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Analysis of Suitability and Carrying Capacity for Ecotourism Purposes in the Sepanjang Beach Tourism Area

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***Abstrack* - Sepanjang Beach offers a broad, long stretch of sand with a small quantity of coral and limestone hills that have turned into cliffs. Through its natural scenery, visitors become interested in visiting Seanjang Beach. The purpose of the study was to analyze the level of suitability of tourism for sustainability. Meanwhile, research related to the area's carrying capacity was carried out to determine the ability of natural resources to maintain their function and quality to provide the recreational experience visitors want. For the sake of ecosystem availability, it is necessary to apply ecotourism principles to provide behavioral limits for humans as tourism actors to carry out recreational activities without reducing tourist satisfaction. The tourism suitability data collection technique uses 11 parameters: beach type; beach width; water depth; water bottom materials; beach slope; current speed; the brightness of the waters; closure of coastal land; dangerous biota; and availability of fresh water. While the carrying capacity of the area is calculated by calculating the economic level of the community around the tourist area, community contribution, visitor activities, the size of the area that visitors can use, length of visit, and the length of time the tourist area is open in one day. The results of the tourist suitability analysis at station 1 were 2.32, station 2 was 2.32, and station 3 was 2.2. The results show the area's carrying capacity is 240 people/day for fishing activities and 744 people/day for visitor recreation activities.**

Keywords—Tourism Suitability Analysis, Area Support, Ecotourism

I. INTRODUCTION

The definition of ecotourism was first introduced by the organization [1] that ecotourism is a form of tourist travel activity to natural areas that aims to conserve the environment and preserve the lives and welfare of local communities. The development of ecotourism, according to [2] is consists of three key elements, namely (1) focus on attractions in the natural environment or specific areas, (2) emphasis on conservation learning and education as a form of tourist interaction with nature, and (3) must be sustainable. The requirements for ecotourism activities of environmental resources to produce optimal utilization lie in the physical parameters and biological parameters. The types of ecotourism, according to PERMENDAGRI Number 33 of 2009 concerning Guidelines for the Development of Ecotourism in Regions, are divided into 4, namely, marine ecotourism, forest ecotourism, mountain ecotourism, and karst ecotourism. Marine ecotourism is a unique tour whose activities are related to the sea and consist of areas on the sea surface, under the sea, and on the coast. The challenge of increasing visitor flow must be balanced with the packaging of a tourist location to produce development in the marine tourism sector. According to [3] the comfort and safety of visitors guarantee the existence of tourism and reasonable steps of change in a tour. Reference [4] shows that physical parameters of the beach are more dominant requirements in the management of coastal tourism.

Sepanjang Beach is located in Gunungkidul Regency, Yogyakarta, a beach with the longest coastline in Gunungkidul from west to east and no coral islands blocking the beach (has no barriers). Sepanjang Beach according to [5] offers views of limestone hills that have turned into cliffs due to being hit by waves. Sepanjang Beach tourism offers a vast expanse of white sand, a unique attraction. Research related to tourism suitability analysis is conducted to determine the sustainability of tourism. Meanwhile, research related to the area's carrying capacity is undertaken to assess the ability of natural resources to maintain their function and quality and provide the desired recreational experience for visitors. Applying ecotourism principles provides behavioral boundaries for humans as tourism actors to carry out recreational activities without reducing tourism satisfaction. Based on these things, research on Sepanjang Beach in determining the value of the Tourism Suitability Index (IKW) of the beach and the assessment of the carrying capacity of the Area needs to be carried out to determine the scale of tourism development and preventive actions for managers in improving the quality of tourism.

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II. Method

A. Time and Location of Research

The research was conducted from July 22, 2024, to August 25, 2024, at Sepanjang Beach, Kemadang Village, Tanjungsari District, Gunungkidul Regency, Yogyakarta.

B. Research Materials and Tools

The materials and tools used during the research can be described in **Table 1**.

C. Data collected

Eleven parameters were included to analyze tourism suitability data collection, and interviews were conducted using a questionnaire for carrying capacity data.

TABLE 1.
DESCRIPTION OF RESEARCH MATERIALS AND TOOLS

Tools and materials	Utilities
Stationery	Recording the results of observations in the field
Camera	Documentation of activities
Meter roll	Measuring the width of the beach
Flow ball	Measuring current speed
GPS	Determining the sampling coordinate points
Secchi disk	Measuring beach brightness
Clinometer	Measuring the slope of the beach
A weighted rope	Measuring the depth of the beach
ArcGIS Software	Creating a tourism suitability analysis map

1) Water Depth

The study measured depth using a weighted rope marked to be measured using a roll meter. Depth determination was made 10 meters from the coastline [6].

2) Beach Type

The type of beach can be determined by direct observation of the kind and color of sand at the research location.

3) Beach Width

Beach width measurements are carried out using a rolling meter, measuring the distance between the last vegetation on the beach and the lowest tidal limit at sampling time [7].

4) Basic Materials of Water

Determination of beach type and water base material is done based on visual observation in the field [6].White Water Base Material/Substrate suits recreational tourism and swimming [8].

The current measurement is 15 meters towards the sea from the coastline, which is considered safe for beach tourism activities. Current speed is measured using a current ball with a rope length of 5 meters, namely by determining the distance traveled by the current ball and then measuring the travel time of the current ball. According to [9] the current speed can be calculated using the formula:

$$V = \frac{S}{T}$$

Information:
V = Current velocity (m/s)
S = Distance traveled (15 meters)
T = Travel time of the current ball (seconds)

5) Beach Slope

Slope measurement using a clinometer placed on the coastline [10]. According to [11], a beach slope of less than 10° is very suitable for beach tourism, while a beach slope of more than 45° is not suitable for beach tourism because it is a steep beach. This aligns with [12], who said that beaches are generally divided into four types: flat, sloping, steep, and shallow. Flat beaches have a slope of <10°, sloping 10-25°, and steep>25°.

6) Brightness of Waters

The brightness measurement is carried out using a secchi disk tied with a rope and slowly lowered into the waters at the observation location until the disk's visual limit cannot be seen. Then, the length of the rope is measured, and the data collection position is recorded [13]. In line with [14], the brightness value is greatly influenced by suspended solids and turbidity, weather conditions, measurement time, and the accuracy of the person taking the measurement. According to [15], beach brightness is calculated by looking at the average depth at which the secchi disk can still be seen (D1), and the secchi disk is no longer visible (D2), namely by calculating as follows;

$$\textbf{Brightness} = \frac{D_1 + D_2}{2}$$

Information:
D1 = Depth of the Secchi disk when visible
D2 = Depth of the Secchi disk when it starts to appear again

7) Coastal Land Closure

Observing coastal land cover is carried out directly by observing land cover conditions. According to [4], several categories determine coastal land cover based on open land accompanied by coconut trees, low or savanna, high bushes, mangrove forests, settlements, ports, mud, rocky, and steep.

8) Observation of Dangerous Biota

Observations of dangerous biota are carried out along the coast to determine whether or not there are dangerous biota that pose a risk to tourists. According to [16], dangerous biota to tourists include gastropods, fire corals, sea urchins, jellyfish, anemones, and sea snakes.

9) Fresh Water Availability

Freshwater availability is observed by measuring the distance between the research station and the location of the freshwater source [6]. According to [12] the suitability matrix of the area for recreational beach tourism is distance of freshwater availability between the tourist area location is very suitable (S1), which is 0.5 km. The availability of clean water in the form of fresh water is essential to support management facilities and tourism services. This is also a criterion for assessing the feasibility of priority development of beach tourism [17].

10) Interview and Questionnaire

The interview method used in this study is a structured interview. Interviews were conducted using a list of questions. According to [18], a questionnaire is a list of written questions previously created and answered by respondents to obtain data by the information needed. Respondents must be at least 17 years old because they are of productive age, the respondent's education must be at least junior high school because differences in the level of education of each respondent affect their thinking patterns and participation in managing or maintaining the existence of natural tourism. The Lemeshow theory was used to determine the respondent sample [19]. Sample calculations are used to calculate the number of samples that cannot be known with certainty. The following is the Lemeshow formula used to determine the sample;

$$\mathbf{n}=\frac{Z^2.\ P.\ (1-P)}{d^2}$$

Information:
n = Sample size/ number of respondents
Z = Z score at 95% confidence = 1.96
P = Percentage of tolerance for sampling error accuracy that can still be tolerated
tolerated 50%, namely p = 0.5
d = Error rate 10%
So, it is known that

$$\mathbf{n}=\frac{1{,}96^2.\ 0{,}5.\ (1\text{-}0{,}5)}{0{,}1^2}$$

$$n = 96.04$$

So, interviews were conducted with 96 respondents, who were then rounded up to 100 respondents.

TABLE 2.
TOURISM SUITABILITY MATRIX

Parameter	Weight	Category	Score
Water depth (m)	0.125	0 – 3	3
		>3 – 6	2
		>6 – 10	1
		>10	0
Beach type	0.200	White sand	3
		White sand mixed with coral fragments	2
		Black sand, slightly steep	1
		Mud, rocky, steep	0
Width of the beach	0.200	>15	3
		10 – 15	2
		3 - <10	1
		<3	0
Basic water material (m/s)	0.170	Sand	3
		Sandy coral	2
		muddy sand	1
		Mud, sandy mud	0
Current velocity (cm/s)	0.080	0 – 17	3
		17 – 34	2
		34 – 51	1
		>51	0
Beach slope (0)	0.080	<10	3
		10 – 25	2
		>25 – 45	1
		>45	0
Water clarity (%)	0.125	>80	3
		>50 – 80	2
		20 – 50	1
		<20	0
Coastal land closure	0.010	Coconut, open land	3
		Shrubs, low bushes, savanna	2
		High thickness	1
		Mangrove forests, settlements, ports	0
Dangerous biota	0.005	There is nothing	3
		Sea urchin	2
		Sea urchins, stingrays	1
		Sea urchins, stingrays, lionfish, sharks	0
Fresh water availability (km)	0.005	<0.5	3
		>0.5 – 1	2
		>1 – 2	1
		>2	0

TABLE 3.
CLASSIFICATION OF TOURISM SUITABILITY ASSESSMENT

Classification	Mark
Very Suitable	≥2.5
In accordance	2.0 ≤ - < 2.5
It is not by	1 ≤ - < 2.0
Inappropriate	< 1

Data Analysis

Using the tourism suitability index [20] and calculating regional carrying capacity according to [12].

Tourism Suitability Analysis

The tourism suitability index [20] can be described In **Table 2**. The calculation of the Tourism Suitability Index (IKW) value is adjusted to the categories in the Coastal Tourism Land Suitability Index Matrix with the following calculation formula [20]:

$$\mathbf{IKW = (Bi \times Si)} \sum_{i=1}^{n}$$

Description =
IKW =Tourism Suitability Index
Bi = Weight of the i-th parameter
Si = Score of the i-th parameter

The tourism suitability interval consists of 4 assessment classifications [20]. The tourism suitability assessment classification can be seen in **Table 3**. The weighting and value are intended to determine the score of the combination of several variables so that the difference in scores between classes can be determined, which is then used to provide a land suitability classification. The land suitability weighting system can be explained as follows:

a) Very Suitable, namely waters that are very suitable for developing a form of utilization without any serious limiting factors or having less significant limitations and no real influence.
b) The waters are suitable enough for developing a specific form of utilization, but there are limiting factors. However, technology can eliminate or reduce these limiting factors.
c) Not Suitable, namely waters suitable for developing a particular form of use in the presence of serious limiting factors.
d) Very Unsuitable, namely the waters are entirely unsuitable for a particular form of use due to the many and significant physical constraints of the Area, making it impossible to develop tourism activities sustainably.

Regional Carrying Capacity

a) Physical Carrying Capacity (PCC) [21]:

$$PCC = A \times \frac{v}{a} \times Rf$$

Description=
A = Area available for tourism
V = A tourist
a = Area required for a particular activity (m^2)
Rf = Correction factor (rotation factor of visits in one day)

There are several considerations in calculating PCC that must be taken into account, namely:

1. According to Douglas (1975) in [22] the area needed for tourists to picnic is 65 m2.
2. The rotation factor (Rf) is the number of daily visits allowed at a location, and is calculated using the formula:

$$Rf = \frac{Long\ time\ open}{Average\ length\ of\ stay}$$

b) Real Carrying Capacity (RCC) [21]

$$RCC = PCC \times Cf_1 \times Cf_2$$

Description=
PCC = Physical carrying capacity
Cf = Biophysical correction factor for Sepanjang Beach tourism. To determine the magnitude of the correction factor, the following formula is used:

$$CF_n = 1 - \left(\frac{M_n}{Mt}\right)$$

Description=
Cfn = nth correction factor based on available correction factor component data
Mn = Real condition of variable fn (correction factor) that is calculated
Mt = Maximum limit of variable fn (100)
Some correction factors needed in research are:

a. Rainfall (Cf_1)

Based on [23] the rainfall correction factor is calculated by comparing the dry and wet months over the past 10 years. The following is the formula used to calculate the Rainfall Index (ICH), namely:

$$\frac{Dry\ month}{Wet\ month}$$

Description =
Dry month = Month with rainfall <60 mm
Wet month = Month with rainfall >100 mm

b. Slope (Cf_2)

The slope correction factor refer to [24] touses a scoring system against the slope class criteria in coastal areas tourists often pass. The calculation refers to the Decree of

TABLE 4.
SLOPE CLASS SCORING

Slope class	Slope class system (%)	Information	Mark
1	0-8	Flat	20
2	8-15	Sloping	40
3	15-25	A bit steep	60
4	25-40	Steep	80
5	>40	Very steep	100

the Minister of Agriculture No. 837/ KPTS/ UM/ 11/ 1980 shown in **Table 4**.

c) Effective Carrying Capacity (ECC) [21]

$$ECC = RCC \times MC$$

Description=
RCC = Real bearing capacity result
MC = Management Capacity
The MC value is determined using the following method:

$$MC = \frac{Rn}{R_t} \times 100$$

Information-
Rn = Number of officers available
Rt = Number of officers required
Referring to [25], the optimal number of officers at beach tourism is 25 people.

The Role of Society

Data was collected by giving questionnaires to 20 people from Kemiri Village or Kemadang Village who participated in Sepanjang Beach management activities. Activities include stalls/gazebos, toilets and prayer rooms, waste management, and ticket or parking attendant services. There are 5 parameters measured, namely community attitudes and behavior towards visitors, community involvement/participation, community support, provision of local economic efforts in the tourism sector, and obtaining benefits/economic influence on tourism activities. Data analysis in this descriptive method uses an inductive process, namely an explanation based on parts supported by primary data or questionnaire results. Identification and grouping are carried out from each respondent so that answers and conclusions are obtained.

The Role of Government

Data collection was conducted by providing a questionnaire to the Gunungkidul Regency Tourism Office, Head of the Destination Development Agency, Mr. Suryanta, to determine the management's characteristics, perceptions, and policies regarding the development of the Sepanjang Beach tourist attraction. The questionnaire answers were then combined with secondary data to obtain conclusions.

III. RESULTS AND DISCUSSION

Tourism Suitability Analysis

The results of the tourism suitability analysis consist of 3 research stations with parameters, namely beach type, beach width, water base material, beach slope, beach land cover, fresh water availability, current speed, dangerous biota, and water depth. The results of observations at each station are presented in **Table 5**.

The water depth was measured at a station 15 m from the coastline during the day. Water depth measurements were carried out at safe swimming or playing locations. Based on [26], that water depth can be an essential factor in determining a coastal tourism area because it is related to the safety of tourists when on the beach.

The type of beach at station 1, station 2, and station 3 is white sand with coral fragments. This happens because Sepanjang Beach has a limestone hill that has been abraded, so the sand looks white. According to [27], beach tourism would be perfect if a beach was sandy or dominated by sand substrate. Based on visual observations, Sepanjang Beach is classified as a white sandy beach with a small quantity of coral. Refer to [28] that one of the variables that makes visitors want to visit Sepanjang Beach is the expansion of white beach with a small quantity of coral with a prominent place so that it has its aesthetic value for visitors. The width of the beach can change because of the speed of the waves influence it. If the wave speed is higher, the width of the beach will be greater. According to [11], the width of the beach that is very suitable for beach tourism is more than 15 meters, while the width of the beach is less than 3 meters is considered unsuitable for beach tourism. Refer to [3] a wide beach can be utilized more widely and can be used optimally. Station 1 has the widest beach width compared to stations 2 and 3. It is known that based on measurements carried out, the width of the beach at stations 1, 2, and 3 is 63.69 m, 40.51 m, and 35.66 m, respectively. The ideal beach width according [29] is >15 m so that Sepanjang Beach can be wide enough for tourism activities.

The basic water material at the research location on Sepanjang Beach is sand with a small quantity of coral. The basic water material in white sand is ideal for supporting these activities because white sand can be used as a place to relax. The basic water material is an essential parameter in beach tourism. According to [3] one crucial factor in beach tourism is the comfort of visitors who play in the sand and as a footrest when walking. This material

TABLE 5.
RESULTS OF TOURISM SUITABILITY ANALYSIS ON ALONG THE BEACH

Parameter	Station		
	1	2	3
Water depth (m)	8.85	7	10.9
Beach type	White sand with a small quantity of coral	White sand with a slight coral	White sand with a little coral
Beach width (m)	63.69	40.51	35.66
Basic water materials	Sandy coral	Sandy coral	Sandy coral
Current velocity (m/s)	0.27	0.21	0.25
Beach slope (0)	8	9	9
Beach brightness (%)	37.2	33.3	49.5
Coastal land closure	Open land, tall trees, coconuts	Open land, tall trees, coconuts	Open land, tall trees, coconuts
Dangerous biota	Sea urchin	Sea urchin	Sea urchin
Fresh water availability (km)	0.04	0.03	0.04
Score	2.32	2.32	2.2

shows visitors do not need to worry because the sand will not hurt their feet.

The current speed at the research location at station 1 was 0.27 m/s, station 2 0.21 m/s, and station 3 0.25 m/s. The results of measurements at stations 1, 2, and 3 can be influenced by wind. Information about current speed is beneficial for various purposes such as considering the type of tourism activities at the research location. In line with [3] that speed is closely related to the safety and comfort of tourism because current speeds that are too high can be perilous for visitors. At Sepanjang Beach, visitors usually play, take pictures, and look for marine biota such as small fish, starfish, crabs, sea snails, and others on coral fragments so that the current speed parameter is critical to measure its suitability. The current speed changes very quickly depending on the time and measurement conditions. According to [30] the classification of current speed consists of 4 categories, namely the slow current category with a speed in the range of 0 - 0.25 m / s, the medium current category with a speed in the range of 0.25 - 0.50 m / s, the fast current category with a speed in the range of 0.5 - 1 m / s and the speedy current category with a speed above 1 m / s. Based on Table 10, if tourism activities are carried out in the morning and afternoon, the current speed is not too high and is not dangerous if used as a place to play, namely around 0.21 m / s to 0.27 m / s. However, if tourism activities are carried out in the afternoon, the current speed is high, namely 0.39 m / s to 0.45 m / s, so playing towards the sea is highly not recommended.

The results of direct measurements in the field using a beach slope compass at station 1 were 100, station 2 was 90, and station 3 was 90. Refer to [3] that the slope of the beach is related to the current coming from the sea; if the beach's slope is steeper, it will result in a more significant current. Most tourists like sloping beaches because they are more comfortable playing on the sand. This is as stated by [12] that a beach slope of less than 100 is very suitable for tourism activities because it makes visitors feel comfortable doing activities in the coastal area.

The brightness value is greatly influenced by suspended solids and turbidity, weather conditions, measurement time, and the accuracy of the person taking the measurement. The clarity of the water about coastal ecotourism activities plays a significant role in the comfort of tourists when swimming. The study results at station 1 obtained 37.2%, station 2 was 33.3%, and station 3 was 49.5%. Based on this, Sepanjang Beach is not recommended for swimming activities because the clarity of the water could be more supportive. Refer to [31] stated that the more particles or dissolved organic matter, the more turbidity in the water will increase. According to the tourism suitability matrix category according to [20] that all stations are included in the score 1 (not suitable). Factors that affect brightness refer to [14] include weather conditions, currents, measurement time, turbidity, and suspended solids as well as the accuracy of the research at the time of measurement.

The entire land cover of Sepanjang Beach is white sand that extends from west to east. Due to the evaluation of the tourist area, based on observations of land cover, there are thorny pandan trees, shrimp pine, waru, and keben. This is a unique attraction because the more plants on the beach, the cooler and more comfortable the conditions around the beach will be. The more types of plants, according to [29] is the more views and comfort can be created for tourists who do tourism activities. Land cover at Sepanjang Beach is very good at supporting the suitability of the land as a tourist area.

During observations at Sepanjang Beach a dangerous biota was found, namely sea urchins hiding behind the coral. This is very dangerous for visitors because it is known that sea urchins can cause fever in humans. Thus, there needs to be an appeal or warning board provided by managers, both the community and the government, for visitors to be careful when approaching the sea. However, sea urchins have ecological and economic roles. The environmental role is as a controller of the growth of algae (*Diadema setosum*) populations for coral reefs. This is as stated by [32] that the Sea urchins can also be used as indicators of heavy metal pollution. In addition to the ecological role, sea urchins also play an economic role, one of which is gonads (eggs) which can be used as food ingredients that have health benefits for humans.

Water availability is an essential thing in life. Not only for the household sector, but also for the tourism sector. Fresh water availability is observed by measuring the distance between the research station and the location of the fresh water source. Based on the measurement results, the distance between the availability of fresh water is station 1 0.04 km, station 2 0.03 km, and station 3 0.04 km. According to [12], the suitability matrix of the Area for recreational beach tourism the distance of fresh water availability between the tourist area location is very suitable (S1) which is 0.5 km. When carrying out tourism activities, the availability of clean water in the form of fresh water is essential to support tourism management facilities and services. This is as stated by [17] that clean water is also a criterion for assessing the feasibility of priority development of coastal tourism.

Based on the calculations that have been done, all research stations have a Tourism Suitability Index (IKW) above 2.0, which means that Sepanjang Beach is a beach tourism that is suitable for tourism activities. Station 1 has an IKW value of 2.32, station 2 is 2.32, and station 3 is 2.2. The value of each tourism suitability parameter at Sepanjang Beach influences the high IKW value. Therefore, Sepanjang Beach is very suitable to be used as a beach tourism.

Regional Carrying Capacity

The regional carrying capacity value is calculated using three categories: physical carrying capacity, real carrying capacity, and effective carrying capacity.

1. *Physical Carrying Capacity/ PCC*

   PCC calculation determines the capacity of tourists that Sepanjang Beach can accommodate. Before making the calculation, there is some information that needs to be known as follows:

   a) The area of Sepanjang Beach is 12,452 m^2.

b) According to Douglas (1975) in [22], the area required for picnicking is 65 m^2 for visitor recreational activities.

c) Before calculating PCC, Rf should be calculated first. It is known that the opening time of Sepanjang Beach tourism is 12 hours. The average length of stay of tourists is 4 hours obtained based on the results of the questionnaire that has been given. Rf is calculated using the following formula:

$$Rf = \frac{Long\ time\ open}{Average\ length\ of\ stay}$$

$$Rf = \frac{12\ hours}{4\ hours}$$

Based on the data above, the PCC obtained the following results:

$$PCC = A \times \frac{v}{a} \times Rf$$

$$PCC = 12.452\ \times \frac{1}{65} \times 3$$

= 574.70 or 575 people/day

The results obtained show that the physical carrying capacity of the Sepanjang Beach tourist area is 575 people/day.

2. *Real Carrying Capacity/ RCC*

The RCC calculation is carried out by considering the correction factors, namely rainfall and slope that affect tourists at Sepanjang Beach. The following is the calculation of the correction factor:

a) Gunungkidul Regency in 2024 is known to have an average number of wet months of 4-5 months, while dry months are 7-8 months. Then the following results were obtained:

$$\text{Rainfall} = \frac{Dry\ month}{Wet\ month}$$

$$\text{Rainfall} = \frac{7}{5}$$

$$\text{Rainfall} = 1.4$$

Then the correction factor is calculated using the following formula:

$$CF_n = 1 - \left(\frac{M_n}{Mt}\right)$$

$$CF_1 = 1 - \left(\frac{1,4}{100}\right)$$

$$CF_1 = 0,986$$

b) Based on [24] that direct calculations in the field, it is known that the slope of Sepanjang Beach is 8-90. Referring to the Decree of the Minister of Agriculture No. 837/ KPTS/ UM/ 11/ 1980. Sepanjang Beach is included in class 2, namely the gentle category and gets a value of 40. Then, the data is calculated using the correction factor formula as follows:

$$CF_n = 1 - \left(\frac{M_n}{Mt}\right)$$

$$CF_2 = 1 - \left(\frac{40}{100}\right)$$

$$CF_2 = 0,6$$

Then the RCC is calculated using the following formula:

$$RCC = PCC \times Cf_1 \times Cf_2$$

$$RCC = 575 \times 0,986 \times 0,6$$

$$RCC = 340.17 \text{ or } 341 \text{ people/day}$$

The real carrying capacity results from correcting the PCC value based on the correction factors of rainfall and slope that affect tourism activities. Based on the calculation results, the RCC value at Sepanjang Beach obtained a result of 341 people/day.

3. *Effective Carrying Capacity/ECC*

After calculating the RCC, continue calculating the ECC to determine the maximum capacity of Sepanjang Beach after considering the correction factor and management capacity. Before calculating the ECC, it is necessary to know the MC value first which can be obtained using the following formula:

$$MC = \frac{Rn}{R_t} \times 100$$

$$MC = \frac{5}{25} \times 100$$

$$MC = 0,2$$

Then the ECC value can be calculated with the following results:

$$ECC = RCC \times MC$$

$$ECC = 341 \times 0,2$$

$$ECC = 68.03 \text{ or } 69 \text{ people/day}$$

Based on the calculations that have been carried out, the results of the effective carrying capacity of the Sepanjang Beach tourist area are 69 people/day or 25,185 people/year. Refer to [33] the area's carrying capacity results are still included in the optimal category because the physical carrying capacity value is greater than the real carrying capacity value and the effective carrying capacity of the area. Data on the number of visitors specifically for Sepanjang Beach is unknown because no calculations were carried out. According to data from the Central Statistics Agency of Gunungkidul Regency in 2023, tourists in Tanjungsari District numbered 1,380,940 people consisting of tourists from Sepanjang Beach, Drini Beach, Kukup Beach, Watu Kodok Beach, Nglolang Beach, Krakal Beach, Betueng Beach, and Ngrumput Beach. This can be an evaluation for the management to apply the calculation of the number of tourists per day. Limiting the number of visitors means that visitors can optimally utilize services related to infrastructure in Sepanjang Beach.

Visitor Characteristics

1) Travel comfort distance

When traveling, visitors need space to do the desired activities. Visitors have a comfortable distance in tourism activities, especially beach tourism. Activities requiring space include playing sand, sunbathing, and capturing moments through taking pictures together. Based on the results in Figure 2, 59% of respondents need a distance of 3 - <4 m from other visitors to avoid disturbing each other. As many as 21% of respondents need 2 - <3 m, as many as 12% of respondents need a distance of 1 - <2 m, and as many as 8% of respondents need 4 - <5 m distance from other visitors.

2) Length of visit

The results of the study based on the average length of time spent visiting Sepanjang Beach are shown in Figure 3, showing that 68% of respondents needed 3 - <4 hours, 20% needed 2 - <3 hours to visit, 7% required 4 - <5 hours, and 5% of respondents needed 1 - <2 hours to visit.

3) Perception of the attractiveness of the tourist environment

Based on the data obtained from 100 respondents, it can be concluded that respondents feel satisfied with the attractiveness of the Sepanjang Beach tourist environment. This is shown based on the percentage of 66.7% of respondents who think that the tourist environment at Sepanjang Beach is quite attractive. The tourist environment includes beautiful natural scenery, coral reefs, a vast and clean stretch of beach sand, and marine biota such as small fish, starfish, sea snails, and other animals that can attract visitors' interest in aquatic tourism.

4) Perceptions of tourism access

Based on data obtained from 100 respondents, it can be concluded that respondents are satisfied with the access to Sepanjang Beach tourism. This is indicated by a percentage of 85.93% of respondents who feel that tourism access at Sepanjang Beach is very supportive of tourism activities. It is known that tourism access is the most essential part to support tourism activities. Adequate tourism access, such as providing visitor footpaths, the availability of facilities for tourism transportation, and signposts at Sepanjang Beach are adequate. The central transportation infrastructure according to [34] is used by tourists to reach tourist destinations is the road network that connects between tourist objects and attractions. If the condition of the road network is good, accompanied by good direction signs, it will make it easier for tourists to get to tourist destinations.

5) Perception of tourism facilities/services

Based on the data obtained from 100 respondents, it can be concluded that respondents are satisfied with the facilities/means available at Sepanjang Beach tourism. This is shown based on a percentage of 81.09% of respondents feel that tourism facilities/means such as the availability of trash bins, toilets, information centers, parking lots, prayer rooms, footpaths, and the presence of stalls at Sepanjang Beach are conducive for visitors in their tourism activities.

6) Perceptions of tourism infrastructure

Based on the data obtained from 100 respondents, it can be concluded that respondents are satisfied with the tourism infrastructure of Sepanjang Beach. This is shown based on a percentage of 89.90% of respondents who felt that the tourism infrastructure at Sepanjang Beach was very supportive of tourism activities. In tourism activities, visitors need a good communication network, electricity, clean water, and a sound waste disposal system to feel comfortable while enjoying and recreating at Sepanjang Beach.

The Role of Society

1) Community attitudes and behavior towards visitors

Based on the interview results, the community is influenced by lifestyle, clothing, and behavior. This is because respondents have to meet visitors every day. The lifestyle change is motivated by the community who have jobs at Sepanjang Beach, the community must be disciplined and orderly by paying attention to polite clothing, good behavior, and changes in daily lifestyle that adapt to visitors. The community has a vital role in tourism development. Refer to [35], realizing tourism development is difficult if these activities threaten the local community. Based on interviews, people feel happy if many tourists come to Sepanjang Beach, because they get more money.

2) Community involvement/participation

Based on their answers, respondents admitted to managing Sepanjang Beach tourism related to environmental protection efforts, such as waste/waste management. However, some respondents were not involved in the institutional/management of tourism management. For waste management, there is already an institution, from Kemadang Village. The name is BUMDES Bahari Sejahtera, the location is before Sepanjang Beach. So every 2x it is taken for each stall, pay IDR 10,000/month. So if you open 2 stalls here, you pay IDR 20,000/month.

Waste management is carried out by BUMDES Bahari Sejahtera Unit TPS3R Sari Limbah Barokah, which consists of the Kemadang Village community. The cost of managing stalls, toilets, and prayer rooms at Sepanjang Beach tourism is IDR 10,000/month, which is taken twice a week. 3R waste management is reducing or reducing the amount of waste, recycling or recycling waste, and reuse or reuse waste. According to [36] that recycling waste can also be a source of additional income for the community.

3) Community support

In realizing the development of Sepanjang Beach tourism, the community agrees to tourism management education/training. This is as stated by [37] that will be a self-control for the community to consider the most significant benefits for environmental and natural conservation. A decrease in the quality and quantity of marine resources, refer to [38] will have an impact on reducing the attractiveness and interest in traveling to Sepanjang Beach, which will result in a decrease in tourist visits due to resource degradation so that people's income decreases.

4) Provision of local economic ventures in the tourism sector

Respondents as business actors and claiming involvement in managing Sepanjang Beach tourism. The community believes that the existence of Sepanjang Beach has increased employment opportunities. In addition, it also provides business opportunities for small entrepreneurs or local communities. In line with [39], business actors provide facilities to meet the needs of tourists and good quality service. In this case, Sepanjang Beach tourism has increased business capital ownership and improved community skills in tourism activities.

5) Obtaining economic benefits/influence on tourism activities

Throughout Beach Tourism has an economic impact on the community. There is an increase in household economic life and the selling value of goods and services produced by the local community. This economic carrying capacity is an acceptable level of ecotourism activities without harming the local main economic activities. Business sectors carried out by the community include selling clothes, hats, food, and others.

The Role of Government

The Gunungkidul Regency Tourism Office handles the management of Sepanjang Beach tourist attraction. Developing Sepanjang Beach tourism aims to empower the community by opening employment opportunities, increasing income and community welfare, and reducing poverty rates. The Gunungkidul Regency Tourism Office strives for tourist destinations not only along the beach to be sustainable and stillenjoyable in the future. Therefore, education/training is held through Pokdarwis as institutions and teaching to apply the seven charms. In addition, there are also local cultural events every specific month, such as sea holidays, so that the local culture does not fade.

According to the Gunungkidul Regency Tourism Office, the inhibiting factor in tourism development is the need for more human resources to manage coastal areas. Therefore, they ask for help from the village community around Sepanjang Beach as parking attendants. The infrastructure is not yet adequate, such as accommodation availability, road accessibility, warning signs, and internet networks, so repairs and improvements are needed.

The government has prepared promotional efforts through social media, fun trips, and events involving investors. In line with [40], tourist destinations need travel agents and promotions to attract visitors. The Gunungkidul Regency Tourism Office hopes that opening up business opportunities or jobs as widely as possible will minimize poverty rates by increasing economic income from tourist attractions. In addition, efforts are being made to improve accommodation, accessibility, and amenities at all tourist attractions in Gunungkidul.

IV. CONCLUSION

Based on the results of the research that has been conducted, it can be concluded that:

1) Development of Sepanjang Beach into an ecotourism area can be realized by considering the beach's physical parameters resulting from the suitability analysis results.

2) The carrying capacity of tourism at Sepanjang Beach for beach recreation activities is 744 people/day, and fishing activities are 240 people/day. Community involvement in management aims to develop a more conservative approach to Beach tourism in the future. The Gunungkidul Regency Tourism Office acts as a supporting capacity for managers and a liaison between Sepanjang Beach tourism and outside parties.

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