Beach recreation suitability and carrying capacity estimations for tourism development in Cianjur, West Java

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Abstract. Cianjur, West Java, has the potential for beach recreation tourism development object. This research was conducted to analyze beach recreational suitability and carrying capacity estimations. The survey method is used for data collection. The parameters observed were the physical appearance of the beach, dangerous biota, supporting facilities, and infrastructure. Data processing was performed to calculate the value of the beach recreation suitability index in order to determine the category of tourism suitability and calculate the carrying capacity of the tourism area. Based on the result of this research, the percentage value of the suitability of 6 beaches ranges from 42.59%-77.77%. There are 4 locations categorized as very suitable, while 1 location is categorized as in accordance with the requirements, and 1 location is categorized as not suitable. The smallest carrying capacity of beach recreation and beach sports tourism object is Batu Kukumbung beach with 140 people/day, while the largest is Tipar Sunlight Beach, with 5139 people/day. This research suggests that Jayanti Beach is a priority for developing beach recreation tourism locations in Cianjur with a slight increase in facilities.

Keywords: beach recreation; carrying capacity; suitability

1. Introduction

Cianjur is one of the districts in West Java Province which has potential for beach recreational tourism. Based on the Cianjur Regency Regional Regulation Number 01 of 2017 concerning the Master Plan for Cianjur Regency Tourism Development and Tourism Implementation (Ripperkab), South Cianjur is designated as a Regency Tourism Strategic Area (KSPK) for coastal ecotourism [1]. The locations included in the KSPK are Cilaki Beach and Jayanti Beach in Cidaun District, then Apra Beach in Sindangbarang District, and Tipar Beach in Agrabinta District. In addition to these beaches, several beaches have beautiful panoramic views of the coast, such as Batu Kukukumbung Beach and Ciwidig Beach in Cidaun District.

These beaches are crowded with visitors only on certain days, such as religious holidays or national holidays [2]. The challenge is how to develop beach recreational tourism and coordinated the requirements of all coastal zone partners in a economical arranging prepare that considers natural [3]. The panoramic and environmental quality of the beach are seemingly what attracts tourists. The ecological or land suitability for beach recreation is the first step to develop marine tourism. Suitability for a particular purpose, through the determination of the value of (class) of land and its use patterns by the potential of the land, so that it can be used appropriately [4].

Developing the beach could increase the number of visitors. A large number of visitors could impact on the physical, ecological, and their convenience or satisfaction rate [5]. Carrying capacity issues spin around contemplations approximately tourist density on the beach. The carrying capacity is defined as the maximum number of persons who can use The carrying capacity is characterized as the most extreme number of people who can utilize a beach at the same time without harming the physical, financial, or socio-cultural situations or
This research was conducted to analyze beach recreational suitability and carrying capacity estimations to achieve sustainable tourism development in Cianjur. 

Table 1. Beach recreation suitability matrix.

| Parameters                      | Weight | Category                                  | Score |
|---------------------------------|--------|-------------------------------------------|-------|
| Beach Type                      | 5      | White sand                                | 3     |
|                                 |        | White sand mixed with coral fragments     | 2     |
|                                 |        | Black sand, a little steep                | 1     |
|                                 |        | Mud, Rocky, Steep                         | 0     |
| Beach Width (m)                 | 5      | >15                                       | 3     |
|                                 |        | 10-15                                     | 2     |
|                                 |        | <10-3                                     | 1     |
|                                 |        | <3                                        | 0     |
| Coastal Land Cover              | 3      | Coconut trees, open land shrubs           | 3     |
|                                 |        | Shrubs, scrub, low grass, savanna         | 2     |
|                                 |        | High scrub                                | 1     |
|                                 |        | Mangrove forest, settlement, harbor       | 0     |
| Hazardous Organism              | 1      | Nothing                                   | 3     |
|                                 |        | Sea urchins                               | 2     |
|                                 |        | Sea urchins, stingrays                    | 1     |
|                                 |        | Sea urchins, stingrays, shark             | 0     |
| Availability of fresh water (km)| 1      | <0.5                                      | 3     |
|                                 |        | >0.5-1                                    | 2     |
|                                 |        | 1-2                                       | 1     |
|                                 |        | >2                                        | 0     |
| View and Cleanliness            | 5      | Sunset & sunrise, beautiful, clean        | 3     |
|                                 |        | Sunset or Sunrise, beautiful, clean       | 2     |
|                                 |        | Quite beautiful, quite clean              | 1     |
|                                 |        | Dirty                                     | 0     |
| Accessibility                   | 5      | Very easy                                 | 3     |
|                                 |        | Easy                                      | 2     |
|                                 |        | Quite easy                                | 1     |
|                                 |        | Difficult                                 | 0     |
| Public Transportation Accessibility| 5      | Very easy                                 | 3     |
|                                 |        | Easy                                      | 2     |
|                                 |        | Quite easy                                | 1     |
|                                 |        | Difficult                                 | 0     |
| Facilities and infrastructure   | 3      | Support                                   | 3     |
|                                 |        | Adequate                                  | 2     |
|                                 |        | Sufficient                                | 1     |
|                                 |        | Nothing                                   | 0     |
| Availability of electricity     | 2      | Support                                   | 3     |
|                                 |        | Adequate                                  | 2     |
|                                 |        | Sufficient                                | 1     |
|                                 |        | Nothing                                   | 0     |
| Availability of Communication Signal | 1    | Telephone signal and internet            | 3     |
|                                 |        | Telephone signal                          | 2     |
|                                 |        | Telephone signal at some points           | 1     |
|                                 |        | No Telephone signal                       | 0     |

diminishing guest fulfilment rate [6].
Table 2. Ecological potential and area of activities matrix.

| No | Category          | K (people) | Lt (m²) | Wp (hours) | Wt (hours) |
|----|------------------|------------|---------|------------|------------|
| 1  | Beach Recreation | 1          | 50      | 4          | 10         |
| 2  | Beach Sport      | 1          | 50      | 4          | 10         |

2. Research methods

2.1 Study area
This research was conducted in the coastal area of South Cianjur, West Java. There were six observation locations spread over three districts, Cidaun, Sindangbarang dan Agrabinta district. There were 4 locations in Cidaun district, Batu Kukukumbung Beach, Cilaki Beach, Ciwidig Beach Jayanti Beach. Sindangbarang dan Agrabinta district each has 1 station, Apra Beach and Tipar Beach. This research activity was carried out from Oktober-November 2017.

2.2 Data collection
The survey method is used for data collection and purposive for station determination [7]. Data collected includes averages and characteristics of tourist destination areas including beach recreation suitability of coastal land with ten parameters and carrying capacity of the region in the form of 4 beach recreation categories such as recreation and beach sport. Supported data taken from several reliable data sources. Qualitative and description described in the form of suitability and carrying capacity evaluation and future prospects to achieve sustainable tourism development [8].

2.3 Beach recreation suitability analysis
Beach recreation suitability analysis is obtained from the value of tourism suitability matrix refers to [9] with some modifications. The assessment supports component of each tourist activity. The parameters observed were the physical appearance of the beach, dangerous biota, supporting facilities, and infrastructure. There were ten parameters contained in the matrix can be seen in table 1.

The results of the suitability matrix will be analyzed for the travel appropriateness based on Yulianda, 2010 [9] using the following equation:

\[ IKW = \frac{Ni}{Nmax} \times 100\% \]  

Information, IKW = Tourism Suitability Index, Ni = Parameter value (weight x score, Nmax = The maximum value of a beach recreation. Class suitability index of beach tourism is [9]: S1 = Very suitable, with a value of 83-100%; S2 = Suitable, with a value of 67-<83%; S3 = In accordance with the requirements, with a value of 50 - <67%; N = Not suitable, with a value <50%.

2.4 Area carrying capacity estimation analysis
Carrying capacity estimation in this research is used area carrying capacity. Area carrying capacity is the maximum number of visitors that can be physically accommodated in an area provided at any given time without causing interference with nature and humans should not exceed 10% of the total utilization zone [10]. The calculation of the ACC in the formula is as follows Yulianda et.al, 2010 [9] and Renjaan & Susanty, 2020 [11] with a modification (table 2).

Evaluate the carrying capacity of the area to be able to suit the number of visitors. Calculation of the carrying capacity of the region within the frame of a equation as takes after [9] and [11] :

\[ ACC = K \times \frac{LP}{LT} \times \frac{Wt}{wp} \]  

Information, ACC = Carrying capacity of tourist areas (people/day), K = Ecological potential of visitors per area unit, Lp = Area or length of area that can be utilized, Lt = Unit area for certain
3. Result and discussion

3.1. Beach recreation suitability

The type and color of sand give their own value to the aesthetics of the beach itself, where beaches with white and medium-sized black sand are very popular for visitors [12]. Based on beach-type Ciwidig Beach, Jayanti Beach and Tipar Beach have white sand while Apra Beach has Black sand; furthermore, Batu Kukukumbung Beach and Cilaki Beach have White sand mixed with coral fragments. The beach sand color results from the sedimentation process that occurs due to the material transport process [7].

The presence of white sand has become an attraction for visitors [13]. The majority of beach width measurements is the distance from the access point to the high-water mark [14]. Tipar Beach is the widest beach with 120 m, while Batu Kukukumbung Beach, Cilaki Beach, and Jayanti Beach have the smallest width with 50 m. The increase in the useful area of the beach along with its length [14].

The cover of beach land dominated by coconut trees, Shrubs, scrub, low grass, savanna, and open land, provides a shady, cool atmosphere and beautiful scenery for visitors who are doing recreational activities [7]. According to the suitability matrix of the conditions of beach land cover, all locations can be classified into very suitable categories. Based on observations at the location and information obtained from the public and visitors, showed there are no harmful biota was found. According to the

Table 3. Beach recreation suitability analysis result.

| Parameters                      | Location       |
|---------------------------------|----------------|
|                                 | Batu Kukukumbung Beach | Cilaki Beach | Ciwidig Beach | Jayanti Beach | Apra Beach | Tipar Beach |
| Beach Type                      | White sand mixed with coral fragments | White sand mixed with coral fragments | White sand | White sand | Black sand | White sand |
| Beach Width (m)                 | 50             | 50           | 100          | 50           | 40          | 120         |
| Beach Land Cover                | Coconut trees, open land shrubs | Shrubs, scrub, low grass, savanna | Shrubs, scrub, low grass, savanna | Shrubs, scrub, low grass, savanna | Shrubs, scrub, low grass, savanna | Shrubs, scrub, low grass, savanna |
| Hazardous Organism              | Nothing        | Nothing      | Nothing      | Nothing      | Nothing     | Nothing     |
| Availability of fresh water (km)| <0.5           | <0.5         | <0.5         | <0.5         | <0.5        | >1-2        |
| View and Cleanliness            | Sun rise, beautiful, clean | Quite beautiful, quite clean | Quite beautiful, quite clean | Sun set, quite beautiful, quite clean | Quite beautiful, quite clean | Quite beautiful, quite clean |
| Accessibility Public            | Very easy      | Very easy    | Very easy    | Very easy    | Easy        | Nothing     |
| Transportation Accessibility    | Quite easy     | Quite easy   | Quite easy   | Quite easy   | Quite easy  | Difficult   |
| Facilities and infrastructure   | Sufficient     | Nothing      | Sufficient   | Adequate     | Sufficient  | Nothing     |
| Availability of electricity     | Support        | Adequate     | Adequate     | Support      | Adequate    | Nothing     |
| Availability of Communication   | Telephone signal and internet | Telephone signal and internet | Telephone signal and internet | Telephone signal and internet | Telephone signal and internet | Telephone signal at some points |
| Total Value                     | 82             | 74           | 77           | 84           | 62          | 46          |
| IKW (%)                         | 75.92          | 68.5         | 71.29        | 77.77        | 57.41       | 42.59       |
| Class suitability               | S2             | S2           | S2           | S2           | S3          | N           |

categories, \( W_t \) = Time provided by the region for tourism activities in one day, \( W_p \) = Time spent by visitors for each particular activity.
matrix of the suitability of the presence of hazardous biota on the coast can be classified into very suitable categories at all locations.

All locations showed that there was almost no trash and kept clean. This can be due to the awareness of visitors about environmental cleanliness is quite good [8]. Cleanliness can also be affected by the season of visit. The research was carried out during the low visiting season, so this allows the beach to be maintained in a clean condition [6].

The availability of clean water in the form of freshwater is important to support management facilities and visitor services. This is also a criterion for evaluating the feasibility of developing beach recreation tourism priorities [15]. Five beaches have availability of fresh water at close range; otherwise, only Tipar Beach has availability of freshwater with some distance. Based on table 3, there are three beaches categorized, suitable, in accordance with the requirement, and not suitable. Jayanti Beach has the highest IKW with 77% categorized as suitable otherwise Tipar beach has the lowest IKW with 42.59% categorized as not suitable. The high IKW value of Jayanti Beach is caused by a good score on several key parameters such as beach type, beach width, coastal land cover, view and cleanliness as well as parameters related to accessibility and facilities.

Jayanti Beach is a priority for developing beach recreation tourism in Cianjur because it has the highest IKW. The thing that needs to be improved from Jayanti Beach is supporting facilities. Access to the beach, as well as public transportation accessibility, facilities and infrastructure, availability of electricity, and availability of communication signals, become important to develop beach recreation. It is clear that more noteworthy speculation in framework and accessibility of administrations may be a administration need in arrange to extend visitors number [6].

### 3.2. Area carrying capacity estimation

Beaches are highly valuable tourist resources. Therefore determination of their carrying capacity is an essential factor for their sustainability [16]. There are 6 locations in Cianjur. Tipar Beach is the widest beach area with 102786 m². Otherwise, Batu Kukumbung Beach is the smallest area with 2804 m². The results of measuring area carrying capacity estimation are obtained as shown in table 4.

| Location     | Category           | K  (people) | Lp        (m²) | Lt        (m²) | Wp  (hours) | Wt  (hours) | ACC        (people/day) |
|--------------|--------------------|-------------|-------------|-------------|-------------|-------------|------------------------|
| Batu Kukumbung Beach | Recreation Beach | 1           | 2804        | 50          | 4           | 10          | 140                    |
| Batu Kukumbung Beach | Recreation Beach Sport | 1           | 2804        | 50          | 4           | 10          | 140                    |
| Cilaki Beach | Recreation Beach | 1           | 5746        | 50          | 4           | 10          | 287                    |
| Cilaki Beach | Recreation Beach Sport | 1           | 24027       | 50          | 4           | 10          | 1201                   |
| Ciwidig Beach | Recreation Beach | 1           | 7194        | 50          | 4           | 10          | 360                    |
| Ciwidig Beach | Recreation Beach Sport | 1           | 24027       | 50          | 4           | 10          | 1201                   |
| Jayanti Beach | Recreation Beach | 1           | 7194        | 50          | 4           | 10          | 360                    |
| Jayanti Beach | Recreation Beach Sport | 1           | 7194        | 50          | 4           | 10          | 360                    |
| Apra Beach   | Recreation Beach | 1           | 5572        | 50          | 4           | 10          | 279                    |
| Apra Beach   | Recreation Beach Sport | 1           | 5572        | 50          | 4           | 10          | 279                    |
| Tipar Beach  | Recreation Beach | 1           | 102786      | 50          | 4           | 10          | 5139                   |
| Tipar Beach  | Recreation Beach Sport | 1           | 102786      | 50          | 4           | 10          | 5139                   |
Carrying capacity is a limitation of tourists in tourism activities [17]. The concept of development tourism has a feature that is limiting the number of tourists. If the number of visitors is not limited, this can threaten the sustainability of the resource itself [18]. Based on table 4, Batu Kukumbung Beach has the lowest ACC with 140 people/day while Tipar Beach has the highest ACC with 5139 people/day. The acc value describes the estimated maximum number of visitors per day in order to protect the environment and visitor’s comfortness.

4. Conclusions and suggestions

Cianjur District government should be a focus on developing one of the beaches tourism objects because it will facilitate its development and supervision. Jayanti Beach is a top priority for developing beach recreation tourism in Cianjur because it has the highest IKW with 77.77%, and it has ACC with 360 people/day. The thing that needs to be improved from Jayanti Beach is supporting facilities for the visitor’s convenience.

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