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Regional Case Study

Evaluation of Waste Management for Ecotourism Development: A Case Study of Goa Rangko, Labuan Bajo, West Manggarai Regency, East Nusa Tenggara, Indonesia

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Abstract

The development of ecotourism in Goa Rangko, Labuan Bajo, West Manggarai Regency, East Nusa Tenggara, has increased waste generation, resulting in environmental degradation and negative impacts on the tourism industry. To address this issue and achieve sustainable tourism, this study aims to investigate the current waste management system in Goa Rangko and propose an optimized solution. The research was conducted through direct field observations and the collection of secondary data from literature and government documents. Waste characterization studies were undertaken to determine waste generation and composition. Based on the findings, a Material Recovery Facility (MRF) was recommended for waste management. The MRF would encompass a source-to-final processing system, ensuring efficient waste handling. Any residue from the process would be appropriately disposed of in the landfill. In addition to the MRF, the study proposes the involvement of the local community, along with education and awareness-raising programs. These initiatives aim to foster a sense of responsibility among the residents and tourists in managing waste sustainably. Moreover, the study suggests implementing an ecotourism certification program to support sustainable tourism development in Goa Rangko.

Keywords: Tourism; waste management; ecotourism certification; community involvement; goa rangko

1. Introduction

Goa Rangko is a tourist attraction located on the main island of Labuan Bajo. It is a beautiful cave with crystal-clear water that provides a serene setting for swimming or photographing. Like any other tourist destination, visitors to Goa Rangko expect comfortable and clean infrastructure. Cleanliness is closely related to environmental sustainability, a top tourist priority (Juniartha et al., 2019, Rama and Wulung 2021, Suryawan et al., 2021a). Improper waste disposal by residents and businesses around the tourist area can decrease tourist attraction. However, the rapid development of tourism infrastructure also requires proper waste management facilities. Despite various approaches by the government, such as hotel and restaurant tax regulation, significant impacts on waste management have yet to be achieved (Leha et al., 2021).

This research is important for improving ecotourism in Goa Rangko because it focuses on the optimization of waste management in the area. As a popular tourist destination, Goa Rangko with 17,361 visitor in 2022 (Ardin, 2023), is facing challenges in managing the increasing amount of waste generated by tourists and local businesses. Poor waste management can lead to environmental degradation, which in turn can reduce the attractiveness of the area for tourists. By analyzing the existing waste management practices in Goa Rangko and proposing recommendations for improvement, this research can help ensure the sustainability of ecotourism in the area. Implementing better waste management practices can reduce the negative impact of tourism on the environment, while also improving the overall visitor experience. Additionally, it can help to preserve the natural beauty of Goa Rangko for future generations of visitors. Proper waste management in Goa Rangko can positively impact both visitors and the surrounding villages. For visitors, proper waste management can improve the destination's cleanliness and overall aesthetic appeal. This can lead to a more enjoyable and satisfying experience for tourists. It can also prevent the spread of diseases and minimize the risk of accidents that may be caused by improperly disposed waste. For the surrounding villages, proper waste management can prevent pollution and contamination of the environment. This can lead to better health outcomes for residents and improve the overall quality of life in the community. Proper waste management can also generate employment opportunities for local residents in waste management and recycling industries, creating a sustainable source of income for the community.

The research on waste management optimization in Goa Rangko is essential as it addresses a critical gap in the current ecotourism development. While Goa Rangko is rapidly becoming a popular tourist destination, the increasing waste generation poses significant challenges for the sustainability of the ecotourism industry. However, existing waste management practices in the area have not been thoroughly studied, and there is a lack of comprehensive strategies to address waste-related environmental degradation (Suryawan and Lee 2023, Phan et al., 2022). This research aims to fill this gap by conducting a thorough analysis of the current waste management practices and proposing recommendations for improvement. This research's novelty lies in its focus on waste management optimization for ecotourism in Goa Rangko. While the region is renowned for its natural beauty and attracts many tourists, the impact of waste generation on the environment and tourism industry has not been adequately addressed in previous studies. This research introduces a novel approach to tackle the waste-related challenges in the context of ecotourism development. It employs direct field observations and waste characterization studies to comprehensively understand waste management practices and their impact on the environment. Moreover, the proposal of a Material Recovery Facility (MRF) as part of the optimized waste management system is an innovative solution to handle waste sustainably.

This research aims to investigate the existing waste management system in Goa Rangko, Labuan Bajo, Manggarai Regency Barat, East Nusa Tenggara. Based on this existing condition, a recommended waste management optimization analysis can be conducted to achieve sustainable tourism in Goa Rangko, Labuan Bajo, Manggarai Regency Barat, East Nusa Tenggara. Compared to previous studies, the gap in this study is that it specifically focuses on the existing waste management system in Goa Rangko, Labuan Bajo, Manggarai Regency Barat, East Nusa Tenggara. While there may have been studies conducted on waste management in other tourist destinations, this study aims to analyze and recommend optimization strategies specific to Goa Rangko. Additionally, this study considers the unique characteristics of Goa Rangko as a relatively new tourist destination still developing within the local community. Previous studies may have focused on more established tourist destinations, and their findings and recommendations may not be directly applicable to Goa Rangko. Furthermore, this study intends to provide a comprehensive analysis of the existing waste management system in Goa Rangko, including identifying current challenges and limitations and proposing specific solutions that take into account the local context and resources available. This in-depth analysis and localized recommendations may not have been addressed in previous studies on waste management in other tourist destinations.

2. Methods

This research was conducted in Goa Rangko, a tourist area located in Labuan Bajo, West Manggarai Regency, East Nusa Tenggara. The study was conducted during the COVID-19 pandemic in December 2020. To collect the necessary data for the research, direct observation in the field was conducted. The research team visited the tourist area of Goa Rangko and observed the existing waste management system. The researchers noted how the waste was managed, whether there were waste bins, how often the waste was collected, and how the waste was transported and disposed of. The results might not entirely reflect the intricacies of waste production and handling across varying seasons or typical tourism scenarios, which could restrict the broad applicability of the findings.

The research method used in this study, which includes direct field observations and secondary data collection, is sufficient to evaluate the current waste management situation in Goa Rangko. The combination of these methods allows for a comprehensive assessment of the waste management practices in the tourist area. Direct observation in the field provided firsthand information on how the waste was managed in Goa Rangko. By physically visiting the tourist area, the research team could observe the existing waste management system, including the presence of waste bins, the frequency of waste collection, and the transportation and disposal methods used. This on-site observation allowed for a real-time assessment of the waste management practices, ensuring accuracy and reliability in data collection. In addition to direct observation, the research team collected secondary data from various literature and documents issued by the local and central governments. This step was crucial in gaining a more comprehensive understanding of the waste management system in Goa Rangko. The secondary data provided valuable insights into government policies, regulations, and initiatives related to waste management, which complemented the direct field observations.

The data collected from both direct observation and secondary sources were then analyzed descriptively, taking into account ideal conditions and solutions from previous studies on waste management practices. This comparative analysis allowed the researchers to identify the gaps and shortcomings in the existing waste management system in Goa Rangko. This research method employed in this study is rigorous and comprehensive, providing a solid basis for evaluating the current waste management situation in Goa Rangko. The combination of direct field observations, secondary data collection, and comparative analysis ensures a thorough assessment of the waste management practices (Davidson et al., 2021, Yadav et al., 2023, Suryawan and Lee 2023, Sutrisno et al., 2023), enabling the researchers to propose effective strategies for achieving sustainable tourism through waste management optimization in the area.

3. Result and Discussion

The Goa Rangko is a tourist destination about 13.7 – 15.6 km from downtown Labuan Bajo. Tourists can reach the cave by motorbike or car in about 28-33 minutes from Labuan Bajo. However, to get to the tourist location of Goa Rangko, which is located within the cave, tourists must also cross by boat as there is no direct access to the location. Boat rentals are available in Rangko Village, and the rental cost ranges from IDR 300,000 to 350,000. This information provides valuable insight into the accessibility of the destination and the cost associated with visiting it. It can be compared with other studies on the accessibility and cost of visiting other tourist destinations to better understand how it impacts tourism in the region.

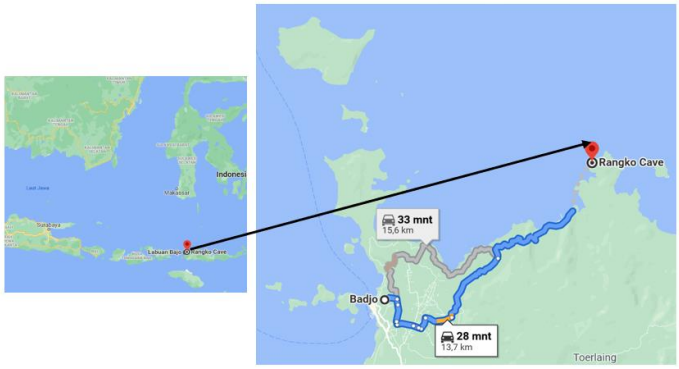

Figure 1. Location of goa rangko tourism object, goa rangko, labuan bajo, west manggarai regency, east nusa tenggara

The satisfaction level of visitors to Goa Rangko tourism with existing facilities and services is at a Tourist Satisfaction Index value of 69.99% (Marselina, Leha and Ota, 2020). This, of course, cannot be separated from the existing waste management (Marselina, Leha and Ota, 2020). The Labuan Bajo Flores Authority Executing Agency (BPOLBF) noted that the average waste generation in Labuan Bajo reached 112.4 m^3/day (13 tons/day), including plastic waste. "Waste in Labuan Bajo is a serious tourism issue" (Mutiah 2021). This includes the problems facing the Goa Rangko tourist destination area at the moment, which are the large amount of plastic waste scattered along the coast, originating from tourists and local communities as well as from the sea (Berita Flores 2020).

The Labuan Bajo Flores Tourism Authority Agency (BOPLBF) is again implementing the BISA (Clean, Beautiful, Healthy, Safe) movement in Rangko Village (Florespos, 2020). The BISA activity was carried out because of the large amount of garbage scattered in the tourist destination of Goa Rangko. In addition, this activity is also an effort to restore the tourism sector through strengthening tourist destinations by implementing hygiene, health, safety and environmentally friendly (Cleanliness, Health, Safety, Environment/CHSE) protocols in a disciplined manner (Berita Flores 2020).

In the conditions of the COVID-19 pandemic, sanitation management must be fulfilled to ensure visitors' safety to tourist attractions. Preparation of sanitation infrastructure such as toilets and trash cans and supporting safety and security is now mandatory. Another thing that needs to be considered in waste management at tourist attractions is the generation of mask waste which is a challenge in itself at tourist attractions (Sari et al.,., 2022). Masks are personal protective equipment that must be used in a pandemic. After it is unsuitable for use, the mask is usually thrown in the usual trash and becomes a source of problems (Septiariva et al., 2022).

In developing a waste management system and selecting the appropriate processing technology, accurate and reliable data regarding the composition and generation of waste is required. The average amount of household waste generation is 2.49 liters/person/ day or 0.29 kg/ person/ day (Leha et al., 2021). Meanwhile, the waste in Labuan Bajo City is dominated by organic waste in food waste which reaches 33.64% of the total waste generation (Leha et al., 2021). Paper waste, with the second largest composition from the household sector, can be sold at 16.97% (Leha et al., 2021). However, physical, geographical, sociocultural, economic, and political factors can affect the composition and generation of waste (Masjhoer 2017, Yulianto and Susanto 2020, Tchobanoglous and Vigil 1993). Especially, the tourism industry can cause a significant impact on the environment concerning people's consumption patterns (Suryawan, Rahman, et al.,., 2021). One of the main impacts of tourism is the change in the generation rate and composition of municipal waste and household waste (Suryawan et al., 2021a). Several previous studies have reported an increase in waste generation in tourist areas due to the high number of tourists during the tourism season (Yusari and Purwohandoyo 2020; Nofriya et al., 2019; Pranata Darma; Rai Kristina 2021). Thus, the composition of waste and the level of waste generation can be different in places that are influenced by the social demographics of tourists and tourism destinations.

Figure 2 illustrates the current situation of waste bin placement in Goa Rangko. From the visualization, it becomes evident that not only is there a scarcity of waste bins in the area, but there's also a glaring lack of provisions for segregation. This suggests that waste is likely being disposed of without any differentiation between recyclables, organics, and other waste types, which could pose significant environmental and management challenges for the region

Figure 2. Trash containers at the goa rangko tourism site

Waste characterization studies are important to understand the waste generation and composition in different tourist attraction areas. This information is essential in planning a sustainable waste management system that can effectively handle the waste generated by tourists and local residents. However, there is a lack of data on waste generation and composition in Labuan Bajo and Goa Rangko, which makes it difficult to plan and implement an effective waste management system. Therefore, studies need to collect data on waste generation and composition in these locations. By quantifying the waste infrastructure required to handle the waste generated, a sustainable waste management system can be planned that matches the capacity. This will help to ensure that the waste generated is appropriately managed, and the negative impact of tourism on the environment is minimized. Based on the results of observations of waste receptacles in the study locations, it is still quite limited. The waste container at the study site only provides a mixed system with all categories of waste. A good container must be separated by category of waste.

Figure 3 illustrates the waste management triangle, emphasizing a systematic progression from prevention to disposal. This visual underscores the critical stages of waste management, prioritizing waste prevention at its apex and culminating in disposal as a last resort, presenting an ideal approach to sustainable waste management. Furthermore, solid waste generated at waste sources and tourist sites must be segregated from the source, perhaps based on the 3R principles (reduce, reuse, and recycle) (Yunik'ati et al., 2019; Pranata Darma; Rai Kristina 2021, Aziz et al., 2020). Organic waste that has leftover,

rotting vegetables can be put in closed containers and then given to nearby households as pet food, which can minimize the amount of organic waste generated in tourist areas, limiting odors. For plastic cups and plastic bottles, users must pay an additional fee for the ticket so that the amount of waste can be efficiently reduced.

Solid waste disposal is also a concern in the Goa Rangko tourism area. Given the lack of a sustainable waste disposal system, solid waste is disposed of by illegal dumping and indiscriminate burning. The use of open dumping has become a common practice in remote areas. Not managing garbage causes many mosquitoes, flies, cockroaches, and rats to carry diseases (Ni'ma et al., 2020). The most challenging aspect of setting up a waste management system is that a landfill requires a large area of land, careful planning, and a very long distance from the nearest city. Good waste management must be carried out to prevent an increasingly inappropriate generation. The use of packaged products to tourist attraction locations must be carried out. As in several tourist areas in Indonesia, such as Bali, single-use plastic bags are no longer permitted (Suwendra 2018, Putri 2019, Widiantara 2020).

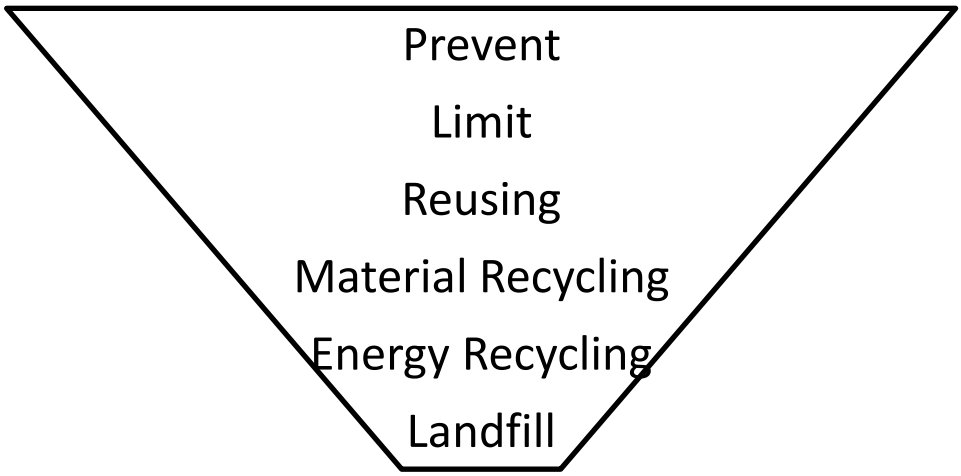

Figure 3. The waste management triangle for goa rangko tourism objects

Waste with a sale value can be recycled or processed into new materials. By system, after the waste is transported, the waste is processed in the material recovery facility (MRF). All non-recyclable waste is incinerated as incineration reduces the amount of waste to at least 10% remaining, maintaining the limited capacity of Singapore's sanitary landfills (Wang et al., 2021). Bai and Sutanto suggest that combustion with energy recovery is a viable option for densely populated and developing islands such as Singapore, Hong Kong, and Japan (Bai and Sutanto 2002). These studies show that planning and developing independent waste management strategies in remote areas is one of the challenges. Incineration with power plants is difficult to do in remote areas with low waste generation. However, shipping the flammable waste components outside the regional centre allows the flammable waste to be reused as electricity. Converting combustible waste into fuel derived from waste (Refuse Derived Fuel) is believed to improve energy recovery (Zahra et al., 2022, Hajinezhad et al., 2016, Koko et al., 2022). In addition, Refuse Derived Fuel (RDF) technology has great potential and has been widely used in Indonesia, especially in tourist areas such as Bali Island (Chaerul et al., 2020, Qonitan et al., 2021, Suryawan et al., 2021b).

Proper waste management at the tourist attraction area can serve as a way to educate visitors and the public about environmental preservation and sustainable tourism. Transferring waste to the Material Recovery Facility (MRF) and subsequent disposal at the landfill is a standard waste management practice. However, the waste management activities at the tourism promotion area can be used as an educational tool for visitors and the public. This can help to promote sustainable tourism practices and encourage responsible waste management practices among tourists. In addition, there is an opportunity for the TPA

to become an ecotourism product, specifically through educational tourism (edu-tourism) programs. Edu-tourism can provide visitors with a better understanding of the local community's environmental, cultural, and socio-economic aspects. This can also help to promote sustainable tourism development programs, which aim to balance economic needs, socio-cultural relations, and environmental preservation.

Community involvement is essential in developing sustainable waste management practices at the tourist attraction area. Community participation can ensure that the local community is seen as a subject and not an object of tourism development. This means that the community should be involved in all stages of waste management planning, including waste generation, collection, transportation, processing, and disposal. Community participation can also help to achieve good waste management practices and is a key factor in achieving waste management goals. Overall, proper waste management practices at the tourist attraction area can serve as a form of outreach and education for visitors and the public, promoting sustainable tourism practices and environmental preservation. The involvement of the local community in waste management planning is essential to achieving these goals.

Based on the findings of the study on waste management in Goa Rangko, the following policy recommendations can be made to support ecotourism in the area:

1. Develop and implement a waste management plan: A comprehensive waste management plan should be developed and implemented by the local government to ensure proper waste collection, sorting, treatment, and disposal. The plan should also include provisions for monitoring and enforcement of waste management regulations.
2. Increase public awareness and participation: A public awareness campaign should be launched to educate tourists and local communities about the importance of proper waste management and its impact on the environment. Local communities should also be encouraged to actively participate in waste management activities, such as waste segregation, recycling, and composting.
3. Establish partnerships with local businesses: Local businesses, such as restaurants, hotels, and tour operators, should be encouraged to adopt sustainable waste management practices. The local government can work with these businesses to provide training and support for waste reduction and recycling.
4. Provide infrastructure for waste management: Infrastructure, such as waste bins and recycling facilities, should be provided in tourist areas to encourage proper waste disposal. The local government should also invest in waste treatment facilities, such as composting and recycling plants, to reduce the amount of waste sent to landfills.
5. Implement ecotourism certification: The local government can develop an ecotourism certification program for businesses and tour operators in Goa Rangko. The certification can be used to recognize and promote sustainable tourism practices, including proper waste management.

Ecotourism certification can support Goa Rangko visitors by assuring them that the tourism activities they participate in are sustainable and environmentally responsible. An ecotourism certification program provides a set of standards and criteria that tourism operators must meet in order to be certified as ecotourism providers. For example, the Global Sustainable Tourism Council (GSTC) offers a certification program that sets standards for sustainable tourism practices. Tourism operators can showcase their commitment to sustainable tourism and assure visitors that their activities are environmentally and socially responsible by achieving certification. Ecotourism certification among tourism operators in Goa Rangko, visitors can have confidence in their travel choices and support sustainable tourism practices. This can help protect the area's natural environment and cultural heritage, while also providing economic benefits to local communities.

To improve waste management in Goa Rangko, several policy recommendations can be implemented. Firstly, conducting waste characterization studies is essential to understand the quantity and composition of waste generated in the area. These studies will provide valuable insights for designing a tailored waste management system and infrastructure that aligns with the specific waste types and

quantities. Secondly, establishing a Material Recovery Facility (MRF) as a source-to-final processing system is recommended. An MRF would enable the efficient sorting and recycling of waste materials, reducing the amount of waste sent to landfills and promoting a more sustainable waste management approach. Strengthening waste collection infrastructure is another critical step. Proper waste containers and collection facilities should be provided in Goa Rangko based on the characteristics of waste generation. Adequate waste collection infrastructure will encourage tourists and locals to dispose of their waste properly, minimizing littering and illegal dumping. Additionally, fostering community involvement and awareness is crucial. Engaging the local community in waste management initiatives through education and awareness-raising programs can create a sense of ownership and responsibility, leading to better waste management practices.

However, this research has some limitations that need to be acknowledged. Firstly, there is a lack of comprehensive data on waste generation and composition in Labuan Bajo and Goa Rangko. Designing an optimized waste management system may be challenging without detailed information on the quantity and types of waste produced. Moreover, the research focused specifically on waste management in Goa Rangko during the COVID-19 pandemic in December 2020. The findings may not fully capture the dynamics of waste generation and management during different seasons or under normal tourism conditions, limiting the generalizability of the results.

Furthermore, while the research recommends recycling as a waste management solution, it does not delve into specific recycling options or the feasibility of regional recycling facilities. Further research on available recycling technologies and their economic viability would provide more concrete recommendations. Lastly, implementing new waste management policies and infrastructure may face challenges like budget constraints and stakeholder resistance. Addressing these implementation barriers is essential to ensure the success and effectiveness of the proposed waste management strategies. Despite these limitations, the research provides valuable insights into the current waste management situation in Goa Rangko and offers valuable policy recommendations for achieving sustainable tourism in the area.

4. Conclusions

Waste management at the Goa Rangko tourist attraction needs to be improved by looking at the concept from source to final processing location. To achieve this, the waste management concept needs to be looked at from the source of waste generation to the final processing location. Proper infrastructure, such as waste containers, must be provided based on the existing waste generation and composition characteristics. However, further studies are needed to determine the waste generation and composition at the location to achieve this. The research also highlights the lack of waste processing locations which can lead to illegal waste dumping. To address this issue, the waste should be collected and further processed by recycling in the nearest city center. This would help manage the waste effectively and contribute to sustainable tourism in the region. It should be noted that the lack of data on waste generation and composition in Labuan Bajo and Goa Rangko is a significant gap in the current understanding of waste management in the region. This area requires further attention, as waste characterization studies can be useful in planning a sustainable waste management system.

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