



Tourism Development Strategies in Goa Ergendang: SWOT and AHP Approaches for Sustainable Growth

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This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Goa Ergendang, located in Deli Serdang, North Sumatra, is a natural tourism destination with untapped potential. This study analyzes strategies for developing sustainable tourism at Goa Ergendang using SWOT (Strengths, Weaknesses, Opportunities, and Threats) and AHP (Analytical Hierarchy Process) approaches. Data was collected through field observations, interviews with local stakeholders, and a survey of tourists and the local community. The SWOT analysis identified the site's strengths, including its natural beauty, unique cave formations, and strong community support.

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Weaknesses include poor infrastructure and limited promotion. External opportunities involve ecotourism development and increased community involvement, while threats include accessibility challenges and competition from other tourist destinations. Based on the SWOT results, Goa Ergendang is positioned in Quadrant I, which calls for an aggressive strategy that leverages its strengths and capitalizes on opportunities. The AHP analysis prioritizes infrastructure improvements, promoting the site through digital platforms, and introducing innovative tourist activities. The study concludes that collaboration between government, private investors, and the local community is essential for the long-term, sustainable development of Goa Ergendang.

Keywords: Goa Ergendang; ecotourism development; SWOT analysis; analytical hierarchy process (AHP); sustainable tourism development; regional planning.

1. INTRODUCTION

Indonesia is endowed with an abundance of natural resources, positioning it as one of the most attractive tourist destinations across various global markets [1]. One of the rapidly growing sectors is ecotourism, which leverages natural resources to attract visitors. The development of tourism in Indonesia is expected to boost economic growth and enhance the well-being of local communities [2,3].

Ecotourism, particularly conservation-based tourism, is increasingly favored by travelers seeking unique and authentic experiences. According to Putri et al. [4], successful ecotourism must balance environmental sustainability with local cultural preservation. This integration is critical to the long-term success of natural tourism destinations [5].

One of the ecotourism sites with significant untapped potential is Goa Ergendang in Deli Serdang, North Sumatra. The cave is known for its unique stalactite and stalagmite formations, as well as a natural pool with varying water temperatures [6]. Despite its remarkable attributes, the number of visitors to Goa Ergendang has sharply declined, especially after the COVID-19 pandemic (Setiani & Sugiyanto, 2021).

The decrease in visitor numbers can be attributed to several factors, including poor accessibility and inadequate facilities [7]. As a leading natural attraction in Deli Serdang, Goa Ergendang faces challenges in infrastructure management and accommodations that are essential for drawing more tourists [8,9].

The role of government and local community participation is crucial in tourism development. While the government is expected to improve infrastructure, local communities are encouraged to actively support tourism activities [10].

Involving local communities in economic activities around tourist destinations can increase local income and support sustainable development [11]. The role of sustainable tourism in supporting community welfare has been echoed globally, aligning with the Sustainable Development Goals (SDGs) target to eradicate extreme poverty by 2030 [12].

Besides poor accessibility, a lack of effective promotion is also hindering the development of Goa Ergendang. According to Hedynata and Radianto [13], appropriate promotion can enhance destination visibility, attract investors, and increase tourist visits. Social media and digital promotion can be strategic tools for boosting the popularity of Goa Ergendang among both domestic and international tourists.

Previous research by Rabbaniyah [14] explored the attractiveness and development of Goa Ergendang's hot springs through qualitative observational and interview methods. The findings revealed that visitors rated the natural landscape and biodiversity positively, but perceptions of historical and cultural heritage were less favorable. Meanwhile, Ningrum et al. (2021) examined the influence of the "Sapta Pesona" program and facilities on visitor numbers at Goa Ergendang, concluding that these factors significantly impacted visits, contributing to 57.2% of the overall increase. Bangun and Dewi [15] also highlighted the influence of "Sapta Pesona" and facilities but found a smaller contribution of 22.7%.

This study differs from previous research by adopting a holistic approach to the sustainable development of Goa Ergendang, employing both SWOT and AHP methodologies. In addition to evaluating tourist attractions and facilities, this research prioritizes the development of various aspects such as accessibility, accommodations, and community involvement. This

comprehensive approach is intended to provide a structured development strategy, enhancing Goa Ergendang's competitiveness as a sustainable ecotourism destination.

2. METHODOLOGY

This study adopts a mixed-methods approach, combining qualitative and quantitative techniques. The research employs SWOT analysis and Analytical Hierarchy Process (AHP) to identify the potential and strategies for developing ecotourism at Goa Ergendang. The primary objective of this research is to analyze the site's tourism appeal, prioritize development factors, and formulate appropriate strategies for enhancing the ecotourism potential of Goa Ergendang.

2.1 Location and Time of Study

The research was conducted in the natural tourism area of Goa Ergendang, located in Penungkiren Village, Sibiru-biru District, Deli Serdang Regency, North Sumatra. This location was chosen because it is a prominent ecotourism destination with untapped potential. The study took place from July to December 2024, involving

field observations and data collection from relevant stakeholders.

2.2 Types and Sources of Data

This research utilizes primary and secondary data. Primary data was collected through in-depth interviews with tourism management teams and direct field observations of the physical conditions and facilities at Goa Ergendang. Secondary data was obtained from previous studies and official documents from the local government and tourism authorities.

2.3 Data Collection Techniques

The following data collection methods were employed:

- **Participant Observation:** The researcher observed the conditions at Goa Ergendang, including accessibility, facilities, and the number of visitors. The observation also included analyzing the natural environment, such as flora, fauna, and the cave's ecosystem, which are major attractions.

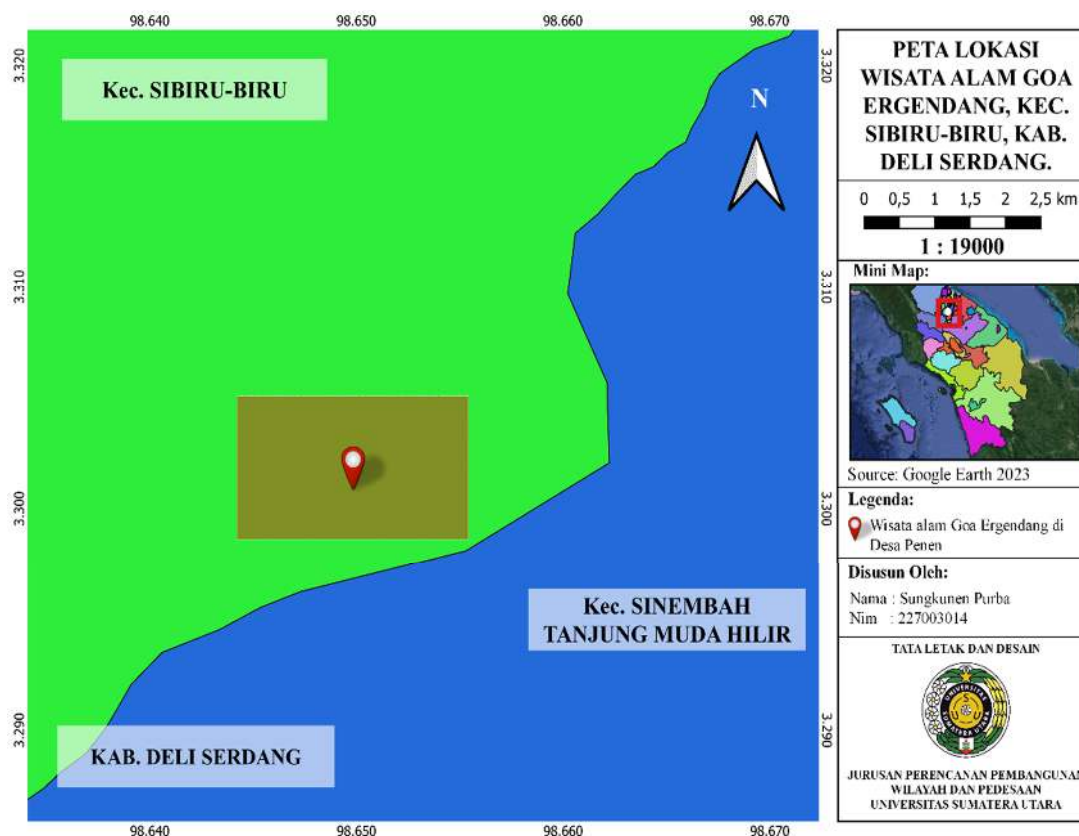


Fig. 1. Research location

- **In-depth Interviews:** Interviews were conducted with the management team, local officials, and several tourists to gain insights into the current conditions and development opportunities. The interview questions covered topics such as perceptions of tourist attractions, challenges faced, and suggestions for improvement.
- **Questionnaires:** Surveys were distributed to tourists and local residents to gather data on their experiences at Goa Ergendang and their perceptions of the available facilities. The questionnaires used a Likert scale to measure tourist satisfaction.
- **Literature Review:** Secondary data was collected by reviewing relevant literature on ecotourism development, particularly those utilizing SWOT and AHP methodologies to determine development strategies.

2.4 Data Analysis Techniques

The data analysis methods used in this study include:

- **SWOT Analysis:** SWOT analysis was employed to identify the strengths, weaknesses, opportunities, and threats in the development of ecotourism at Goa Ergendang. The SWOT analysis was conducted based on interviews, observations, and quantitative data from distributed questionnaires to 10 key informants from various fields.
- **Analytical Hierarchy Process (AHP):** AHP was used to prioritize the development aspects of the Goa Ergendang tourism area. This process involved evaluating various factors such as accessibility, tourism appeal, accommodations, and community participation. The evaluation was carried out through Focus Group Discussions (FGDs) with stakeholders, including tourism managers, academics, and local government officials. The data from FGDs was then processed using Expert Choice software to determine the priority weights of each development aspect [16].

2.5 Data Validity and Reliability

To ensure the validity and reliability of the data, this research employed method triangulation, comparing data from observations, interviews, and questionnaires to ensure consistency. Additionally, the use of AHP, a data-driven quantitative approach, ensured that the findings were measurable and could be analyzed objectively [15].

3. RESULTS AND DISCUSSION

3.1 General Overview of the Study Location

Deli Serdang Regency spans an area of 2,497.72 km² with a population of approximately 1,953,986 in 2022. Penungkiren Village, where Goa Ergendang is located, is predominantly inhabited by the Karo ethnic group and is situated 35 km from Medan City. Goa Ergendang is part of the STM Hilir region and falls under the regulation of Law No. 10 of 2009 on Tourism. Despite its proximity to Medan, accessibility to Goa Ergendang remains challenging, with a travel time of around 1.5 hours by private vehicle or 2 hours by public transportation.

3.2 Ecotourism Appeal of Goa Ergendang

The tourism potential of Goa Ergendang was assessed based on six main criteria: attraction, accessibility, socio-economic conditions, accommodation, supporting infrastructure, and clean water availability. Each criterion was evaluated using a weighted scoring system to provide an overall assessment.

3.3 Tourism Attraction

The attractiveness of Goa Ergendang is crucial for tourism development, focusing on natural uniqueness, flora and fauna, cleanliness, safety, and comfort. The Table 1 summarizes the assessment.

3.4 Accessibility

The evaluation of accessibility reveals that, while Goa Ergendang has significant potential, poor road conditions are a critical issue affecting tourist numbers (Table 2).

Accessibility is identified as the main challenge that needs immediate improvement.

3.5 Socio-Economic Conditions

The majority of Penungkiren Village residents are farmers, with most having completed secondary

education. Although the community supports tourism development, more effort is needed to maximize the economic benefits for the local population (Table 3).



Fig. 2. Natural conditions of the Goa Ergendang Tourist Site

Table 1. Assessment of tourism attraction elements at Goa Ergendang

Element	Weight (a)	Score (b)	Total Score (a × b)
Uniqueness of natural resources	6	30	180
Prominent natural resources	6	25	150
Tourism activities	6	30	180
Cleanliness	6	20	120
Safety	6	30	180
Comfort	6	25	150
Total Score			960

Goa Ergendang achieved a total score of 960, indicating that the site holds strong potential for further development

Table 2. Assessment of accessibility for Goa Ergendang

Element	Weight (a)	Score (b)	Total Score (a × b)
Road conditions	5	15	75
Distance from city	5	20	100
Type of road	5	25	125
Travel time	5	30	150
Total Score			450

Table 3. Socio-economic condition assessment of Penungkiren Village

Element	Weight (a)	Score (b)	Total Score (a × b)
Spatial planning	5	15	75
Occupation	5	20	100
Community response	5	25	125
Land status	5	15	75

Education level	5	30	150
Total Score			525



Fig. 3. Road leading to the Goa Ergendang Tourist Site

3.6 Accommodation

The assessment shows that accommodation facilities at Goa Ergendang remain limited, directly impacting visitor numbers (Table 4).

3.7 Supporting Infrastructure

The supporting infrastructure at Goa Ergendang is considered adequate, with a total score of **240**, reflecting that existing facilities help support tourism development (Table 5).

3.8 Clean Water Availability

The availability of clean water at Goa Ergendang is excellent, with a total score of **720**, indicating that the site is highly suitable for development in terms of water resources (Table 6).

3.9 Ecotourism Development Priorities

Based on the Focus Group Discussions (FGD) and analysis using Expert Choice, the priority development aspects for Goa Ergendang are presented in the Table 7.

Table 4. Accommodation assessment for Goa Ergendang

Element	Weight (a)	Score (b)	Total Score (a × b)
Accommodation	3	15	45
Number of rooms	3	10	30
Total Score			75

Table 5. Supporting infrastructure assessment for Goa Ergendang

Element	Weight (a)	Score (b)	Total Score (a × b)
Supporting facilities	3	50	150
Basic infrastructure	3	30	90
Total Score			240

Table 6. Clean water availability assessment for Goa Ergendang

Element	Weight (a)	Score (b)	Total Score (a × b)
Water volume	6	30	180
Distance to the site	6	30	180
Water quality	6	30	180

Flow ease	6	30	180
Total Score			720



Fig. 4. Well Infrastructure

Table 7. Priority development aspects for Goa Ergendang based on AHP

Criteria	Weight	Rank
Management aspects	416	1
Attraction aspects	227	2
Institutional aspects	157	3
Socio-economic aspects	149	4
Environmental aspects	54	5

Management aspects emerge as the top priority, which includes improving accessibility, accommodations, and supporting infrastructure. Attraction aspects are the second priority, focusing on innovating tourism activities such as cave exploration and additional facilities.

3.10 Development Strategy Analysis

The development strategy for Goa Ergendang tourism is based on a detailed Internal Strategic Factors Analysis Summary (IFAS) and External Strategic Factors Analysis Summary (EFAS). These factors help identify key strengths,

weaknesses, opportunities, and threats to create a strategic plan.

3.10.1 Internal factors

Internal factors are divided into strengths and weaknesses that affect the development of Goa Ergendang (Table 8).

3.10.2 External factors

External factors consist of opportunities and threats that can influence the site's development (Table 9).

Table 8. Internal strategic factors analysis summary (IFAS) for Goa Ergendang

Internal Strengths	Weight	Rating	Score
Pristine and cool environment	0.12	4.00	0.47
Beautiful caves and hot springs	0.10	4.00	0.40
Affordable food and beverage facilities	0.08	3.00	0.25
Proximity to Medan	0.08	3.00	0.23
Unique cave tourism experience	0.10	3.00	0.30
Strong community support	0.08	3.00	0.25

Total Strengths Score			1.89
Internal Weaknesses	Weight	Rating	Score
Limited freshwater availability	0.08	3.00	0.23
Lack of tourism promotion	0.09	3.00	0.27
Green zone restrictions limiting development	0.09	4.00	0.37
Declining visitor numbers due to limited funding	0.09	4.00	0.35
Insufficient facilities to become a tourism village	0.10	3.00	0.29
Total Weaknesses Score			1.50

Table 9. External strategic factors analysis summary (EFAS) for Goa Ergendang

External Opportunities	Weight	Rating	Score
Safe environment	0.11	4.00	0.44
Eco-friendly area	0.11	4.00	0.44
Preservation of trees and green spaces	0.11	4.00	0.44
High potential for further natural development	0.11	4.00	0.46
Productive economic activities	0.10	3.00	0.30
Opportunity for forming tourism awareness groups	0.09	3.00	0.26
Total Opportunities Score			2.35
External Threats	Weight	Rating	Score
Inadequate infrastructure	0.09	3.00	0.28
Poor accessibility	0.10	3.00	0.29
Competition from other tourism sites	0.07	3.00	0.22
Lack of innovation	0.10	3.00	0.30
Total Threats Score			1.10

3.11 SWOT Matrix and Strategic Planning

Table 10. SWOT matrix and strategic development plan for Goa Ergendang

SWOT Strategy Matrix	Strengths (S)	Weaknesses (W)
Opportunities (O)	SO Strategies	WO Strategies
- Safe and eco-friendly environment	- Maximize natural beauty and community support for tourism	- Improve security through partnerships with government
- High development potential	- Promote the site through digital channels	- Collaborate with stakeholders to improve infrastructure
- Opportunity to create tourism awareness groups	- Innovate tourism activities (e.g., cave lighting, photo spots)	- Train locals in tourism management
Threats (T)	ST Strategies	WT Strategies
- Poor infrastructure	- Improve road access and provide alternative routes	- Educate tourists and locals on eco-friendly tourism practices
- Competition from other sites	- Differentiate with unique features (e.g., private hot springs)	- Repair outdated infrastructure
- Lack of innovation	- Collaborate with local businesses for better service quality	- Organize events to attract visitors

Based on the IFAS and EFAS analysis, the total score places Goa Ergendang in Quadrant I of the SWOT matrix, indicating a Strengths-Opportunities (SO) Strategy. This strategy leverages internal strengths to capitalize on

external opportunities, focusing on aggressive development.

3.12 Strategic Recommendations

1. **Promote Tourism:** Utilize digital media to promote the unique aspects of Goa Ergendang, such as its caves and hot springs. Provide information on alternative access routes to improve visitor numbers.
2. **Leverage Community Support:** Engage the local community in tourism activities and encourage their participation in managing the site sustainably.
3. **Improve Infrastructure:** Collaborate with the local government to enhance infrastructure, including roads, facilities, and accommodations, to provide a better visitor experience.
4. **Innovation:** Introduce new attractions, such as photo spots, eco-friendly lighting within the caves, and private hot springs to differentiate the site from competitors.
5. **Partnerships:** Strengthen partnerships between local government, private investors, and the community to boost funding and resources for long-term sustainable growth.

3.13 Discussion

The results of this study reveal significant potential for the sustainable development of Goa Ergendang as a leading ecotourism destination in Deli Serdang, North Sumatra. By using the SWOT analysis, several critical strengths and weaknesses have been identified that can inform the strategic development of the area. The AHP approach further allows for the prioritization of key aspects such as infrastructure improvement, promotional efforts, and innovative tourism activities.

3.13.1 Leveraging strengths for tourism development

Goa Ergendang's primary strength lies in its unique natural environment, including its cave formations and hot springs. This aligns with previous research that highlights the importance of leveraging natural resources to attract ecotourism [1,4]. The pristine environment and community support are crucial to establishing the area as a unique ecotourism destination. However, effective management is necessary to ensure the long-term sustainability of these natural assets, as suggested by Hadiwijoyo [6].

3.13.2 Addressing infrastructure and accessibility weaknesses

The findings indicate that poor infrastructure and accessibility are significant barriers to increasing tourist visits, which is consistent with prior studies [2,7]. Infrastructure improvements, particularly road access and accommodations, must be prioritized to enhance the overall tourist experience. Improving these aspects will not only attract more visitors but also create economic opportunities for local communities, as suggested by Wulandari [11].

3.13.3 Harnessing opportunities for eco-tourism and community involvement

The opportunities for developing eco-tourism at Goa Ergendang are vast, particularly given the growing trend towards nature-based and sustainable tourism [3]. Increased community participation in tourism management, as recommended in the AHP analysis, can ensure that the local population benefits economically from the influx of tourists, thereby enhancing local support for conservation efforts [10]. Collaboration with local government, investors, and private sector stakeholders is essential for realizing these opportunities.

3.13.4 Mitigating threats through innovation and promotion

The threats posed by competition from other tourist sites and poor accessibility can be mitigated through innovation in tourism activities and effective promotion. Previous studies highlight the importance of digital promotion strategies [13], and the AHP results suggest prioritizing these efforts to boost Goa Ergendang's visibility. Innovative tourism products, such as eco-friendly cave lighting, private hot springs, and enhanced photo spots, can differentiate the destination from competitors [16].

3.13.5 Strategic development and sustainability

The overall strategic development plan for Goa Ergendang, informed by the SWOT and AHP analysis, indicates that a progressive strategy focusing on infrastructure, promotion, and innovation is crucial for long-term growth. The study's findings are consistent with the literature

on sustainable tourism development, which emphasizes the balance between environmental conservation and community engagement [1]. Future research could explore the impact of specific tourism activities on local biodiversity and the socio-economic conditions of the community.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusion

The development of ecotourism at Goa Ergendang holds significant potential, driven by the area's unique natural resources and strong community support. The SWOT analysis highlights key strengths, such as the site's pristine environment, the beauty of the caves and hot springs, and the active involvement of the local community. Despite these strengths, weaknesses such as limited freshwater availability, insufficient promotion, and inadequate facilities pose challenges to the site's optimal development.

Externally, the analysis identified opportunities in the eco-friendly and safe environment, along with the potential for natural resource development. However, the site faces threats, including poor infrastructure, accessibility issues, and competition from other tourism destinations. The SWOT matrix positions Goa Ergendang in Quadrant I, indicating that the best strategy is to leverage the site's strengths and capitalize on opportunities while addressing its weaknesses and mitigating threats.

To ensure sustainable development, it is essential to focus on improving infrastructure, promoting the destination through digital channels, and introducing innovative features to attract tourists. The active collaboration between the government, private sector, and local communities is vital to achieving long-term success.

4.2 Recommendations

To enhance the development of Goa Ergendang as a prominent ecotourism destination, several key recommendations are proposed. First, improving accessibility and infrastructure is crucial. Immediate efforts should focus on upgrading road conditions and providing alternative routes, which can be achieved through collaboration between local government and private stakeholders. Furthermore,

enhancing infrastructure, including accommodations and other supporting facilities, will play a pivotal role in increasing visitor satisfaction and boosting tourist numbers.

Strong digital promotion strategy is essential to raise awareness of Goa Ergendang's unique attractions. Utilizing social media and other digital platforms will help attract both domestic and international tourists, significantly improving the site's visibility and appeal. By leveraging modern marketing tools, the tourism potential of the area can be maximized.

Fostering strong partnerships between the government, private investors, and local businesses is essential for sustainable growth. Public-private collaborations can provide the necessary funding and resources for infrastructure development, promotional efforts, and environmental conservation initiatives. Such partnerships will ensure that Goa Ergendang continues to grow as a sustainable ecotourism destination, benefiting both the local economy and the environment.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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