Therefore, a deep understanding of the socio-economic conditions of the community becomes a key component in formulating inclusive and sustainable management strategies. Considering this complexity, an integrative approach between ecological and socio-economic aspects is essential to achieve sustainable coastal management. This approach aligns with the concept of social-ecological systems, which states that ecosystem sustainability cannot be separated from human behavior, social structures, and the surrounding economic systems. Integrating these two aspects allows for a more comprehensive analysis of environmental pressure sources and the community's role in mitigation and adaptation. Consequently, combining ecological and socio-economic data provides a strong foundation for evidence-based policies and more targeted management strategies.

Based on this context, this study was conducted to provide a comprehensive picture of the ecological and socio-economic conditions of Nambo Beach and to formulate sustainable management strategies that consider the link between the two. The research questions include: (1) what are the socio-economic conditions of the local community in utilizing coastal resources and their involvement in tourism management; (2) what is the ecological condition of Nambo Beach, especially regarding water quality and coastal vegetation; and (3) what integrative strategies can be developed to support sustainable tourism management. Answering these three questions becomes an important basis for formulating a coastal management approach that is evidence-based and responsive to both environmental and community needs.

In line with the research questions, this study aims to: (1) analyze the socio-economic conditions of the coastal communities at Nambo Beach related to tourism activities and the use of coastal resources; (2) assess the ecological condition of Nambo Beach through measurements of seawater quality and vegetation cover analysis; and (3) formulate sustainable management strategies based on integrating ecological and socio-economic aspects. The results of this study are expected not only to enrich the literature on coastal social-ecological dynamics but also to provide practical recommendations for local governments, tourism managers, and communities in developing Nambo Beach sustainably.

2. Material and Methods

This research was carried out in October-November 2025 at Nambo Beach, Nambo District, Kendari City, Southeast Sulawesi Province.



Fig. 1: Nambo Beach, Nambo District, Kendari City, Southeast Sulawesi Province by land use

3. Results and Discussion

Nambo Beach is one of the tourist destinations located in the city of Kendari. The seawater quality for tourism development at Nambo Beach in this study can be observed by comparing physical and chemical parameters. The physical parameters include Temperature, Clarity, Odor, and TSS, while the chemical parameters are pH, Salinity, TSS, Dissolved Oxygen (DO), and BOD. Data collection in this study used a survey method, and data were taken using purposive sampling, which is expected to represent the areas of the study affected by pollutant sources at Nambo Beach.

The condition of seawater quality in the sustainable tourism management at Nambo Beach in this study can be seen from the seawater quality standards based on physical and chemical parameters. The physical parameters include Temperature, Clarity, Odor, and TSS, while the chemical parameters are pH, Salinity, TSS, Dissolved Oxygen (DO), and BOD. The results of the water parameters measurements in the Nambo Beach Tourism Area are presented in **Table 1**.

Table 1. Results of environmental parameter measurements

Water Parameters	Unit	Measurement Results	Quality Standards
Temperature	°C	31,6	
Water Transparency	m		
Smell		Natural	Natural
TSS	Mg/l	96	80
pH		7,37	
Salinity	%	34	s/d 34
TDS		11,0	
Disolved Oksigen (DO)	mg/l	5,34	>5
BOD	mg/l	3,70	20

Temperature

The measurement results show that the water temperature at Nambo Beach Tourism in Kendari City is 31.6°C. As a tourist area, water temperature is used to determine the potential and existence of breeding and growth of marine animals. Temperature affects the metabolic activity of marine organisms. This temperature is still ideal for marine tourism purposes. Based on the average measurement results, the

water temperature at Nambo Beach is within the natural range and meets the quality standards for tropical waters. These results are in line with [14], which states that the natural temperature of tropical waters in Indonesia ranges from 23–32°C. Therefore, the water temperature at Nambo Beach can be considered normal and still supports the sustainability of the marine ecosystem.

pH

The measurement results showed that the pH levels in the waters of Nambo Beach Tourism ranged from 7.3 to 7.5. These values are still within the standard range of seawater quality for marine tourism [15], which is 7.0–8.5. Thus, the pH conditions in the waters of Nambo Beach Tourism meet the required quality standards and indicate that the water quality is still suitable for supporting marine tourism activities.

pH values that are around neutral to slightly basic indicate that the chemical conditions of the water are relatively stable. pH stability is very important because it affects various physical, chemical, and biological processes in the water, including nutrient availability, microorganism activity, and the survival of aquatic life. Having the right pH also makes the area more comfortable for tourists and helps support the sustainability of coastal ecosystems as a tourist attraction.

The results of this study are in line with findings that suggest coastal waters with a pH value between 7.0–8.5 are generally still capable of supporting marine life as well as various usage activities, including marine tourism [16]. Therefore, based on the measurements obtained, the pH conditions in the waters of Nambo Tourist Beach can be considered good and still meet the requirements to support sustainable marine tourism activities.

Salinity

Measurements show that the salinity levels in the Nambo Beach tourist area range from 33–34‰. According to the seawater quality standards for marine tourism as stated in the Decree of the Minister of Environment and Forestry of the Republic of Indonesia Number 22 of 2021, this range still meets the seawater quality standards, so the waters are considered suitable to support marine tourism activities. In general, seawater salinity in Indonesia is around 30–35‰ [17]. Therefore, the salinity in the Nambo Beach tourist area is still considered natural and reflects relatively stable water conditions.

This condition is suspected to be influenced by the oceanographic characteristics of Nambo Beach, which is dominated by seawater, making the impact of freshwater input from rivers relatively small. In addition, tides, water circulation, evaporation rates, and rainfall also affect salinity variations in the area. The stable salinity range indicates that the waters of Nambo Beach still have good environmental conditions to support marine life, maintain the balance of the coastal ecosystem, and support the area's use as a marine tourism destination.

TSS

The measurement results show that the TSS at Nambo Beach tourist area is 96 mg/l. Generally, the TSS in marine tourism areas is around 20 mg/l. The high TSS value at Nambo Beach tourist area is considered high and can be caused by soil erosion carried by rain, disposal of household waste and waste from tourism facilities (such as restaurants and lodging) that are not properly managed, which can increase the content of suspended organic and inorganic materials in the waters. Additionally, the traffic of tourist boats, fishing boats, and activities at the harbor can stir up sediments at the bottom of shallow waters, disrupting the photosynthesis process and reducing the quality of the habitat for aquatic life.

Dissolved Oxygen (DO)

The DO measurement results in the Nambo beach tourism area ranged around 5.34 mg/l. In each data collection area, the DO values obtained indicate that the waters are in very good condition and still meet the seawater quality standards in the Decree of the State Minister of Environment No. 22 of 2021 for marine tourism, with DO values >5 mg/l. Therefore, the DO concentration in the Nambo beach area is still considered suitable for a beach tourism area. In Nambo beach, the DO value is the highest, which is inversely related to its low temperature, the presence of algae, phytoplankton, and marine plants that produce oxygen through photosynthesis.

BOD (Biochemical Oxygen Demand)

Biochemical Oxygen Demand, or BOD, is the amount of biological oxygen needed by microorganisms to break down organic matter aerobically. Knowing the BOD value in water is useful to get information about the level of pollution load present in the water due to wastewater from households or industries, in order to develop a biological treatment system for the polluted water [18].

The BOD analysis results are above the seawater quality standard in the Minister of Environment Decree No. 22 of 2021 for marine tourism, which is 3.70 mg/l. When BOD is high, microorganisms use more dissolved oxygen in the process of decomposing organic matter. As a result, the dissolved oxygen concentration in the water will decrease [19].

The quality of seawater in the Nambo Beach tourist area is affected by various activities along the coast, from tourism, residential areas, to sea sand mining. Based on laboratory test observations, the seawater quality still tends to meet the standards, but there are some indicators that show ecological pressure that need attention so that this condition does not reduce the long-term sustainability of the marine ecosystem in the Nambo Beach area.

Ecological Aspect Conditions Based on Vegetation Land Cover of Nambo Beach Tourism Area

The development of tourist areas accompanied by infrastructure development and increased socio-economic activities of the community has led to a growing demand for land. Along with population growth and the intensity of tourism activities, changes in land use occur, especially the conversion of natural or agricultural land into built-up areas to support tourist facilities, residential areas, and other infrastructure [20]. Here is an image interpretation; the land cover map of Nambo Beach Tourism Area shows several types of land cover classes.



Figure 1. The result of image interpretation shows that, in general, the land cover in the Nambo coastal area in 2024 has an area of 5,910 hectares with different land cover classes.

Table 3. Data on Vegetation Land Cover Area in the Nambo Beach Tourism Area Based on SHP 2024

No	Description	Area (ha)	Percentage (%)
1	Very Low	0.180	0.030
2	Low	0.849	0.144
3	Moderate	1.322	0.224
4	High	1.833	0.310
5	Very High	1.726	0.292
Total		5.910	100

Source: GIS Analysis Results 2025

Based on the SHP results from 2024, the Nambo Beach tourist area still shows a relatively diverse vegetation cover spread across the coastal area, shrubs, residential areas, mixed dryland agriculture, and mangrove zones. The classification results show that the total vegetation area that year reached 5,910 hectares. In general, the vegetation cover condition in 2024 indicates that the Nambo Beach tourist area still maintains relatively stable ecological quality. The dominance of trees and mangroves shows that natural landscape elements continue to prevail compared to open or non-vegetated areas. The still extensive mangrove presence is a strong indicator that ecological processes in the littoral zone are still functioning well, while coastal vegetation helps maintain soil stability and provides protection for the tourist area.

Strategic for the Sustainable Management of Nambo Beach Tourism Area with an Integrative Ecological-Social Approach

The environmental factor analysis in this study aims to evaluate internal factors (IFE) including strengths and weaknesses, and external factors (EFE) including opportunities and threats faced by the Nambo beach tourism area. Environmental analysis, covering both internal and external environments, greatly influences the development of strategies for Nambo beach tourism.

Internal environmental factors include strengths that can be used and weaknesses that managers of Nambo Beach Tourist Area need to watch out for. External environmental factors include opportunities that can be

taken advantage of and threats that managers need to prepare for. You can see the results of the internal and external environmental analysis in **Table 4**.

Table 4. Internal and External Strategic Factors of the Nambo Beach Tourism Area Management

Internal Factors		External Factors	
No.	Strengths		Opportunities
1.	Nambo Beach has attractive natural potential that appeals to tourists.	1	The Tourism Village and Blue Economy Programs provide development opportunities.
2.	Strategic location with easy access from Kendari City.	2	Potential collaboration with universities and research institutions.
3.	Active participation of the local community (Tourism Awareness Group/Pokdarwis and MSMEs.)	3	Digital promotion increases the number of tourists.
4.	Support from the local government for tourism revitalization.	4	Local MSMEs can grow with tourism.
5.	Attractive local culture and culinary heritage.	5	Environmental education can be integrated into tourism.
No.	Weaknesses (W)		Threats (T)
1.	Waste management and cleanliness are still not optimal.	1	Mass tourism has the potential to degrade environmental quality.
2.	Public facilities (toilets, information boards, parking areas) are still inadequate.	2	Economic–ecological imbalances may lead to conflicts
3.	There is no regular monitoring of coastal ecosystems.	3	Climate change and coastal erosion threaten the long-term sustainability of the beach.
4.	Public awareness of sustainable tourism remains low.	4	Community income depends on the holiday season.
5.	Dependence on government assistance.	5.	Research findings have not yet been fully implemented

Internal Factor Analysis Summary (IFAS) The IFAS matrix is used to determine the extent of the role of internal factors in the management of Nambo Beach Tourism Area in Nambo Village, Nambo District. The IFAS matrix shows the internal conditions of the tourist area in the form of strengths and weaknesses calculated based on weight, rating, and score. The results of the weight, rating, and IFAS score calculations can be seen in **Table 5**.

Table 5. Calculation of Weights, Ratings, and Scores of the Internal Factor Analysis Summary (IFAS)

Internal Factors		Mark
No.	Strengths (S)	
1.	Nambo Beach has natural potential that attracts tourists	0,69
2.	Strategic location, easily accessible from Kendari City	0,66
3.	Local community participation (tourism awareness groups/Pokdarwis, SMEs/UMKM)	0,71
4.	Local government support for tourism revitalization	0,59
5.	Attraction of local culture and cuisine	0,34
Total		3,00
No.	Weaknesses (W)	
1.	Waste management and cleanliness are still not optimal	0.32
2.	Public facilities (toilets, information boards, parking) are not yet adequate	0.42
3.	There is no regular monitoring of coastal ecosystems	0.38
4.	Awareness of sustainable tourism is still low	0.51
5.	Dependence on government assistance	0.55
Total		2,18
Difference between strengths and weaknesses		0,82

Source: Primary data, processed in 2025

External Factor Analysis Summary (EFAS)

The EFAS matrix is used to understand how significant the role of external factors is for the management of Nambo Beach Tourism Area in Nambo Village, Nambo District. The EFAS matrix shows the external conditions of Nambo Beach tourism area in terms of opportunities and threats, which are calculated based on weights, ratings, and scores. The results of the weight, rating, and EFAS score calculations can be seen in **Table 6**.

Table 6. weight, rating, and EFAS score of External Factor Analysis Summary

External Factors	Mark
Opportunities (O)	
The Tourism Village Program and blue economy provide opportunities for development.	0.32
Potential collaboration with universities and research institutions.	0.42
Digital promotion increases the number of tourists.	0.38
Local MSMEs (SMEs) can grow alongside tourism.	0.51
Environmental education can be integrated into tourism.	0.55
Total	2,82
Threats (T)	
Mass tourism may reduce environmental quality.	0.42
Economic–ecological imbalance may cause conflicts.	0.60
Climate change and coastal erosion threaten beach sustainability.	0.20
Community income depends on the holiday season.	0.33
Research findings have not been fully implemented.	0.23
Total	1,78
Difference between opportunities and threats	1,04

Determining the Position of Nambo Beach Tourist Area

To get the quadrant, calculations are done by comparing internal factors and external factors.

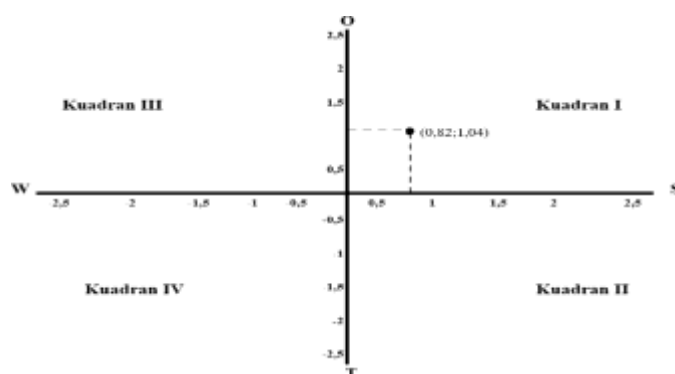


Figure 2. SWOT Quadrant Diagram
Source: Primary Data, processed 2025

The strategy produced is in Quadrant I, which is the Aggressive strategy. This strategy is one that uses internal strengths to take advantage of external opportunities.

Quadrant I – Aggressive Strategy (SO)

Focus: Leveraging strengths to seize opportunities.

1. Developing the “Nambo Marine Tourism Area” based on the blue economy, combining recreational tourism, conservation, and local community empowerment (S1 + O1).
2. Boosting digital branding and integrated tourism promotion through collaboration with universities and creative communities to expand tourist reach (S2 + O2 + O3).
3. Integrating cultural tourism, culinary experiences, and environmental education into the thematic tour package “Nambo Cultural & Eco Tour” to attract tourists based on local values (S5 + O5).

Quadrant II – Diversification Strategy (ST)

Focus: Using internal strengths to face external threats.

1. Develop coastal conservation zones and control mass tourism with a community-based ecotourism approach (S1 + T1).
2. Encourage the strengthening of community institutions (Pokdarwis) to become more independent and not rely on government aid (S3 + T4).
3. Establish a coordination forum for Nambo coastal management between the government, community, and universities to mitigate abrasion and climate change (S4 + T3).

Quadrant III – Turn Around Strategy (WO)

Focus: Leveraging external opportunities to overcome internal weaknesses.

1. Improving public facilities and beach cleanliness through collaborative programs between the government, universities, and local tourism awareness groups as part of Nambo Tourism Village (W1 + W2 + O1).
2. Developing a coastal ecosystem monitoring system based on university research to support sustainable coastal tourism (W3 + O2).
3. Organizing training and education on sustainable tourism for the community and local SMEs to strengthen eco-friendly tourism capacity (W4 + O4).

Quadrant IV – Defensive Strategy (WT)

Focus: Minimizing internal weaknesses and avoiding external threats.

1. Build a community-based integrated waste management system to reduce the negative impact of mass tourism on the beach environment (W1 + T1).
2. Implement coastal zoning planning and risk management to address threats from erosion and climate change (W3 + T3).
3. Establish an economic-ecological monitoring mechanism to maintain a balance between tourism growth and environmental sustainability (W5 + T2).

4. Conclusion

This study shows that the socio-economic conditions of the Nambo Beach coastal community are greatly influenced by tourism activities, with most of the community's income coming from the service sector, small trade, and tourism transportation. However, community involvement in managing the area is still low due to limited environmental knowledge, lack of facilities, and low awareness of sustainable tourism. Ecologically, the water quality at Nambo Beach generally still meets marine tourism standards, although there is pressure from high TSS and indications of increasing organic matter through BOD values. Coastal vegetation cover, including mangroves, is still dominant but has started to degrade due to the intensity of tourism and facility development. The integration of social and ecological findings confirms that the sustainability of Nambo Beach requires a strategy that can balance community economic interests with ecological carrying capacity. The main strategies recommended include improving community capacity, strengthening local institutions, developing conservation-based tourism, regular ecosystem monitoring, improving waste management and tourist facilities, as well as collaboration between the government and community in mitigating environmental impacts. An integrated ecological social approach emerges as the key to maintaining the long-term sustainability of Nambo Beach tourism area.

6. Abbreviations

DO	Dissolved Oxygen
BOD	Biochemical Oxygen Demand
TSS	Total Suspended Solids
TDS	Total Dissolved Solids
SWOT	Strengths, Weaknesses, Opportunities, Threats
IFAS	Internal Factor Analysis Summary
EFAS	External Factor Analysis Summary

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