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Sustainability Analysis of Kalong Cave Ecotourism in Pasir Panjang Village, Komodo National Park

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ABSTRACT

The management and development of the Kalong Cave tourist attraction has become part of the economic source for the people of Kampung Rinca, Komodo National Park. The sustainability of the management of this tourist attraction depends on the balance between four main aspects, namely ecology, social, economy, and institutions. Therefore, a comprehensive evaluation is needed regarding the sustainability status of the management of the Kalong Cave tourist attraction, in order to identify various factors that influence and formulate solutions to optimize management. This study aims to analyze the level of sustainability of the management of the Kalong Cave tourist attraction on Rinca Island using the Multi-aspect Sustainability Analysis (MSA) approach. This method allows the assessment of four aspects of sustainability consisting of 31 interrelated factors, including ecology, social, economy, and institutions. The stages of this research include: 1) preparation of the location and respondents, 2) data collection using the survey method with interview techniques, 3) data analysis using the Multi-aspect Sustainability Analysis (MSA), to describe the level of sustainability of the Kalong Cave tourist attraction based on the aspects and attributes developed, 4) analysis of the management strategy of the tourist attraction through a realistic and ideal scenario approach, to the sensitive factors of the Kalong Cave tourist attraction. The results obtained indicate that the sustainability status of the Kalong Cave tourist attraction in Komodo National Park is sustainable with an index of 69.33%. To improve the sustainability status to very sustainable, scenario 1 was chosen, namely the realistic scenario with improvements to 8 sensitive factors so that the sustainability index becomes 89.47%

INTRODUCTION

Indonesia has extraordinary natural wealth and biodiversity, one of which is Komodo National Park (TNK) located in East Nusa Tenggara Province. This area is famous not only for its natural beauty, but also as a natural tourist destination that has great potential in the tourism sector. One of the main attractions in TNK is the Kalong Cave, located on Rinca Island. This tourist attraction has an important role in supporting the economy of the Rinca Village community who live around the area. The Kalong Cave is home to thousands of bats that fly out of the Cave at dusk, creating an extraordinary view. The natural beauty around the Kalong Cave is also very enchanting, with views of the blue sea and beautiful landscapes, making it one of the must-visit attractions. The management of the Kalong Cave and the Komodo National Park area as a whole is under the responsibility of the Komodo National Park Office (BTNK), the management of the Kalong Cave is also carried out together with the Tourism Awareness Group (Pokdarwis) in Rinca Village, which has the task of preserving nature while developing sustainable tourism. The purpose of this management is to create a balance between nature conservation and empowering the local community economy. Local communities play an important role in the tourism sector, for example as tour guides, accommodation providers and various other services. The existence of attractions such as Gua Kalong also provides economic benefits to the community, with many tourists coming to enjoy the natural beauty while interacting with the local community.

Although the Gua Kalong tourist attraction has made a positive contribution to the local economy, its management faces complex challenges. The sustainability of the management of this tourist attraction depends on the balance between four main aspects, namely ecology, social, economy, and institutions. Therefore, a comprehensive evaluation of the sustainability status of the management of the Gua Kalong tourist attraction is needed, in order to identify various factors that influence and formulate solutions to optimize its management.

This study aims to analyze the level of sustainability of the management of the Gua Kalong tourist attraction on Rinca Island using the Multi-aspect Sustainability Analysis (MSA) approach. This method allows the assessment of four aspects of sustainability consisting of 31 interrelated factors, including ecology, social, economy, and institutions. The results of this analysis are expected to provide an overview of the current level of sustainability and recommendations for steps that need to be taken to improve the management of this tourist attraction to make it more sustainable. In addition, this research is expected to provide a significant contribution to the management of sustainable tourism in Komodo National Park, as well as produce relevant policy recommendations for the management of the Kalong Cave tourist attraction, which can provide optimal benefits for local communities and nature conservation.

METHODS

Research Location

This research was conducted from September to November 2024, located in Pasir Panjang Village, Rinca Island, Komodo National Park.

Types and Sources of Data

The type of data used in this study is secondary data obtained through literature searches, while primary data is obtained from filling out questionnaires by conducting direct interviews with the community, and key stakeholders such as managers, village governments, and Pokdarwis. Secondary data refers to information that has been collected by other parties for different purposes, which in this study was obtained through literature searches such as documents, books, articles, and other relevant sources. According to Sugiyono (2017), secondary data is generally used to enrich primary data or to provide an overview of the research topic. In contrast, primary data is data collected directly by researchers from the first source, namely the community and key stakeholders, such as managers, village governments, and Pokdarwis. This data is obtained through filling out questionnaires and direct interviews with

respondents. This interview aims to dig deeper information about their experiences and views related to the research object. Arikunto (2010) stated that primary data provides more accurate and relevant information because it comes directly from the object being studied.

Determination of Research Location

The technique for determining the research location is Purposive Sampling. According to (Sugiyono, 2016) Purposive Sampling is a sampling technique with certain considerations. This research was conducted in Kalong Cave, Rinca Island, Komodo District, West Manggarai Regency. The basis for determining the location is (1) the tourist attraction is in a conservation area which in its management must apply the principles of sustainability; (2) Kalong Cave is a new attraction and there has been no previous research related to the development of Kalong Cave tourism using the Multi-aspect sustainability analysis approach.

Determination of Respondents

Determination of respondents in this study used the Purposive Sampling method, namely a sample determination method with various considerations (Sugiyono, 2017). The population in the study or respondents were managers, Pokdarwis, village government and the Rinca Village community based on certain criteria, namely respondents understand data, information, or facts from an object being studied (Siregar, 2017). The respondents in this study numbered 6 people who were selected because they had knowledge or direct involvement in the management of the Gua Kalong tourist attraction.

Data Analysis

One of the modeling techniques developed to measure the sustainability of the Gua Kalong tourist attraction is a sustainability assessment technique using a multi-aspect sustainability analysis technique or Multi-aspect Sustainability Analysis (MSA) from Eximpro software. This software is a development of the previous tool, namely RAPFISH (Firmansyah, 2022). The principle used is a rapid assessment process, where respondents are not a sample size but key stakeholders/key persons who can be discussed through in-depth interviews or through observation and focus group discussions (Paulus et al., 2018). Several stages in the implementation of MSA sustainability analysis are the analysis stages, namely aggregate status values, aspect status values, future condition values, status value ordination, aspect lever factors, uncertainty errors, validation with random iterations, and policy priority scenarios.

Scenario selection can be done in MSA Sustainability Analysis based on the status values that appear. In addition to scenario values, lever factors are also the basis for the analysis of emerging scenarios. If researchers want to conduct a tiered scenario analysis (moderate scenario, optimistic scenario, and progressive scenario), then researchers can determine it by choosing the number of scenarios and driving factors to be analyzed. In this study, researchers used a tiered scenario analysis, namely realistic scenarios and idealistic scenarios. MSA Sustainability Analysis is used to find sustainability status values, performance indices, or performance indices of activities, places, activities, institutions, or companies in order to self-assess or assess conditions and descriptions to determine the strategies that must be carried out in the future. This assessment is also called a rapid assessment because it uses an existing database that is delivered through experts or selected respondents who meet the criteria. Then this assessment can be improved at any time if there is new data or conditions without having to re-analyze with the latest formulation or build a new model. The conceptual framework for the MSA approach is shown in Figure 1

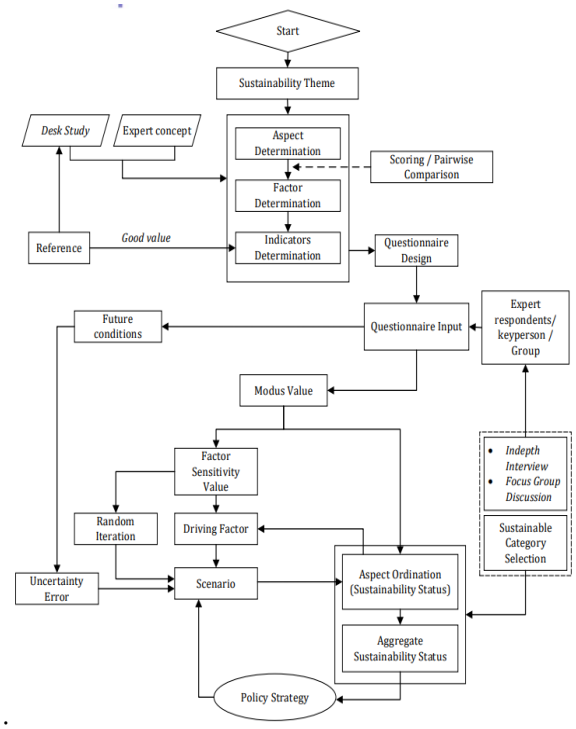


Figure 1. Conceptual Framework of the Multi-Aspect Sustainability Analysis Approach (Firmansyah, 2022)

RESULTS AND DISCUSSION

Overview of the Research Location

Administratively, Rinca Village is called Pasir Panjang Village and is part of Komodo District, West Manggarai Regency, NTT. This village is responsible for 6 hamlets, namely Bajo, Komodo, Beringin Jaya, Kampung Baru, Kerora and Kukusan Hamlets. Komodo, Bajo, Beringin Jaya and Kampung Baru hamlets are in one area; Kerora Hamlet is in the southern part of Rinca Island, while Kukusan is outside the island and only Kukusan is not part of the Komodo National Park Area. This village has an area of 21,764 km2.

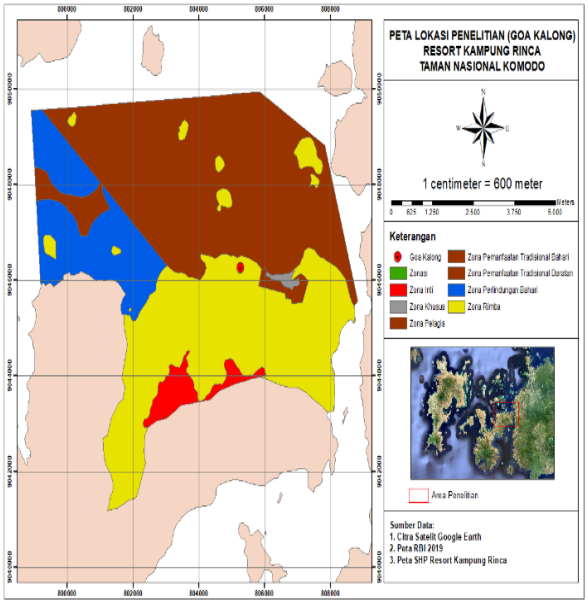


Figure 2. Map of Kalong Cave Research Location

Kalong Cave is located on Rinca Island which is within the Komodo National Park Area, which is famous for the presence of endemic wildlife, namely the Komodo dragon (Varanus komodoensis) and its natural beauty. Kalong Cave is an interesting natural cave, especially because it is a shelter for thousands of bats that can often be seen entering and exiting the cave at dusk. Activities that can be done in Kalong Cave are enjoying the spectacular sunset view with thousands of bats flying out of their nests, creating a stunning atmosphere. In addition, activities that tourists can do are Bird Watching around the Rinca village forest.

Sustainability Analysis of the Kalong Cave Ecotourism Attraction

A multi-aspect sustainability analysis of the four aspects of sustainability can identify sensitivity lever variables for ecological aspects, social aspects, economic aspects and institutional aspects that affect the sustainability of the Kalong Cave ecotourism attraction in Pasir Panjang Village, Rinca Island. The results of MSA on each aspect are described as follows:

A. Ecological Aspect

The sustainability index of the Kalong Cave ecotourism attraction in the ecological aspect is 71.33% with the category of "sustainable", where in the future this value can increase but not significantly because it has a future condition value of 50%. The results of the sustainability analysis in the ecological aspect can be explained in Figure 2.

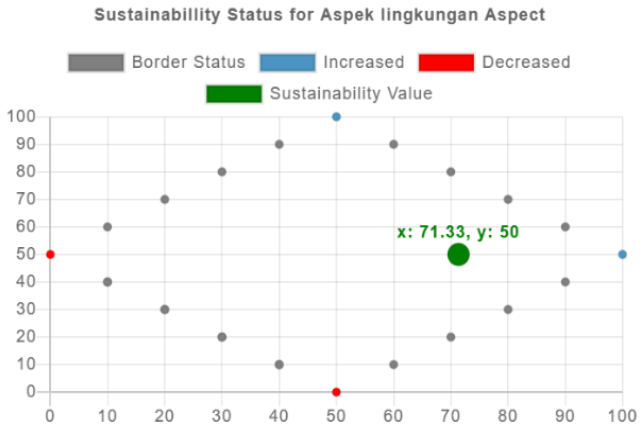


Figure 2. Status of Ecological Aspect Sustainability

From the results of the ecological aspect lever analysis shown in Figure 3, it is known that of the 9 factors analyzed, there are 5 sensitive factors that influence the sustainability of the Kalong Cave ecotourism, namely: (1) beauty/diversity, (2) sensitivity, (3) plastic waste management, (4) cultural potential, and (5) human potential. Information related to the lever factors of the sensitivity lever variables can be explained in Figure 3.

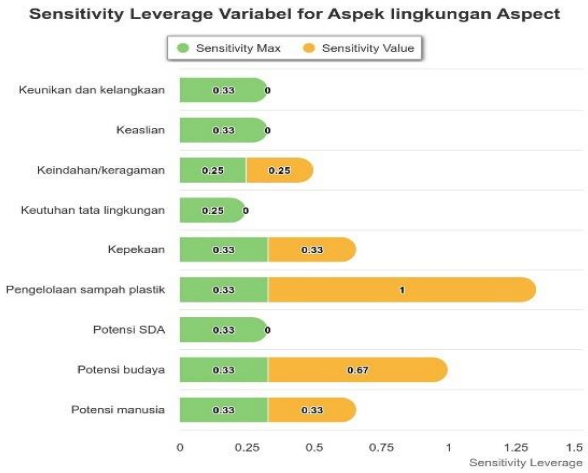


Figure 3. Variables Leveraging the Sensitivity of Ecological Aspects

The most sensitive factor affecting the sustainability of the Kalong Cave ecotourism from an ecological aspect is plastic waste management. The lack of knowledge and education regarding the impact of poorly managed waste has an impact on the lack of public awareness in managing plastic waste. Various efforts have been made by the community to destroy or dispose of plastic waste such as burying it in the ground or burning it, but these efforts have caused other problems such as the production of combustion gas and the emergence of plastic to the surface again after being buried (Sahwan et al., 2005). Therefore, managers (stakeholders) and the village government are making 3R efforts and policies implemented by the government, education for the community is needed so that plastic waste can be managed properly starting from the household level.

Efforts to manage waste in Rinca Village are still lacking by the village government itself, this can be seen from the community who still pile up and burn waste. There are several efforts made by stakeholders such as reducing plastic and bottle waste and then making crafts, but they have not had a major impact on reducing plastic waste. Regarding stakeholders, Guerrero et al. (2013) wrote that waste management involves several parties with different interests who play a role in building a waste management system. An explanation of the role of stakeholders, such as the government, the community, and technical parties in waste management is important for developing an effective, efficient, and sustainable waste management system model (Guerrero et al. 2013). The right solution in the plastic waste management process involves several important aspects such as public education. The government can conduct an educational campaign that focuses on the negative impacts of plastic waste, encourage the public to use environmentally friendly products, and integrate environmental education into the school curriculum (Sari and Sudarti 2022). The leverage sensitivity value of the variable shows the difference between the real status (based on the mode value) and the random iteration status value (based on the mean opinion), where the difference between the two should not be more than 5%. The respondent's estimated error value describes the range of confidence between factors where the closer the real status value and the random iteration status value, the smaller or better the error rate, while the greater the range between the two values (or more than 0.5), the higher the error rate. Therefore, it is necessary to review respondents' opinions to verify the gaps between respondents' opinions (Firmansyah, 2022

Figure 4. Sensitivity of Leverage Variables, Random Iteration Validation Status, and Respondent Error Estimates to Ecological Aspects

Based on the sensitivity value of the leverage variable, the ecological aspect has a good status value because the range between real and random iteration status is 1.67% or below 5%, where the real status is 71.33% and the random iteration status is 73%.

A. Social aspect

The sustainability index of the Gua Kalong tourist attraction in the social aspect is 75% with the category "**sustainable**", where in the future this value can increase but not significantly because it has a future condition value of 50%. Compared to the sustainability index value of the Gua Kalong multi-aspect tourist attraction, the sustainability index value of the Gua Kalong tourist attraction in the social aspect is above the sustainability index value of the Gua Kalong multi-aspect tourist attraction. An overview of the sustainability index in the social aspect can be seen in Figure 5.

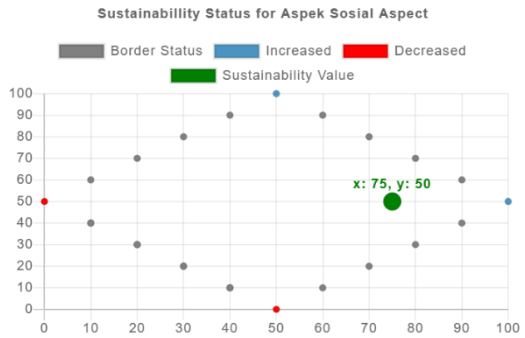


Figure 5. Status of Social Aspect Sustainability

From the results of the analysis of social aspect levers shown in Figure 6, it is known that of the 6 factors analyzed, there are 3 sensitive factors that influence the sustainability of the Kalong Cave tourist attraction, namely: (1) education level, (2) population employment, and (3) level of knowledge & public awareness. Information related to the lever factors of the sensitivity lever variables can be explained in Figure 6.

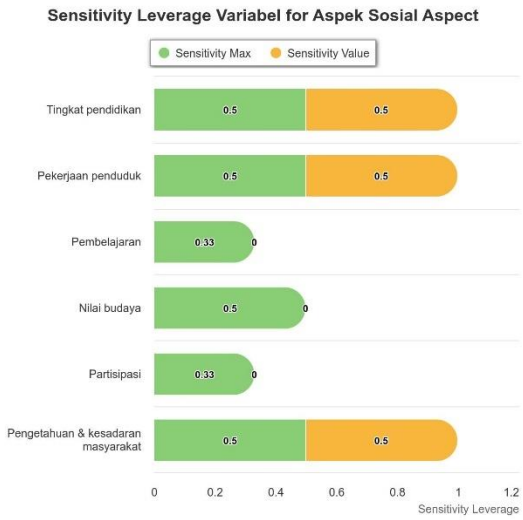


Figure 6. The Lever Factors of the Sensitivity Lever Variables

Figure 6 Variables leveraging the sensitivity of social aspects. The most sensitive factor affecting the sustainability of the Kalong Cave tourist attraction from a social aspect is the level of education. From the results of observations and interviews, the indicator of the level of education of the community around the area is classified as moderate, namely junior high school-high school. The level of education of the community around the tourist attraction greatly influences how the community understands and maintains tourism potential. Communities with higher levels of education, such as high school or college graduates, are better able to understand the importance of nature conservation and how to manage tourist attractions responsibly. Conversely, if the level of education is low, such as only at the junior high school level, the community may be less aware of the importance of preserving the environment and may be involved in activities that damage nature, such as pollution or physical damage to the cave. Therefore, good education can improve the community's ability to participate in conservation efforts and sustainable tourism management. Thus, good education can improve the community's ability to participate in conservation efforts and sustainable tourism management, which is important to deal with threats to the tourism sector. Without sufficient understanding, uncontrolled tourism activities can cause environmental damage, exploitation of natural resources, and a decrease in the quality of the tourist experience. Through proper education, the community will be more aware of the importance of preserving tourist destinations, so that conservation efforts can be more successful in protecting the natural beauty and local culture.

The level of community education plays a significant role in the management of tourist attractions and their sustainability. As stated in this study, people with higher levels of education generally have a better understanding of the importance of nature conservation and responsible management of tourist attractions. This is in line with the opinion of Shrestha (2012) who stated that higher education can increase community awareness and ability to manage natural resources, including tourist attractions, in a more effective and sustainable manner. Individuals with higher levels of education find it easier to understand the negative impacts of poorly managed tourism activities on the environment.

In addition, according to Davis and Kline (2006), higher education is also related to increased community knowledge about conservation practices and sustainable environmental management. Therefore, good education can foster an understanding of the importance of preserving nature and encourage people to participate in environmentally friendly tourism management activities.

The next sensitive attribute is the occupation of the population. Based on field observations, the people of Rinca Island, especially the people of Rinca Village, work as fishermen. Due to the geographical conditions, namely that people live on the island, most of the population are fishermen. However, with the determination of the Komodo National Park Area (TNK), with Rinca Island as one of the tourist destinations, Rinca Island has become known to the wider community, both local and foreign. The community can take advantage of the tourism potential around it, one of which is the Kalong Cave tourist attraction, which is an alternative job or income other than fishermen.

The type of work held by the local community affects their dependence on the tourism sector. For example, if most of the population works in the tourism sector, such as tour guides, innkeepers, or traders, they will be more affected by the condition of the tourist attraction. Conversely, if some of the population works in other sectors that are not directly related to tourism, such as farming or crafts, dependence on the tourism sector can be reduced, thereby helping to maintain environmental balance. According to the Social Exchange Theory initiated by George Homans (1958), people who feel the benefits of well-managed tourism will be more motivated to preserve the tourist attraction. Homans (1958) stated that "social relationships are formed through the exchange of benefits between individuals or groups," which means that people who receive economic benefits, such as jobs in the tourism sector, will care more about preserving the tourist attraction. Conversely, if the benefits received are limited, their participation in preservation can be reduced. Research by Sustainable Tourism Development (2011) also shows that when people feel they receive direct benefits, they are more supportive of sustainable tourism management and preservation. The next sensitive attribute is the level of knowledge & awareness of the local community. Based on field observations, the level of knowledge and awareness of local communities regarding the sustainability of ecotourism is still relatively low towards sustainable ecotourism. Community knowledge and awareness of the importance of the sustainability of tourist attractions greatly influences how they are involved in the management and preservation of tourist areas. Communities that have sufficient knowledge and high awareness of the negative impacts of tourism, such as environmental damage and cultural shifts, tend to be more active in preserving the local environment and culture. They are also more supportive of environmentally friendly management policies. In the context of ecotourism, the concept of sustainability includes more than just environmental preservation, but also empowerment of local communities and preservation of culture (Epler Wood, 2017; Hall & Lew, 1998). The main objective of this concept is to provide a rich tourism experience for visitors, while ensuring that tourism activities do not damage nature and support the welfare of local communities (Buckley, 2009; Sibila Lebe & Milfelner, 2006). Knowledge of the negative impacts of tourism can change people's attitudes, while awareness of the importance of sustainability will strengthen their intention to act in accordance with the principles of sustainable ecotourism. A study published in the journal Tourism Management showed that good knowledge about ecotourism can increase community participation in environmental and local cultural conservation activities, which in turn supports environmentally friendly management policies (Gómez-Baggethun et al., 2010). On the other hand, the Journal of Sustainable Tourism also emphasized that high awareness of sustainability issues encourages communities to be more involved in ecotourism management and the preservation of natural resources and cultural heritage (Mowforth & Munt, 2015). In other words, increased knowledge and awareness will increase collective actions that support the preservation of nature and culture, which in turn encourages the sustainability of ecotourism.

Figure 7. Sensitivity of Leverage Variables, Random Iteration Validation Status, and Respondent Error Estimates for Social Aspects

Based on the sensitivity value of the leverage variable, the social aspect has a good status value because the range between the real status and the random iteration is 5% or less, where the real status is 75% and the random iteration status is 70%.

A. Economic Aspect

The sustainability index of the Kalong Cave tourist attraction in the economic aspect is 66.7% with the category "**sustainable**", where in the future this value can increase but not significantly because it has a future condition value of 50%. The results of the sustainability analysis in the economic aspect can be explained in Figure 8.

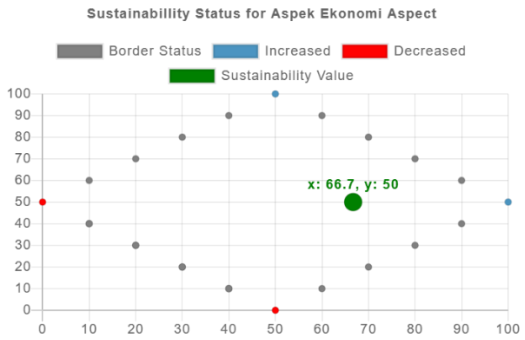


Figure 8. Sustainability Status of Economic Aspects

Compared to the sustainability index value of the multi-aspect Gua Kalong tourist attraction, the sustainability index value of the Gua Kalong tourist attraction in the economic aspect is above the sustainability index value of the multi-aspect Gua Kalong tourist attraction. From the results of the analysis of the economic aspect levers shown in Figure 4, it is known that of the 10 factors analyzed, there are 3 sensitive factors that affect the sustainability of the Gua Kalong tourist attraction, namely: (1) number of homestay rooms, (2) distance from the city, and (3) type of road. Information related to the lever factors of the sensitivity lever variables can be explained in Figure 9.

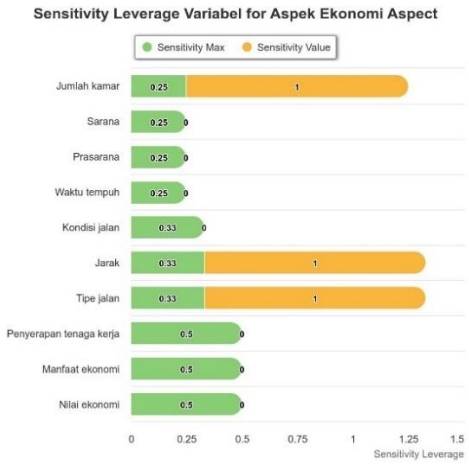


Figure 9. Economic Aspect Sensitivity Lever Variables

The most sensitive factor affecting the sustainability of the Gua Kalong tourist attraction from an economic aspect is the number of rooms in the homestay. Referring to the theory of Dewandaru et al. (2021), amenities are supporting facilities in tourism activities whose main aim is to provide comfort for tourists. Amenities that include supporting facilities such as accommodation, restaurants, and travel agents have an important role in creating comfort for tourists, as expressed by Riwukore et al. (2021). According to (Tjiptono, 2019) facilities are services provided by tourist attractions to support the comfort and activities of visitors. Adequate and standard facilities can increase the attractiveness of a tourist attraction, thus giving a positive impression of visitors and can attract tourist visits. The number of homestay rooms around the tourist attraction greatly affects the sustainability of tourism in Gua Kalong. Homestays are accommodations managed by the local community, providing an experience that is closer to local culture. This factor is directly related to several things such as visitor capacity, if the number of homestay rooms is limited, then visitors who come will have difficulty finding a place to stay, especially during the holiday season or weekends. This can reduce tourist comfort and encourage them to look for other tourist attractions that are more easily accessible. Easy accessibility and good infrastructure can increase visitor satisfaction and increase the likelihood of tourists returning (Delamartha et al., 2021). On the other hand, the impact on the environment, if the number of homestays increases excessively without proper management, can risk damaging the surrounding ecosystem. The addition of homestays that do not consider environmental aspects can cause environmental damage, thereby reducing tourist attractions and potentially reducing the quality of the tourist experience. The next sensitive attribute is the distance from the city to the Kalong Cave tourist attraction. The distance from the city to Pasir Panjang Village, Rinca Island> 15 km. According to Bagus & Wanda (2018), to achieve successful tourism destination development, continuous efforts are needed to improve quality, as well as create a positive image in the eyes of visitors and local communities. In this case, a thorough understanding of the important elements in a tourism destination, namely Attraction, Accessibility, Amenities, and Ancillary (known as the 4A), is crucial. Fulfillment of these four aspects can not only increase tourist satisfaction but also build a strong destination image. Setiawan et al. (2023) stated that there are several efforts that can be made to develop a tourist attraction, one of which is through the development of components based on the 3A concept, namely attractions, accessibility, and amenities. The distance of Kalong Cave from the city center affects various aspects in the management of this tourist attraction. The long distance has an important impact, both in terms of accessibility and empowerment. The further the location of the tourist

attraction from the big city, the more difficult and expensive the transportation costs that tourists must pay. This can limit the number of visitors who come, but for some tourists, the long distance is actually an attraction because it provides a quieter natural experience away from the crowds. The long distance can also be an opportunity for the surrounding community to gain economic benefits through the tourism sector, such as providing accommodation or selling local products.

The next sensitive attribute is the type of road. According to Sugiharto and Sari (2023), in developing tourist destinations, it is important to ensure accessibility that suits the needs of tourists, including ease of reaching the location and the provision of adequate road signs to guide tourists' journeys. This factor is very crucial, because good accessibility can increase visitor comfort and help optimize the potential of tourist destinations. The type of road from the village to the Gua Kalong tourist attraction is a footpath, but the road to Gua Kalong is rocky. Although the condition of the rocky dirt road, Pokdarwis Rinca has arranged the road well so that tourists can walk safely and comfortably. The condition and type of road to Gua Kalong greatly affect the comfort of tourists' travel. Bad or poorly maintained roads can make the trip unpleasant, even endangering safety. In addition, damaged road conditions can damage the surrounding environment and have a negative impact on the local ecosystem. Good and well-maintained roads, on the other hand, will provide a safer and more comfortable experience for tourists, thus increasing their interest in visiting. Therefore, adequate road infrastructure is very important to support smooth tourism and protect the environment. Theory of Riwukore et al. (2021) also added that good accessibility includes adequate local transportation and terminals to accommodate tourists' travel to the destination

Figure 10. Sensitivity of Leverage Variables, Random Iteration Validation Status, and Respondent Error Estimates to Economic Aspects

Based on the sensitivity value of the leverage variable, the economic aspect has a good status value because the range between real status and random iteration is 2.7% or below 5%, where the real status is 66.7% and the random iteration status is 64%.

A. Institutional Aspect

The sustainability index of the Kalong Cave tourist attraction in the institutional aspect is 69.5% with the category "**sustainable**", where in the future this value can increase but not significantly because it has a future condition value of 50%. The results of the sustainability analysis in the institutional aspect can be explained in Figure 11

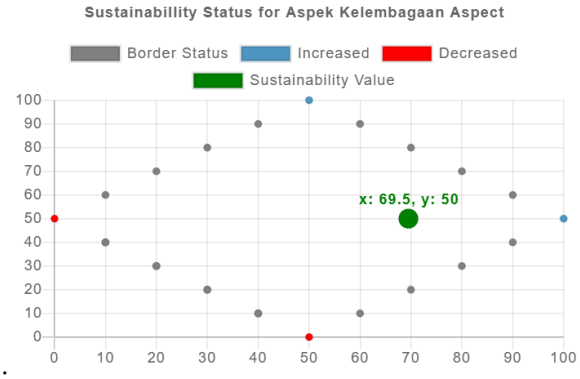


Figure 11. Sustainability Status of Institutional Aspects

Compared to the sustainability index value of the multi-aspect Gua Kalong tourist attraction, the sustainability index value of the Gua Kalong tourist attraction is above the sustainability index value of the multi-aspect Gua Kalong tourist attraction. From the results of the analysis of institutional aspect levers shown in Figure 5, it is known that of the 6 factors analyzed, there are 3 sensitive factors that affect the sustainability of the Gua Kalong tourist attraction, namely: (1) partnership and collaboration (2) monitoring and evaluation and (3) providing training or socialization. Information related to the lever factors of the sensitivity lever variables can be explained in Figure 12.

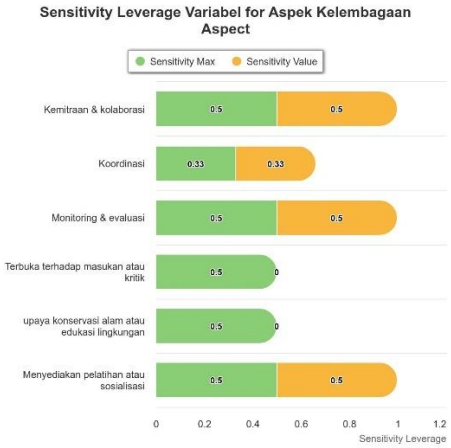


Figure 12. Institutional Aspect Sensitivity Lever Variables

The most sensitive factor affecting the sustainability of Kalong Cave ecotourism from an institutional aspect is partnership and collaboration. Ecotourism that involves the community in all aspects of its development and management is often referred to as community-based ecotourism. According to the Ministry of Culture and Tourism and WWF-Indonesia (2009: 2), the community-based ecotourism model is an ecotourism development approach that supports and enables the full involvement of local communities in the planning, implementation, and management of ecotourism businesses and the distribution of profits obtained. In addition, research by Masud, et al. (2017: 110-111) states that community-based ecotourism is the basis for sustainable development. This development provides important resources for the community to improve their standard of living, protect natural and cultural heritage, and provide economic benefits to them.

The sustainability of ecotourism in Kalong Cave is greatly influenced by partnerships and collaborations between related parties, such as the government, community, private sector, and non-governmental organizations. According to Jamal & Getz (2000), effective collaboration can ensure optimal resource utilization and reduce conflicts between parties, as well as strengthen environmental conservation. Butler (2008) also emphasized the importance of involving all stakeholders in decision-making to ensure the sustainability of ecotourism, which not only provides economic benefits but also supports the preservation of the local environment and culture. Such collaboration also allows for the economic empowerment of local communities in an environmentally friendly context, in line with the principles of ecotourism that balance economic benefits and nature conservation (Torres & Momsen, 2004). Therefore, collaboration between the parties involved is very important to achieve the goal of sustainability in the Kalong Cave ecotourism.

The next sensitive attribute is monitoring and evaluation. Monitoring and evaluation are very important activities in maintaining the sustainability of the Kalong Cave tourist attraction. Monitoring is carried out to monitor the condition of the tourist attraction continuously, while evaluation aims to assess the extent to which the policies and programs implemented can achieve the desired goals. Monitoring will help detect changes in environmental or social conditions that may be detrimental, while evaluation will measure the impact of tourism activities on the community and the environment and the effectiveness of the policies implemented. The Sustainable Development Theory put forward by the Brundtland Commission (1987) states that in order to maintain the sustainability of a system (including tourist attractions), there needs to be strict monitoring and evaluation of the environmental, social, and economic impacts arising from tourism activities. The sustainable tourism management model, this model proposes that tourism sustainability must include management based on evaluating the impact on ecosystems, local economies, and social welfare, as well as sustainable infrastructure development. The next sensitive attribute is providing training or socialization. It is important to provide training and socialization to visitors and the community in order to support the sustainability of ecotourism, especially in Kalong Cave. Pforr & Hosie (2007) stated that this training can increase visitors' awareness of the environmental impacts of their tourism activities and guide them to behave in an environmentally friendly manner. In addition, McCool & Moisey (2008) emphasized that socialization to local communities is also very important, because they play an active role in preserving the environment and culture. Through ongoing training, visitors and the community can collaborate with each other in ensuring that the Kalong Cave ecotourism develops sustainably, maintaining a balance between economic benefits and nature conservation.

Figure 13. Sensitivity of Leverage Variables, Random Iteration Validation Status, and Respondent Error Estimates for Institutional Aspects

Based on the sensitivity value of the leverage variable, the institutional aspect has a good status value because the range between real status and random iteration is 2.5% or below 5%, where the real status is 69.5% and the random iteration status is 67%.

Kalong Cave Tourism Object Scenario

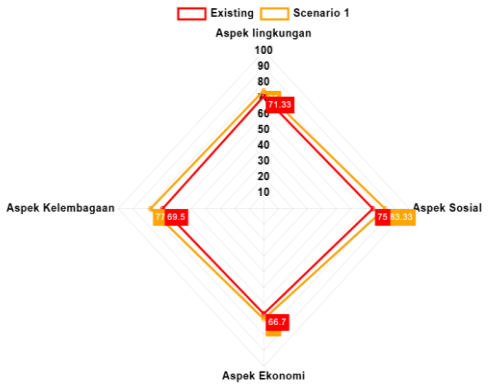
The sustainability value in the existing condition in aggregate is 70.63 with a sustainable category where the highest aspect is the social aspect with a status value of 75. The leverage factor is carried out in the scenario simulation by taking as many as 1 leverage factor in each aspect so that the sustainability status value in scenario 1 (realistic) in aggregate increases to 76.54 or enters the very sustainable category. In detail, the existing conditions and scenario status values can be seen in Table 1.

Table 1. Status and Sustainability Value of Existing Conditions and Scenarios

Sustainabillity Value

No.	Aspect	Existing	Scenario 1
1	Aspek lingkungan	71.33	75
2	Aspek Sosial	75	83.33
3	Aspek Ekonomi	66.7	70
4	Aspek Kelembagaan	69.5	77.83
	Total Average	70.63	76.54
	Status Sustainabillity	Sustainable	Very Sustainable

Nilai indeks The sustainability of the Kalong Cave tourist attraction for each aspect can be described in the form of a pie chart as shown in Figure 14. The diagram shows that various aspects have a sustainable status category as indicated by the red line. Improvement of all aspects needs to be done so that the sustainability value can be increased through improvement scenarios. The orange line shows a realistic improvement scenario (scenario 1) for each aspect. In this scenario, one of the most sensitive factors is selected that affects each aspect whose sustainability is assessed, as previously explained.



Value	Status Sustainabillity
0 - 25	Unsustainable
> 25 - 50	Low Sustainable
> 50 - 75	Sustainable
> 75 - 100	Very Sustainable

Gambar 14. Diagram Layang-Layang Indeks dan Status Keberlanjutan Objek Wisata Gua Kalong

CONCLUSION

The management of the multi-aspect Kalong Cave tourist attraction is still sustainable with ecological aspects of (71.33%), social aspects of (75%), economic aspects of (66.7%) and institutional aspects of (69.5%). Of the four multi-aspects, the social aspect has the highest sustainability value. Future conditions are expected to improve if current conditions can be maintained, which is 70.63%, because it has very good prospects. The priority scenario chosen is a realistic scenario, because it is easier to implement in policy. Thus, overall this condition can increase to 76.54% (very sustainable). The main factors that drive the social aspect to achieve very sustainable status are the level of education, employment, and public knowledge and awareness.

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