Geosfera Indonesia
p-ISSN 2598-9723, e-ISSN 2614-8528
available online at : https://jurnal.unej.ac.id/index.php/GEOSI
Vol. 9 No. 2, August 2024, 208-227

https://doi.org/10.19184/geosi.v9i2.46551

Research Article

Spatial Patterns of Tourism: Towards Legally-Based Tourism Village Regulations Based on Physical Carrying Capacity Analysis

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ARTICLE INFO

Received :
2 February 2024

Revised :
24 July 2024

Accepted :
29 July 2024

Published :
22 August 2024

ABSTRACT

Lowita Beach was a tourist area in Suppa District, Pinrang Regency, with 11 tourist attractions. The annual increase in visitors to Lowita Beach can compromise tourist comfort and damage the area's natural habitat. This is the basis for researchers to analyse the Physical Carrying Capacity (PCC) of Lowita Beach. This study aimed to determine the characteristics of tourist activities, assess the physical carrying capacity of the area, and formulate the role of tourist villages in managing the Lowita Beach area. The research approach used was research and development, as initiated by Borg and Gall: the calculation of Physical Carrying Capacity (PCC), area parameters, and the number of tourists. The study population comprised 93 tourists who visited the Lowita Beach area. Data was collected through the completion of questionnaires, interviews, measurements, and field observations. A quantitative-descriptive approach was used for data analysis. The Physical Carrying Capacity (PCC) analysis reveals that Lowita Beach's ideal capacity is 1 visitor per day, yet it currently hosts an average of 35 visitors daily, significantly surpassing this threshold. This overcapacity indicates that the beach is experiencing environmental strain and underscores the need for management strategies to align visitor numbers with sustainable limits. In conclusion, despite the physical carrying capacity (PCC) of Lowita Beach being 17 visitors per day, the present daily visitor count suggests that the beach is currently facing overcrowding, albeit not to a significant extent. Hence, it is necessary to implement policy interventions from the tourist villages of Tasiwalie and Wiringtasi, which should include the establishment of standardized operating procedures and fostering collaboration among stakeholders, in order to ensure sustainable tourism management at Lowita Beach.

Keywords: Physical Carrying Capacity; Village Tourism; Collaborative

INTRODUCTION

These aspects include carrying capacity, land use differentiation, destination impacts, application of spatial linkages for tourism development, historical data, and chronology of phenomena (Jasman et al., 2023; Zhang et al., 2023). Tourism significantly impacts social and economic changes in communities and the physical environment (Więckowski, 2022). Tourism has an impact on the environment due to globalisation factors (Ali et al., 2021; Grofelnik & Kovačić, 2023; Palazzo et al., 2021; Toubes et al., 2021), such as the modernisation of promotional

content through digitalisation (Toubes et al., 2021) and traditional paradigms still developed by the community about tourism, such as mass tourism or tourism based on the number of visitors. (Cárdenas-García et al., 2022; Sacramento, 2023) It is suggested that mass tourism is characterised by the movement of tourists in large numbers. Therefore, the spatial aspect is an approach to assess the impact of large tourist movements.

Implementing sustainable tourism is a challenge in the face of mass tourism. Coastal area tourism management must maximise integrated coastal zone-based management that considers spatial aspects (Smith et al., 2023). Studies on overtourism in destinations with excessive tourist visits have focused on the social carrying capacity approach (Blázquez-Salom et al., 2023; Buitrago & Yñiguez, 2021; García-Buades et al., 2022; Santos-Rojo et al., 2023). According to previous study by Laignel et al. (2023), tourists in coastal areas result in shoreline changes that have negative impacts. The density of visitors has led to changes in coastal land, pollution of beach sand, habitat destruction, waste, and water pollution (Cinelli et al., 2021; Stan et al., 2021). Even tourist activities such as swimming, sunbathing, surfing, diving, and SCUBA are predicted to be future problems (Davenport & Davenport, 2006). Therefore, regulating the number of tourists in coastal areas is necessary to achieve sustainable tourism. In this context, Wilks (2023) argued that it is essential to have the ability to manage tourist destinations that can accommodate visitors' recreational needs while maintaining the 'originality' of the beach.

Beaches are essential tourism resources, so it is crucial to determine their carrying capacity to manage and utilise them wisely (Wu et al., 2022). Tourism Carrying Capacity (TCC) refers to the level of tourist activity a land can support without causing physical and environmental damage (Zhao et al., 2021). Analysing the carrying capacity of a beach can provide valuable information for sustainable management planning (Da Silva, 2002; Liu et al., 2023). Tourism Supportability produces priority program recommendations, designs, and implements measures to protect coastal areas exposed to mass tourism (Portz et al., 2023). The physical carrying capacity of the beach can be evaluated through legal written rules, such as tourist village regulations (Hardjosoekarto & Lawang, 2021; Putra et al., 2023). Through the tourist village regulations, the managers compile written rules in standard operating procedures to govern tourist villages or tourist areas.

One of the roles of Tourism Villages, as outlined in the ASEAN Standard, is to implement environmental sustainability (Arida et al., 2017). The allure of beach tourism is the sand's condition, the beach's cleanliness, and the natural panorama. However, if there are more and more visitors, it reduces the space for movement and has the potential to produce garbage. This can ultimately make the beach crowded, originally intended to be a refreshing place. Tourism Village managers may utilise the results of the physical environment carrying capacity study to regulate the number of visitors management (Jamin & Rahmafitria, 2022; Štekerová et al., 2022). This approach may be contrary to the tourism business model that seeks to maximise profit, but it can help maintain Lowita Beach's allure.

Tourism carrying capacity assessment is needed in beach management. Diniz et al. (2024) argues that tourism carrying capacity aims to understand the extent to which a place or tourist attraction can bear the impact of human activities without compromising ecological sustainability. Tourism carrying capacity is a parameter to assess the ability of the area to determine the minimum number of tourists so that recreational activities can still provide satisfaction (Aguilar et al., 2021; González Hernández et al., 2023). One model for evaluating the carrying capacity of tourism is by calculating physical carrying capacity (PCC), fundamental carrying capacity (RCC), and total carrying capacity (TCC) or the number of visitor groups per day or the number of visitors (people) per day. The various components of TCC have the following order: PCC-C-RC-C-TCC (Ríos-Jara et al., 2013). It can be concluded that evaluating tourist areas is a process of measuring and assessing their aspects by the principles of sustainability.

The Pantai Lowita area is a popular tourist destination in Pinrang Regency, South Sulawesi (Nur et al., 2023). It comprises three main tourist attractions located in two villages in the Suppa district: Tasiwalie and Wiring Tasi. Both villages are part of the Ministry of Tourism and Creative Economy's village tourism network (Ministry of Tourism and Creative Economy, 2024). According to data obtained from the Pinrang Regency Tourism, Youth, and Sports Office

for the years 2022-2023, there were 9,437 visits to the Lowita Center in Tasiwalie Village, 2,239 visits to the Lowisata Villa Mutiara Beach in Tasiwalie Village, and 1,017 visits to the Lowisata Kembar Beach. Field observations on 21/10/2023 showed an increase in the number of tourist visits to Lowita Beach after the COVID-19 pandemic. From 2020 to 2023, there has been an average annual increase of 0.8% in the number of tourists, meaning an additional 75 yearly.

The presence of tourists has both positive and negative impacts on the local population (Boonsiritomachai & Phonthanukitithaworn, 2019; Casas-Beltrán et al., 2020; Cinelli et al., 2021). Residents benefit from the rental of gazebos, boats/banana boats, restaurants, parking, and guest houses. Developing homestays or accommodations utilising local homes contributes positively to the local community's income (Wulandari et al., 2022). However, negative impacts include increased pressure on the physical environment. Stan et al. (2021) argued that excessive litter reduces the aesthetics of the beach, and poor water quality results in a decline in the environmental and economic value of the coast. In this situation, tourist areas must be managed not only to increase the financial income of the local population but also to consider negative impacts. The presence of tourists can impact the social and cultural values of the local community. Social and economic jealousy arises due to the imbalance in the number of visitors between attractions, particularly in villages with coastal potential in the Suppa District. Therefore, efforts are needed to address the issue by limiting and distributing tourist activities. Tourist villages play a role in determining tour packages, enabling the distribution of tourism potential.

Effective coastal area governance in the future requires genuine participation from residents through interventions based on rules established through mutual agreement. According previous study by Nawari et al. (2021), tourism area managers consider the number of tourists allowed to enter the location to stay within the carrying capacity of the physical environment. Candia et al. (2020) explained that physical carrying capacity evaluates the duration of activities and rotation of tourists, effective area, physical limiting factors, and management aspects. This analysis is essential for developing sustainable integrated tourism area planning (Hazzan et al., 2009). The development of tourist villages as a village program must consider the carrying capacity of the tourist area. However, in reality, the approach to developing tourist villages has only been viewed from the perspective of existing potential.

The landscape's beauty, charm, and uniqueness attract tourists (Terkenli et al., 2021; Włodarczyk, 2009). The beauty of a landscape produces spiritual admiration for visitors (Akgiş İlhan et al., 2022; Chang et al., 2021; Wang & Marafa, 2021). Tourism managers must control visitor density, reduce noise levels, and minimise view obstructions, as tourists prefer panoramic views (Ram & Kay Smith, 2022). The local community can also shape uniqueness through sustainable tourism site management. Akgiş İlhan et al. (2022) & Wang & Marafa (2021) reported that tourist visits can occur if the local community managing the tourist area can create a 'sense of place' at a tourist attraction. According studies by Hidayat et al. (2023) & Sánchez-Prieto et al. (2021), planning and marketing tourism destinations is essentially an act of shaping the image of a place by giving meaning to the geographic space where both residents and visitors contribute to the interpretation of a tourist attraction. Therefore, creating a 'sense of place' image in coastal areas requires evaluating the quality of the tourist destination.

The tourism direction and branding of Kabupaten Pinrang is 'The Longest Sunset in South Sulawesi" (Mihardja et al., 2019). Involving local communities is essential when planning tourism ventures to ensure sustainability (Li et al., 2021) and protect the environment by restricting travelling (Sahahiri et al., 2023). Tourism is treated as an economic and management field that is considered to have its authority. A systems-based approach to managing tourism impacts is needed (Ioannides & Stoffelen, 2023). However, previous studies has yet to explore the carrying capacity of the coastal areas in Kabupaten Pinrang, including its relationship towards current global tourism trends in the context of coastal spatial planning and development, such as community engagement, cleanliness, and low pollution. It is necessary to investigate the existing conditions of the coastal tourism areas in Kabupaten Pinrang to aid future development and establish the tourism image of Kabupaten Pinrang. Based on the above description, this study aims to 1) Identify the characteristics of tourism activities in the Lowita Beach area, 2) Analyse

the physical carrying capacity of Lowita Beach, and 3) Formulate recommendations for the management model of the Lowita Beach area through the role of the tourism village.

METHODS

Study Area

This research was conducted in Pinrang District, South Sulawesi. The survey location was Lowita Beach, a tourist attraction in Tasiwalie and Wiringtasi Tourism Village, Suppa District (Figure 1). The study was conducted at Lowita Beach, a tourist attraction in Tasiwalie and Wiringtasi Tourism Villages, Suppa District, Pinrang Regency, South Sulawesi Province. Data collection took place from May to October 2023, spanning six months.

Figure 1. Study Area

Research Instrument

The researcher acts as a data collector and an active instrument. Data collection tools, such as questionnaires, checklists, GPS, drones, and tape recorders, are used according to the needs of the field. This completeness helps to ensure the validity of the research results.

Data source

Data were obtained through observation and field surveys to determine the existing conditions and tourism activities in the research location. The existing tourism activities were classified at Table 1.

Table 1. Tourist Activities in Marine Ecotourism

Beach Tourism	**Maritime tourism**
Beach Recreation	Beach and ocean recreation
Panoramic	Resort
Resort	Diving and sightseeing, submarines Snorkeling.
Swimming and sunbathing	Surfing, Jet skiing, Banana Boat, Glass Bottom Boat
Beach sports like beach volleyball, beach walking, and discus throwing are popular.	Seagrass ecosystem tourism and its impact on local fishermen
Boats	Island tours, educational tours, and tours.
Fishing	Wildlife tourism (turtle, dugong, whale, bird, mammal, crocodile))

Source: (Ressurreição et al., 2022)

Primary data is used in survey research methods (Sugiyono, 2020). The requirements of primary and secondary data and the presentation of each type of data are as follows (Table 2):

Table 2. Data sources

Data Requirements	**Data Types**	**Data Source**
Site Overview and Existing Conditions	Quantitative / Primary	Field Survey
Location Photo	Qualitative/Primary	Field Survey
Land Use Map	Quantitative / Primary	Field Survey
Statistical data	Qualitative/Primary	Pinrang Regency Statistical Data
Village Profile	Qualitative/Primary	Sub-district archives, village archives, and interviews.
Tourism Data	Qualitative/Primary	District Archives/Tourism Office

Data Analysis

Tourism carrying capacity analysis is conducted to determine the maximum number of users that can engage in activities at a destination (Ando et al., 2022). Tourism carrying capacity (TCC) is calculated by considering the physical carrying capacity (PCC), fundamental carrying capacity (RCC), and adequate carrying capacity (ECC) of the beach site (Wu et al., 2022). Equation 1 determines the Physical Carrying Capacity (PCC):

$$PCC = \frac{A}{A\mu} \times Rf \quad (1)$$

Description: PCC is the physical carrying capacity, A is the area of tourist sites visited, Au is the area available per individual visitor, and Rf is the rotation factor or ideal number of visitors per day. The considerations used in the calculation of PCC are:

Two factors determine the area requirement for swimming by tourists:

a) For picnic activities, each person requires an area of 65 m^2, according to (Fandeli, 2002) :
b) The rotation factor (Rf) is calculated using the Equation 2:

$$Rf = \frac{Opening\ Time}{Average\ time\ per\ visit} \quad (2)$$

Where Rf is the rotation factor/turnover time in tourism activities; 1 day = 24 hours (Fandeli, 2002).

Real Carrying Capacity (RCC) is the number of visitors that can visit a tourist area, with a correction factor (CF) based on the characteristics of the area applied to the PCC (Wu et al., 2022; Zhao et al., 2021). We used Equation 3 to measure RCC.

$$RCC = PCC - Cf1 - Cf2 - Cf3 - Cf4 \quad (3)$$

Description:
RCC = Real Carrying Capacity,
PCC = Physical Bearing Capacity,
Cf = Correction Factor

The carrying capacity guides the maximum number of tourists that can be accommodated without threatening the local ecosystem (Cinelli et al., 2021; Zhao et al., 2021).

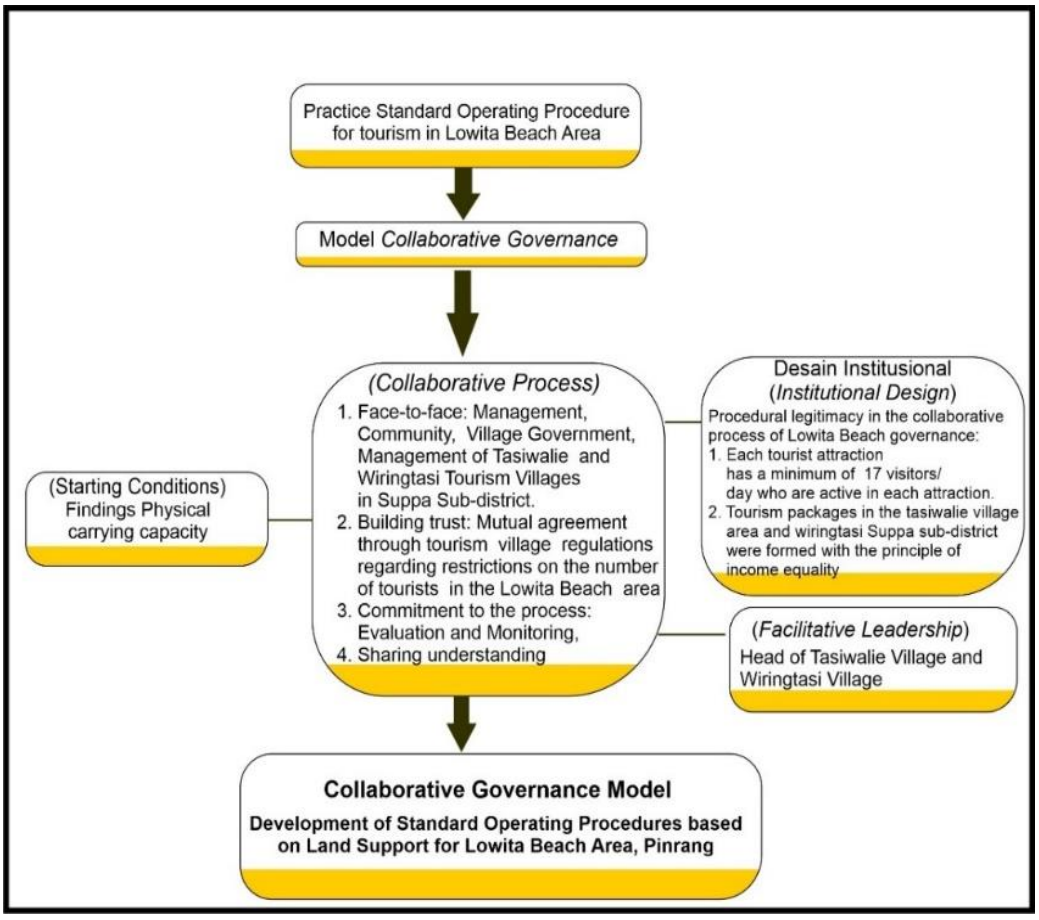

Figure 2. Standard operating procedures for tourism in the Lowita beach area, Pinrang Adopting a collaborative governance model (Ansell & Gash, 2008)

The results of the analysis of the carrying capacity of the Lowita beach area became the main focus in the preparation of the tourism village governance standards. The involvement of tourism village stakeholders is a critical factor in achieving a sustainable beach area through establishing tourism village regulations. One of the regulations explicitly emphasises the maximum number of tourists, the duration of activities, parking arrangements, and entry and exit routes. Wiringtasi Village and Tasiwalie Village in Suppa Sub-district, Pinrang Regency, are Tourism Villages designated by the Ministry of Tourism (Ministry of Tourism and Creative Economy, 2024).

RESULTS AND DISCUSSION

Lowita Beach Overview

Aquaculture is also practised in the coastal areas of Tasiwalie and Wiringtasi, in addition to tourism activities. Tasiwalie and Wiringtasi Villages, located in Suppa Sub-district, Pinrang Regency, are coastal areas with untapped economic potential. The Lowita Beach Area offers various tourism activities, as observed at Table 3. According to Table 3, tourism activities in the Lowita Beach Area primarily focus on beach-related activities, including beach recreation, panoramas, resorts/rest stops, beach sports (such as beach volleyball, beach walks, and disc throwing), boating, and fishing. Although marine tourism activities have yet to be optimally developed, the lack of understanding of marine tourism governance is a significant factor. This has resulted in the absence of tourism activities such as animal cultivation, fishing tourism, and seagrass ecosystem tourism in the study location. Furthermore, there needs to be more information about the potential beneath the surface seawater, which has led to the absence of tourism activities such as diving and snorkelling in the study location.

Table 3. Tourism Activities in the Lowita Beach Area.

Beach Tourism	Existing	Maritime tourism	Existing
Beach Recreation	v	Beach and ocean recreation	v
Panoramic	v	Resort	v
Resort	v	Diving and sightseeing, submarines Snorkeling.	x
Swimming and sunbathing	v	Surfing, Jet Ski, Banana Boat, Glass Bottom Boat	v
Beach sports like beach volleyball, beach walking, and discus throwing are popular.	v	Seagrass ecosystem tourism and its impact on local fishermen	v
Boats	v	Island tours, educational tours, and tours.	v
Fishing	v	Wildlife tourism (turtle, dugong, whale, bird, mammal, crocodile)	v

Note: v - Developed, x - Undeveloped/Not Developed

Managers of tourist attractions in the Lowita Beach area develop various activities to attract tourists (Figure 3 and Figure 4). Watching the sunset is a popular activity for visitors to Lowita Beach, attracting families and groups. Accommodation facilities are available in the area, including resorts and rest stops at Hesan Lowita, Elle Kalukue Beach, Villa Lowita, Twin Lowisata Beach Tours, and Gazebo H midi. According to the interview results from August 28, 2023, the manager offers prices ranging from 300,000 to 500,000 based on the visitors' needs and orders. Jet Ski is a popular water sport, but due to its high cost of Rp.500,000/30 minutes, it is mainly enjoyed by the upper middle class. The banana boat is the best-selling water ride available at the Lowita Center, with visitors paying only Rp. 20,000/group.

Figure 3. the Banana Boat Activity

Figure 4. Beach Recreation Activities

Physical Carrying Capacity

Tourist areas are necessary for Lowita Beach, which offers beaches for tourist activities. The following data (Table 4) on tourist visits is the object of study in two villages in the Suppa sub-district.

Table 4. Tourist Visits in the Lowita Beach Area

Tourist Attractions	The Village	District	Tourist Visits in 2022
The Lowita Center	Tasiwalie	Suppa	9,437
Lowisata Beach Villa Mutiara	Tasiwalie	Suppa	2,239
Lowisata Twin Beach	Wiringtasi	Suppa	1,017

The Physical Carrying Capacity (PCC) calculation is based on the area and number of tourists. To determine the need for tourist areas in the Lowita beach area of Suppa District, measurements were taken using the ArcGIS 10.8 mapping application and GPS records. The resulting data was then processed using satellite image interpretation to identify the areas suitable for tourism. The processed data reveals the total area of tourist sites in the Lowita Beach Area of the Suppa District (Table 5).

Table 5. the area of Lowita Beach in Suppa Sub-district

Tourist Attractions	The Village	District	Area (m^2)
The Lowita Center	Tasiwalie	Suppa	386.32
Lowisata Beach Villa Mutiara	Tasiwalie	Suppa	259.61
Hesan Lowita	Tasiwalie	Suppa	281.79
Elle Kalukue Beach	Tasiwalie/ Wiringtasi	Suppa	861.71
Vibes B&R	Tasiwalie	Suppa	264
Villa Lowita	Tasiwalie	Suppa	525
Lowisata Twin Beach	Wiringtasi	Suppa	3.019,42
Black Orange Beach	Wiringtasi	Suppa	
H Middi Pavilion	Wiringtasi	Suppa	
Total			5.597,85

The area of Lowita Beach was calculated based on boundary data obtained through participatory mapping of each tourist attraction and then totalled as a whole. Collecting area data posed a challenge due to the need for clear and official delineation boundaries, relying only on information from the manager. Some tourist objects serve as dividing walls to mark the boundaries. The total area of Lowita Beach is 5,597.85 m^2 or 0.55 ha.

Table 6. Duration of Tourist Visits in the Lowita Beach Area

Length of stay	Frequently	Percentage
1-2 Hours	14	48%
3-4 Hours	6	21%
5-6 Hours	4	14%
7-8 Hours	5	17%
Number of Informants	29	100%

According to the Table 6, 48% of visitors spend 1-2 hours at Lowita Beach, indicating short visits by locals or those with time constraints. The frequency of visits lasting 3-4 hours and 7-8 hours were almost equal, with six informants (21%) and five informants (17%), respectively. This suggests that, on average, visitors spent 2 hours or 120 minutes in the Lowita Beach area of the Suppa sub-district.

In January-December 2022, the Lowita Beach area received 12,693 visitors, averaging 1,058 visitors per month and 35 visitors per day. The physical carrying capacity (PCC) refers to the maximum number of visitors that can be accommodated in the space provided at any given time. The recovery factor or turnover factor determines the area requirements for tourists. According to Douglass (Fandeli, 2002), each tourism activity has a different TF number. For picnic activities, each person requires an area of 65 m^2, which is the standard tourist activity area requirement for picnics per person. The rotation factor (Rf) for picnic activities in the Lowita Beach area in Tassiwalie and Wiringtasi villages, Suppa Subdistrict, is 5. This value was obtained by dividing the total opening schedule at tourist sites (10 hours, from 08.00 to 18.00) by the average length of tourist visits (2 hours per visit).

Using this data, we can calculate the physical carrying capacity (PCC) of the Lowita Beach area. The PCC of Lowita Beach Area is 17 tourist visitors per day. This indicates the maximum number of visitors that can be accommodated in the area at any given time without overcrowding.

Table 7. the physical carrying capacity of the Lowita Beach area

Space Utilization	Picnic Zone	Picnic Activities	Rotation Factor	PCC Value per day of visitors
Lowita Beach Area	A (m^2)	B (m^2)	Rf (hours)	
Lowita Center	5,597.85 square meters or 0.55 hectares.	65	5	17 tourists visit per day
Lowisata Beach Villa Mutiara				
Hesan Lowita				
Elle Kalukue Beach				
Vibes B&R				
Villa Lowita				
Lowisata Kembar Beach Tourism				
Black Orange Beach				
H Middi Pavilion				

Note : B = 65 m^2, Standard Requirements for a Picnic Activity Area/Person; B = 65 m^2, Standard Requirements for a Picnic Activity Area/Person; Rf = 5=The facility is open for 10 hours daily, and visitors can stay up to 2 hours.

According to the calculations in Table 7, the maximum number of tourists in the Lowita Beach area of Suppa District daily while maintaining visitor satisfaction is 17. It is important to note that land-carrying capacity significantly impacts visitor satisfaction (Putri & Ansari,

2021). The B value, which determines the area needed by a tourist to continue to experience satisfaction (Fandeli, 2002). The value of B used in this calculation of physical carrying capacity pertains to the type of tourist activity on the beach, which is 65 m^2. The PCC value of the Lowita Beach area exceeds the maximum limit, as described below:

- Based on data from 2022-2023 and the average number of visitors per month, the estimated number of monthly visitors is 1,058.
- If calculated per day, the estimated number of daily visitors is 35. According to the actual conditions, these numbers are below the physical carrying capacity value of 17 daily visitors.

Although the condition is still within a small margin of the carrying capacity, it has exceeded it. Without early prevention, degradation due to increased tourist visits is possible in Lowita Beach.

Figure 5. Lowita Beach Area Support Visualisation Map for Recreational and Picnic Activities in Pinrang Regency

This research produced a map, shown in Figure 5, to visually represent the Lowita Beach area and the Tourism Carrying Capacity (TCC) approach used to evaluate tourism development in the coastal area of Pinrang Regency, South Sulawesi, Indonesia. The map has become a topic of discussion among tourism stakeholders in Tassiwalie Village and Wiringtasi Village, Suppa Sub-district, regarding the implementation of sustainable tourism. The Carrying Capacity Index map guides designing the future direction of sustainable tourism in coastal areas (Leka et al., 2022).
Roles and Responsibilities of Tourism Villages:

The agreement between the manager, local government, and the community directs the area towards cultural and environmental conservation efforts—collaborative governance as a strategy to overcome conflicts of interest in implementing tourist restriction policies. Collaborative governance is proposed to address the conflict of interest in tourism village governance. This finding is in line with previous studies by Ayuningtyas et al. (2023), Chai et al. (2021), Huang et al. (2023), Diniz et al. (2024), Baloch et al. (2022, 2023), and Pereira & dos Anjos (2023) that found roles and responsibilities of tourism villages. According to Ayuningtyas

et al. (2023), the town is responsible for directing and improving the community's economy by developing tourist villages. Therefore, it is necessary to adopt a systematic approach to tourism development policies in tourist villages considering the land's carrying capacity. Policymaking in tourist villages involves routine training programs for local communities to educate tourists and promote compliance with imposed restrictions (Chai et al., 2021; Huang et al., 2023; Polontalo et al., 2023). The tourist village is a facilitator that informs entrepreneurs about the benefits of these restrictions in developing tourism activities. Integrating tourist carrying capacity and assessing the coastal scenario provides a more comprehensive and practical framework for the sustainable management of beaches (Diniz et al., 2024). To achieve this, the roles and responsibilities of tourist villages should be prepared to limit the number of tourists. Stakeholders should collaborate to carry out these roles and responsibilities through governance. As stated, collaborative governance involves shared norms and mutually beneficial interactions between actors (Ansell & Gash, 2008). The outcome of collaborative governance is the creation of standard operating procedures for managing Tasiwalie Village and Wiringtasi Village in Suppa District. A Standard Operating Procedure (SOP) can assist managers and residents in regulating the number of tourists at tourist attractions, as suggested in the model SOP for tourism in the Lowita Beach area of Pinrang Regency, based on an analysis of tourism carrying capacity. As a follow-up, community service activities are necessary to assist in developing beach governance involving stakeholders from Tasiwalie and Wiringtasi villages. This governance will be translated into legally-based tourism village regulations based on shared commitments. Legal Protection of Tourism Consciousness has become a reference in the governance of destination areas, as revealed by Carito et al. (2023); Hussain (2021); Liberato et al. (2021).

Designing a set of rules on tourism village governance is done through collaborative governance. However, in practice, collaboration between stakeholders faces various conflicts of interest. Pearce (2015) raised the issue of conflicts of interest arising between business interests and government regulations on the West Coast of New Zealand and suggested that explicit separation was needed to maintain a system of checks and balances. The findings by Ianos et al. (2012) also discussed conflicts of interest in managing the Tanah Lot coastal area, which is included in the *Tanah Lot* Special Tourism Attraction Area (KDTWK). The agreement between the manager, local government, and the community directs the area towards cultural and environmental conservation efforts. Collaborative governance is proposed as a strategy to overcome conflicts of interest in implementing tourist restriction policies. This approach involves separating business interests from government regulations. By prioritizing collaboration, conflicts in implementing tourist restriction policies can be effectively addressed.

This analysis of PCC values does not consider biophysical factors or social carrying capacity. As a result, the carrying capacity of tourism has yet to be calculated considering environmental conditions (Zelenka & Kacetl, 2014). Biophysical ecological factors significantly influence the carrying capacity of tourist sites. It is essential to consider PCC values when planning the development of attractions. Zekan et al. (2022) proposed that using PCC standards for tourist destinations helps determine the priority scale of regional development. However, in this study, Social Carrying Capacity was not calculated for the average value of each day within 12 months. According to Tokarchuk et al. (2021), Social Carrying Capacity is analyzed from questionnaire data of local communities and tourists to determine visitor perceptions of comfort and satisfaction. Peak travel times occur during school holidays (May, June, July), Christmas and New Year holidays (December-January), and Eid holidays. The research conducted at Lowita Beach was limited to May and October 2023.

Therefore, future research could be focus on empirical findings from the destination by incorporating abiotic factors of the tourism environment and social carrying capacity while also considering time. This research has two main takeaways: Firstly, in developing tourist destinations in Pinrang Regency, it is crucial to involve stakeholders. Standard operating procedures for beach tourism management should be implemented, emphasizing visitor numbers and distribution at tourist sites. Overcrowding at tourist attractions should be controlled if the area cannot sustain high visitor numbers. The economic impacts of tourism management restrictions must also be considered, as limitations on visitors could affect the

income of local attraction managers. Secondly, the research results underscore the importance of defining collaborative roles and responsibilities among stakeholders. Community involvement is essential for effectively implementing tourist regulation policies, conducting field tests, and ensuring the dissemination and adoption of these policies. Ma (2022) has introduced an early warning system for tourism areas based on the Internet of Things (IoT). This system addresses tourist safety concerns, accidents arising from carrying capacity issues, congestion at tourist sites, and visitor polarization. Geographic Information Systems (GIS) are also utilized to enhance the effectiveness of these management strategies. Geographic information system as a tool to develop the direction and objectives of tourism development.

Geographic Information Systems (GIS) play a crucial role in enhancing tourism development and environmental management by providing advanced tools for analyzing spatial data, visualizing geographic information, and supporting strategic decision-making. GIS enables the effective mapping and management of tourism resources, improves the presentation of non-spatial attributes like cultural and historical contexts, and facilitates the evaluation of environmental factors and carrying capacities. Through its integration with emerging technologies and its application in various studies, GIS helps address challenges in planning, risk assessment, and sustainable development, ultimately contributing to more informed and efficient management of both tourism and environmental resources. Geographic Information Systems (GIS) play a crucial role in enhancing tourism development and environmental management. Hoang Tu et al. (2023) emphasized the importance of GIS in managing environmental aspects such as land, water, air quality, and waste. The necessity of conducting thorough and precise analysis alongside GIS assistance in decision-making is emphasized. Additionally, there is a recommendation for future advancements to focus on integrating GIS with emerging technologies. Jasman et al. (2023) found the incorporation of GIS into tourism maps to overcome limitations in representing non-spatial attributes like location and cultural history. This highlights the essential role of digital information systems in supporting sustainable tourism and cultural heritage preservation. Rezvani et al. (2022) introduced a novel approach using the Ordered Weighted Averaging (OWA) model with GIS to evaluate risks in identifying potential natural-based tourism (NBT) areas. The study demonstrates how different levels of optimism impact categorizing high-potential areas and provides strategies for informed decision-making in resource allocation. Scalabrini et al. (2022) demonstrated the effectiveness of a Web-GIS for outdoor tourism in Northern Portugal, enhancing destination decision-making and promotional efforts by offering detailed information to tourists and aiding in itinerary planning. Widjaja et al. (2021) conducted mapping and classification of tourist sites in Barru Regency, advocating for integrating this data into an Android application and the official tourism website to improve public access and streamline tourism management. Finally, Zhao et al. (2021) evaluated the overall carrying capacity of coastal regions using a matter-element extension method and an index system. The results indicate that the coastal capacity of Fujian Province is moderately positive and improving, offering a valuable approach for assessing coastal capacity and promoting sustainable development. In summary, these academic studies collectively highlight the pivotal role of GIS in overcoming various challenges by enhancing data accessibility, refining decision-making processes, and supporting sustainable tourism and environmental management.

CONCLUSION

The land characteristics of the Lowita Beach area are located in two village administrative areas: Tasiwalie and Wiringtasi Villages, Suppa District, and Pinrang Regency. According to satellite image delineation, the total area is 6505.38 m^2. Current beach tourism involves visitors engaging in activities such as picnics, observing and enjoying the panoramic sunset, swimming, sunbathing, and beach sports like volleyball and walking. Boating and fishing are also popular. Existing marine tourism, such as Jet Sky, banana boats, boats, and stays at the resort/inn, are carried out. Research into the Physical Carrying Capacity (PCC) of Lowita Beach, which has a threshold of 17 visitors per day, has shown that the number of daily visitors still needs to be ideal. However, the PCC calculation is based on average monthly visits, indicating that the beach is

already overcrowded, although not significantly so. The Tasiwalie and Wiringtasi tourism villages in the Suppa District must play a role in policy intervention to address this issue. This includes the development of standard operating procedures for tourism activities. These procedures should be based on the tourism village rules for beach tourism governance. To achieve this, collaborative governance among stakeholders is essential. Implementing these policies and regulations can help maintain the carrying capacity and ensure sustainable tourism at Lowita Beach.

ACKNOWLEDGMENTS

Thank you to the Director of Makassar Tourism Polytechnic for facilitating lecturer research activities through Decree of the Director of Makassar Tourism Polytechnic Number: PT.01.01/210/PTP-III/KEMPAR/2023 Dated 24 May 2023 concerning Individual Researchers in the Makassar Tourism Polytechnic Environment in 2023. Activities are charged to DIPA Makassar Tourism Polytechnic Fiscal Year 2023 Number: 040. Budget 2023 Number: 040.01.2.538869/2023 Activity Code: 5349.SAD.003.071.C MAK.521219.

DECLARATIONS

Conflict of Interest

We declare no conflict of interest, financial or otherwise.

Ethical Approval

The research has been approved by the Makassar Tourism Polytechnic. All research was carried out in accordance with Makassar Tourism Polytechnic research ethics guidelines applicable when human participants are involved.

Informed Consent

On behalf of all authors, the corresponding author states that all participants have been given informed consent and agreed to take part in this study.

DATA AVAILABILITY

Data used to support the findings of this study are available from the corresponding author upon request.

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