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Analysis of Sepancong Hill Tourism's Carrying Capacity in the District of Bengkayang

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Abstract. Sepancong Hill is one of the tourist attractions in Bengkayang Regency. According to the survey, there is an increase in tourist visits from day to day. If it continues, it will lead to environmental problems caused by an excessive number of tourists. This research aimed to get the maximum number of tourists according to the carrying capacity of Sepancong Tourism. The method used in this study is to calculate the Physical Carrying Capacity (PCC), Real Carrying Capacity (RCC), and Effective Carrying Capacity (ECC). The analysis used is descriptive quantitative analysis. Sepancong Hill nature tourism is divided into two areas, such as the campsite and Orchid Park. This research showed that the PCC of both areas is 182 and 356, respectively. The RCC of the campsite and orchid park are 51 and 101. The ECC of the camping area and Orchid Park are 51 and 101. The carrying capacity values for both are obtained by the equation PCC > RCC ≥ ECC. The PCC of the whole hill of Sepancong is 352. It means that the carrying capacity of Sepancong Hill is large and can still accommodate tourists with all tourist activities.

Keyword: Campsite, Maximum Number of Tourists, Orchid park, Sepancong Hill, Tourism Carrying Capacity

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1 Introduction

The carrying capacity of the ecosystem must be the consideration in a plan for developing natural tourism. The environment or nature used for natural resources usage, including tourism objects is intended to function well and not disregard the preservation of environmental functions. There are several factors inhibiting the development of tourism, such as natural, environmental and social constraints. Therefore, it is important to come to an agreement on sustainability levels for each destination, which can be based on resources [1], activities [2], or communities [3]. The carrying capacity of tourism encompasses a variety of physical, social, and economic effects caused by tourism, each defined with its traits and aftermath [4]. Carrying

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capacity is a good starting point for evaluating various interactions amongst the real circumstances of the resource used for recreational purposes as well as the perceived quality, quantity, and experience's quality from the supply and demand perspectives. Bengkayang Regency has a tourist attraction, namely Sepancong Hill. It is in Cipta Karya Village, Sungai Betung District. Since its construction in March 2020, Sepencong Hill has been a popular new tourist destination.

Based on a preliminary survey of tourism managers, tourist visits are increasing day by day, especially during holidays and major holidays. If tourism activities transcend the carrying capacity to damage the existing environment, it can have implications for the loss of ecological benefits and economic benefits. The carrying capacity of nature tourism is the ability of a natural tourism attraction to accommodate the number of visitors in a location and within a specific time frame without endangering the physical, economic, and socio-cultural environments of natural tourism areas [5]. Visitor management strategies are necessary for the use of natural resources for the general public. However, because misuse can result in resource degradation, it can be difficult to balance the real impacts of usage that offers a high-standard visitor experience [6].

Carrying capacity aims to prevent and minimize problems that occur in the environment caused by an excessive number of tourists so that the quality of visitor satisfaction can be maintained [7]. This study's objective was to acquire the maximum number of tourists according to the value of the carrying capacity of the natural tourism of Sepancong Hill, Bengkayang Regency. It is crucial to analyze the environment's carrying capacity. Thus the number of visitors does not exceed the environment's carrying capacity.

2 Research Method

This research was conducted in June 2021 to July 2021, at the Sepancong Hill natural tourist attraction, Cipta Karya Village, Sungai Betung District, Bengkayang Regency, West Kalimantan. It has an altitude of 400 meters above sea level (asl). The carrying capacity of Sepancong Hill tourism in this research is divided into two places, namely the campsite and the Orchid Park which is located at the foot of Sepancong Hill. Comprehensive data is required for supporting areas at the hill foot and the hilltop area to fully understand the Sepancong Hills' tourism carrying capacity. Data collection includes both primary and secondary data. The primary data was collected in the field using direct measuring methods, and data on the vegetation was used to determine correction factors (environmental biophysical parameters) and a few questionnaires and interviews to determine the value of the visit rotation factor (Rf). On another side, secondary data was gathered by researching relevant studies.

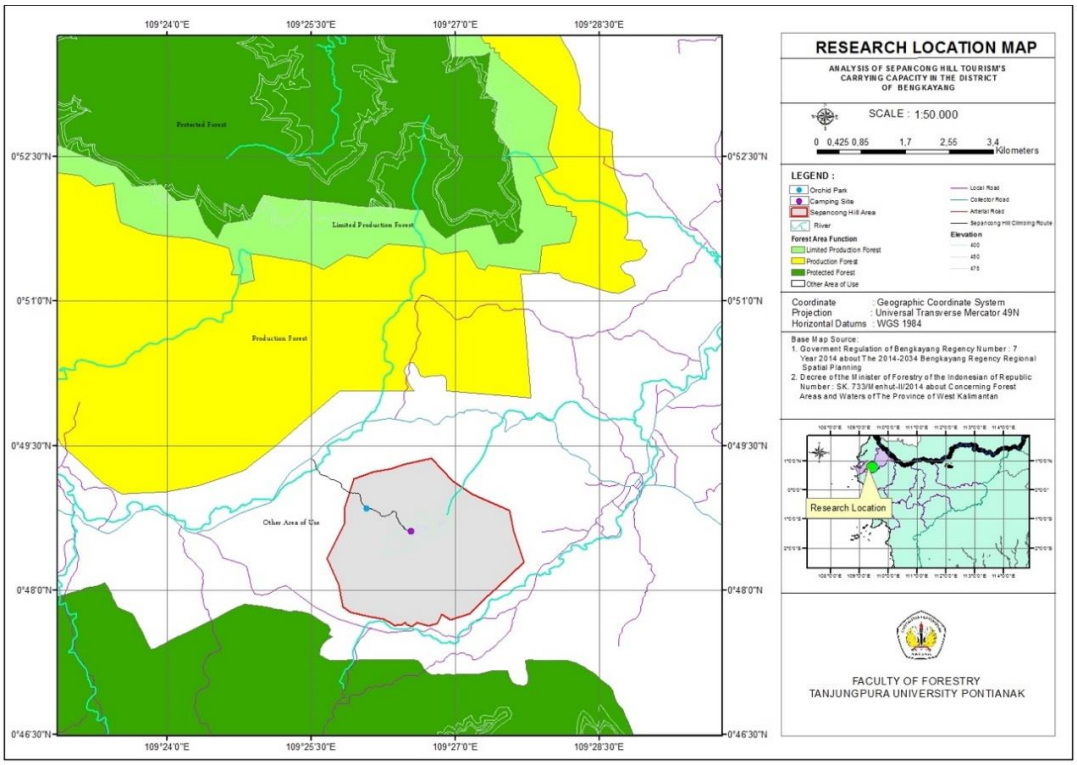

Figure 1 Research location map

The carrying capacity is referenced in the analytical framework. This framework offers the highest number of visits based on the physical, biological, and management characteristics of the region. This analytical framework considers three important determinants: Physical Carrying Capacity (PCC), Real Carrying Capacity (RCC), and Effective Carrying Capacity (ECC) [8]. Details of the analysis carried out are as follows:

2.1 Physical Carrying Capacity (PCC)

PCC is used to describe the maximum number of tourists that can physically fit into a designated area during a specific period of time [9]. PCC is calculated based on the comfort area of tourist activities. The formula for PCC calculations developed by [10] and modified by [11] is as follows:

$$PCC = A\ x\ \frac{1}{B} + Rf \quad (1)$$

Information:

A : Area used for tourism (m^2)

B : The area needed by a tourist to travel while still getting satisfaction, camping activities are 90 m^2 and picnic activities are 65 m^2 according to [11]

Rf : Rotation factor (Rf) or open time/average visiting time.

2.2 Real Carrying Capacity (RCC)

Real carrying capacity (RCC) is constrained by the biophysical factors of the environment in the tourism area. The formula used to calculate RCC refers to the [10] formula as follows:

$$RCC = PCC\ x\ \frac{(100 - Cf1)}{100}\ x\ \frac{(100 - Cf2)}{100}\ x \ldots x\ \frac{(100 - Cfn)}{100} \quad (2)$$

The variables gathered from the tourist area are used to determine the correction factor. These variables include Rainfall correction factor (Cf1), slopes (Cf2), soil sensitivity to erosion (Cf3), and vegetation (Cf4). The exact carrying capacity in each location varies depending on the conditions of the area when determining biophysical variables. According to research done by [12] in the Turkish region of Termessos National Park, the biophysical variables included as limiting variables were parameters of excessive sunlight, rainfall, erosion, storms, accessibility, and wildlife disturbance. This study adopted biophysical characteristics, such as slope, rainy season, water body cover, forest cover, and month of high wave occurrence, as limiting factors, in contrast to the research carried out by [13] at Pisang Island Ecotourism. The findings of observations made in the Sepancong Hill tourist region reveal biophysical characteristics that are thought to be limiting factors for the environment's ability to support Sepancong Hill.

The rainfall index for the Bengkayang area during 2020–2021, from May 2020 to April 2021 is used to calculate the rainfall correction factor (Cf1). Then the rainfall correction factor (Cf1) is calculated using equation (3), referring to the formula of [10], modified by [16]:

$$A = \frac{(total\ number\ of\ visiting\ days)}{(total\ number\ of\ rainy} \quad (3)$$

Slope assessment had been carried out using a scoring system based on slope class criteria on segments actively passed by tourists regarding the slope class classification. According to Minister of Agriculture Decree No. 837/Kpts/UM/11/1980. Track length and land area data were collected using the GPS tool in the field survey. While the Bengkayang Regency Spatial Plan slope map was superimposed on the research site to obtain the slope data.

The soil sensitivity adjustment factor is calculated based on the soil type as specified in the Decree of the Minister of Agriculture No. 836/Kpts/UM/11/1980. Tourism-related activities can harm a tourist attraction's vegetation diversity. Therefore, it was viewed as a restricting factor. The Simpson Diversity Index (SDI) equation is used to calculate the Sepancong Hill adjustment factor for flora diversity [17].

2.3 Effective Carrying Capacity (ECC)

The effective carrying capacity is the maximum number of tourists permitted by environmental conditions and management capabilities without affecting demand for tourism-related activities [15]. Effective carrying capacity is the result of a combination of real carrying capacity with tourism area management capacity, the formula used to calculate RCC is below [10]:

$$ECC = RCC \; x \; MC \tag{4}$$

The parameter of area management capacity is approached through the capacity of management officers in tourist areas by using the formula of [10]:

$$MC = \frac{Rn}{Rt} \; x \; 100\% \tag{5}$$

Information:

MC : Management capacity

Rn : Number of available management officers

Rt : Number of management officers needed during peak season

The next stage for carrying capacity assessment is comparing PCC, RCC, ECC with the number of tourist visits per day [11] with the following conditions:

$$PCC > RCC \; and \; RCC \geq ECC \tag{6}$$

a. If the value of PCC > RCC and RCC ≥ ECC means that the carrying capacity is large,

b. If the value of ECC > RCC > PCC means that the number of tourists has exceeded the carrying capacity limit,

c. If the value of PCC = RCC = ECC means optimal power.

3 Result and Discussion

The ability of a tourist attraction to accept a certain number of visitors within a specific period and space is known as carrying capacity. Carrying capacity must be analyzed to determine how many people can visit at once without endangering the surrounding environment. It will allow for the preservation of the location's physical integrity as well as its ability to perform its intended functions simultaneously. When analyzing the carrying capacity of the environment in Sepancong Hill nature tourism, three factors were taken into account: physical carrying capacity (PCC), real carrying capacity (RCC), and effective carrying capacity. (ECC). According to the

result, the Orchid Park area is 2475 m^2, while the camping space in Sepancong Hill is 6334 m^2). Sepancong Hill is a tourist destination located in Pungo Hamlet, Cipta Karya Village, Sungai Betung District, Bengkayang Regency, West Kalimantan Province. It was inaugurated in March 2020 by BUMDes Panyanggar. In this study, the carrying capacity of tourism for Sepancong Hill was assessed using two different tourist destinations which are the Sepancong Hill camp area (Figure 1a) and the Orchid park tourist spot (Figure 1b). It is located at the foot of Sepancong Hill.

Figure 2 Sepancong Hill nature touristm (a) camp area, (b) Orchid Park

3.1 Physical Carrying Capacity (PCC)

The value of physical carrying capacity is one of the most important indicators in a tourism development plan that can be carried out by the manager of the Sepancong Hill tourist area.

States that the use of carrying capacity standards at a tourist location can have a positive impact in preventing activities that are detrimental to tourism development [12]. The outcome of PCC calculations reveal that the Sepancong Hill tourist area in the camp area is physically able to accommodate several 182 people/day and the Orchid park area can accommodate several 356 people/day. The value of the physical carrying capacity of the Sepancong Hill camping and the orchid park, if it is related to the present average daily visitor count of 150 tourists, has been satisfied from the value of the Sepancong Hill. However, tourists can still feel satisfied. This value is still below the physical carrying capacity determined by the computation results when compared to the average daily number of visits during this period, which is 150 visitors. The creation of tourist attractions is based on the physical carrying capacity, which is the value calculated by taking into consideration the environmental, biophysical, and managerial aspects. To conserve and maintain the stability between environmental factors and tourism-related activities, the Sepancong hill can still be optimized in the future, for instance, by increasing the number of visitors by 17.58% based on physical carrying capacity.

3.2 Real Carrying Capacity (RCC)

The RCC displayed the number of tourists that a region could support using a correction factor (Cf) based on the region's characteristics and applied to the PCC without harming the area's natural ecosystems and environment [12]. RCC is the total number of tourists that are permitted to visit with several correction factors acting as a barrier. The real carrying capacity value in the Sepancong Hill Spot 2 camping area is 51 people/day, and for the Orchid Garden is 101 people/day. Compared to the PCC value, this number is significantly lower. Recommendations for enhancing current facilities can be helpful to site management.

Correction factors (Cf) for Sepancong Hill nature tourism are rainfall, slope, soil sensitivity to erosion, and vegetation. The results of the calculation of the four correction factors are rainfall (Cf1), slope (Cf2), soil sensitivity to erosion (Cf3), and vegetation diversity (Cf4). Calculation of the rainfall correction factor in Bengkayang Regency obtained a rainfall ratio of 8,58mm/day. In addition to the rainfall correction factor in calculating the real carrying capacity, there is also a slope correction factor.

Another factor limiting the real carrying capacity is the land slope. The calculation results show that the slope of the Sepancong hill campsite is 28.10%, and the orchid garden is 13.75%. These two tourist spots refer to the classification of slope class. Sepancong Hill campsites are in the steep class category, while Orchid Park is in the sloping category. The correction factor of the land slope becomes a limiting factor. The steeper or steeper the track and land that must be traversed by tourists. The greater the energy and time required by tourists. In steep and very steep areas, tourists are not recommended to carry out any tourist activities for safety reasons [20]. Several paths and areas leading to Sepancong Hill tourism have quite steep land. Steep land has the potential for landslides. Thus, efforts are needed from the manager to minimize the potential for landslides. An effort maybe made to maintain and expand the quantity of vegetation on steep ground and create terraces on quite steep land.

The correction factor for soil sensitivity to erosion based on observations shows that the camp area and Orchid Gardens both have sensitive or high soil sensitivity. Soil sensitivity was obtained by looking at the soil type in the area. The results obtained showed the soil type in the two tourist spots was Podzolic soil type. Podzolic soil is yellow to tan characteristics of soil, clay texture, sticky consistency, lumpy soil structure, low base saturation, and strong aggregate stability [11]. The type of podzolic soil is sensitive or easily eroded soil (high erodibility) with a value of 60. The greater the erodibility, the potential for erosion/landslides is higher [5]. To reduce the likelihood of landslides, the manager must take action. Among the actions that can be taken are the construction of terraces, particularly in steep terrain, and the maintenance or expansion of plant life, particularly those with a deep root system. Other adjustment elements

for Sepancong Hill natural tourism include slope and soil sensitivity to erosion. Vegetation correction factors are also present.

Based on direct observation in the field at the Sepancong Hill campsite, 17 species were found with a total of 664 individuals, while in Orchid Park, 26 species were found with a total number of 648 individuals. Orchid is dominated by the Madang marukuwung plant.

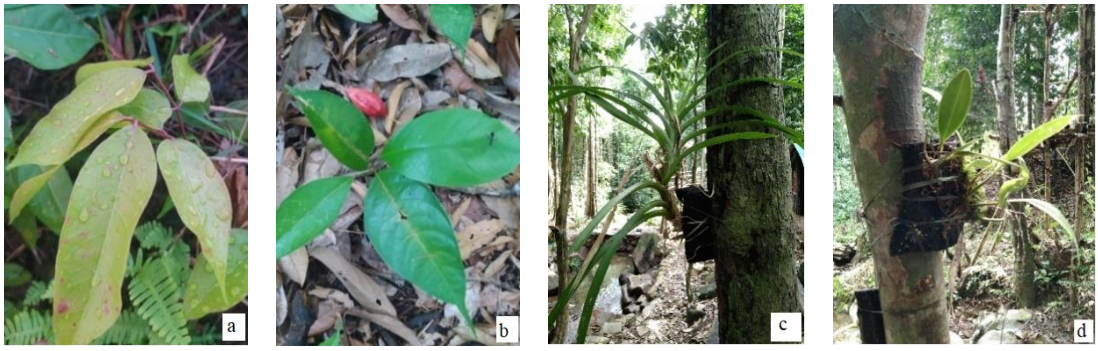

Figure 3 Camping area and Orchid Park vegetation: (a) jengkol (*Archidendron pauciflorum*), (b) madang marukuwung/tagula (*Litsea* sp), (c) cane orchid (*Grammatophyllum speciosum*), (d) moon orchid (*Phalaenopsis bellina*)

The Orchid Park tourist spot has several collections of orchid plants from inside and outside Sepancong Hill. The most common orchid types found in the Orchid Park tourist spot (which comes from within the Sepancong Hill habitat) are the sugarcane orchid (*Grammatophyllum speciosum*) in Figure 2c and the moon orchid (*Phalaenopsis bellina)* in Figure 2d. Several other types of orchids originating from outside Sepancong Hill include Kalimantan black orchids (*Coelogyne pandurata* Lindl), Cattleya orchids, Dendrobium orchids, Vanda orchids (*Vanda limbata*), striated orchids (*Phalaenopsis celebensis*), pencil orchids (*Papillionanthe hookeriana*) and others. Some of these types of orchids have been lost due to the actions of irresponsible persons to take them and bring them home. The vegetation correction factor (Cf4) values in the Sepancong Hill campsite and Orchid Park are 0.69 and 0.80 respectively. The species diversity at both locations, both in the Sepancong Hill campsite and the Orchid Park, the flora diversity was still quite stable.

According to the observational results, Sepancong Hill's environmental carrying capacity for nature tourism is constrained by biophysical factors, such as rainfall, slope, soil sensitivity to erosion, and vegetation. The RCC value of both Sepancong Hill campsite is 51 people/day, and the RCC Orchid Park is 101 people/day, has been fulfilled.

3.3 Effective Carrying Capacity (ECC)

ECC is the maximum number of visitors that can be accommodated by Sepancong Hill tourism at a certain time by considering both the correction factor and management capacity (MC), specifically the availability of employees. The calculation results of ECC value at Sepancong

Hill tourism for the camp area is 51 people/day, and for the Orchid park area, it is 101 people/day. The ECC value of both the Sepancong Hill campsite and the Orchid park is sufficient compared to the current average number of visits. However, on certain days such as major holidays or holidays, tourists who come can reach >150 people/day, which value has exceeded the ECC for the Sepancong hill campsite. The solution that can be done is to increase the number of officers/managers, especially during the peak season of visiting the Sepancong Hill campsite. Thus, it does not cause excessive carrying capacity.

In order to determine the carrying capacity of all Sepancong Hill tours, the variables PCC, RCC, and ECC were compared to the daily average of tourist visits using the formula PCC > RCC and RCC ≥ ECC. The results of the calculation of physical carrying capacity (PCC), real carrying capacity (RCC), and effective carrying capacity (ECC) in the Sepancong Hill campsites and Orchid park, obtained the following equation:

a. The value of the carrying capacity of the campsite: PCC > RCC (182 > 51) and RCC ≥ ECC (51 ≥ 51)

b. The value of the carrying capacity of the Orchid Park area: PCC > RCC (356 > 101) and RCC ≥ ECC (101 ≥ 101)

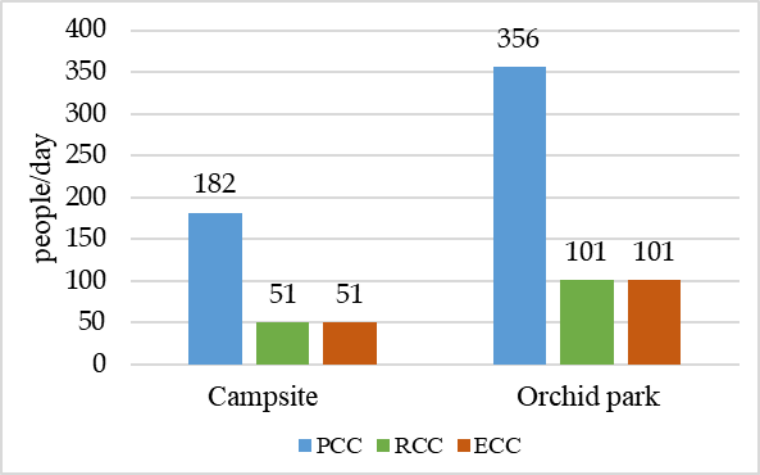

Figure 4 PCC, RCC and ECC of the campsite and Orchid park

The results show that the tourism carrying capacity of the two areas has a large capacity or does not exceed the limit. It indicates that Sepancong Hill tourism can still provide visitors with properly executed tourism-related activities as long as the maximum carrying capacity of tourism is not exceeded. According to [22], tourism activities by optimizing the carrying capacity of the environment can increase the quality of life and add value to natural resources. As a result, future generations will be able to keep and enjoy the natural resources employed for

tourism development, which will boost both the level of tourist satisfaction and the ability of nature to retain and enjoy its benefits.

4 Conclusions

The assessment result of the carrying capacity in Sepancong Hill tourism has great value. The carrying capacity values analyzed are three factors. First, the physical carrying capacity (PCC) for the camp area of 182 people/day, and the Orchid Park of 356 people/day. Second, the value of the real carrying capacity of the campsite is 51 people/day, and for Orchid Park is 101 people/day. Third, the value of the Effective Carrying Capacity (ECC) of the campsite and the Orchid park is 51 people/day and 101 people/day, respectively. The overall PCC of Sepancong Hill is 352 people/day. Overall this value is obtained by the equation PCC > RCC and RCC ≥ ECC. It means the carrying capacity value is high to accommodate the number of tourists who come. Based on this value, it can conclude Sepancong Hill tourism can still accommodate tourists with all tourism activities carried out properly as long as it does not exceed the existing carrying capacity.

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