



## Buhunuah Hill Tourism Supporting Capacity of Tunggul Boyok Village, Bonti Sub-District, Sanggau Regency

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### ABSTRACT

Buhunuah Hill is a tourist destination located in Petuo Hamlet, Tunggul Boyok Village, Bonti District, Sanggau Regency, West Kalimantan Province. This Buhunuah Hill tourist attraction is still relatively new, so there is a lack of information about the number of proper tourist capacities in the Buhunuah Hill camping area, which is not optimal. Therefore, it is necessary to conduct research on the Buhunuah Hill Tourism Carrying Capacity for its development. This study aims to obtain the value of the carrying capacity of the area, including physical carrying capacity, real carrying capacity, and effective carrying capacity. This study used survey, observation, and interview methods. The analysis used is quantitative descriptive analysis. This study shows that the physical carrying capacity (PCC) value of the camping area is 11, the real carrying capacity (RCC) value for Buhunuah Hill tourism is 11, and the effective carrying capacity (ECC) value for Buhunuah Hill tourism is 11. The carrying capacity value results are obtained by the equation  $PCC = RCC = ECC$ . This means that the carrying capacity value of Buhunuah Hill tourism is optimal and can accommodate tourists with all tourism activities as long as it does not exceed the maximum value of tourism carrying capacity.

**Keyword:** Buhunuah Hill Tourism, Effective Carrying Capacity, Physical Carrying Capacity, Real Carrying Capacity, The Maximum Number Of Tourists Visiting, Tourism Carrying Capacity



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## 1. Introduction

Petuo Hamlet is located in Tunggul Boyok Village, Bonti District, Sanggau Regency, West Kalimantan Province. It has natural resources that have the potential as a natural tourist attraction with the name Buhunuah Hill, which was designated on January 8, 2022, by the Youth, Sports, and Tourism Office of Sanggau Regency. The part of the attraction object for tourists is the diversity of interesting and unique flora and fauna resources [1].

On certain occasions, Bukit Buhunuah is used as a meeting place, such as the formation and inauguration meeting of the Tourism Awareness Group (POKDARWIS), Saturday Sunday Camp, and SAKA Tourism. The width of the hilltop is 721.67 m<sup>2</sup>, so the tourist area is not comfortable, but the natural beauty of the hilltop is very attractive, especially in the morning, like being above the clouds (Figure 1).



**Figure 1.** Bukit Buhunuah photo spot

It is necessary to research the carrying capacity of tourism to get the capacity of the number of tourists in Bukit Buhunuah. Carrying capacity is the maximum number of people who can visit a tourist attraction at the same time without causing damage to the physical environment, economy, and socio-culture and decreased tourist satisfaction. The development of a tourist attraction has good planning if the number of tourists does not exceed its carrying capacity [2].

The research aims to obtain the carrying capacity value of the area, including physical carrying capacity (PCC), real carrying capacity (RCC), and effective carrying capacity (ECC) in the Bukit Buhunuah camping area. The PCC was calculated based on the comfort area in activities. RCC was limited by the area's tolerance level. ECC was influenced by management capacity [3].

## 2. Research Method

The research was conducted in November 2022 at the Bukit Buhunuah natural tourist attraction, Petuo Hamlet, Tunggul Boyok Village, Bonti District, Sanggau Regency ( $0.42792787249478065^{\circ}$  N,  $110.61975124540133^{\circ}$  E). The research uses a survey method to obtain the tourism support capacity of Bukit Buhunuah [4]. Data collection techniques were conducted through open interviews, observation, and literature study. Primary research data was obtained through direct observation and open interviews with the POKDARWIS and the Head of Tunggul Boyok Village. The data can be described as follows: campsite tourism area, number of tourists, visiting time, flora (trees) and fauna (birds), number of management officers, number of officers, and data on soil sensitivity to erosion (soil type). Secondary data was obtained in the form of literature studies (Central Bureau of Statistics of Sanggau Regency) and Indonesian landform maps (RBI). The data can be described as follows: rainfall data, slope data, and data on soil sensitivity to erosion (soil type). Meanwhile, supporting data was obtained from all supporting information related to the research sourced from various related agencies or institutions, such as the Tunggul Boyok Village Office and UPT KPH East Sanggau Region. The literature studies relevant to the research include a location map to show the location of Bukit Buhunuah Tourism and the general conditions of the research location. The general conditions were the location, area, and management status of physical conditions.

Tools used in the study: camera, questionnaire sheet, GPS, logbook, binoculars, maps of the topography of Indonesia (RBI), contour maps, soil type maps, maps of Indonesian forest areas, ropes, measuring tapes, a clinometer, a bird species identification book "Birds in Sumatra, Java, Bali, and Kalimantan" [5], a tree species identification guidebook "Forest tree species identification field guide", and GIS Software (ArcMap 10.8.1 or below).

The PCC analysis is an area relating to the size and number of feasible physical space areas. The PCC value was used in the analysis of the carrying capacity based on the tourist environment method [4].

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

Description :

- A = Area used for tourism
- B = The area required by a tourist to travel while still obtaining satisfaction. The need for a tourist area per person for camping activities is 90 m<sup>2</sup>
- Rf = Rotation factor (Rf) is the number of daily visits allowed to one location (opening period / average time per visit)

The RCC is the number of tourists allowed to visit a tourist attraction with a correction factor (CF) taken from the characteristics of the object applied to the PCC [10].

$$RCC = PCC \times \frac{(100-Cf1)}{100} \times \frac{(100-Cf2)}{100} \times \frac{(100-Cf3)}{100} \times \frac{(100-Cf4)}{100} \times \frac{(100-Cf5)}{100} \quad (2)$$

Description :

- PCC = Physical Carrying Capacity
- Cf...Cfn = Correction factors of the environmental biophysical parameters of a tourist area

The correction factor (Cf) is obtained from field observation variables, namely:

### 2.1 Slope correction factor (Cf<sub>1</sub>)

A tourist area with flat or sloping land slopes will provide more comfort. For slope correction factor [6]. The assessment is carried out using a scoring system on the slope class criteria in the segments of the area that are actively passed by tourists concerning the classification of slope classes in the Decree of the Minister of Agriculture No.837/kpts/UM/11/1980 [7]. The slope correction factor (Cf<sub>1</sub>) data collection method uses the slope percentage formula equation [8].

$$S = \left( \frac{\Delta h}{D} \right) 100\% \quad (3)$$

Description :

- S = Slope (%)
- Δh = Altitude difference (m)
- D = Distance between highest and lowest point (m)

### 2.2 Correction factor for soil sensitivity to erosion (Cf<sub>2</sub>)

The soil sensitivity of a tourist area is very influential on tourism activities. A tourist area with high soil sensitivity means it has a high rate of erosion or landslides [6]. The correction factor for the level of soil erosion sensitivity is assessed based on the type of soil by the Minister of Agriculture Decree No.837/kpts/UM/11/1980 [7].

$$Q = \frac{\sum \text{average dry month}}{\sum \text{average wet month}} \times 100\% \quad (4)$$

### 2.3 Climate correction factor (rainfall) (Cf<sub>3</sub>)

The calculation of the climate (rainfall) correction factor (Cf<sub>3</sub>) is in the form of a ratio/index of the Q value (dry/wet months) for the last 10 years. Climate classification in Indonesia is based on the ratio between Dry Month (BK) and Wet Month (BB), namely using the Schmidt and Ferguson formula to calculate the ratio (Q) [9]. The magnitude of the Q value can determine the type of rainfall of a place or area.

### 2.4 Tree vegetation correction factor (Cf<sub>4</sub>) and Bird fauna correction factor (Cf<sub>5</sub>)

Vegetation/tree correction factor (Cf<sub>4</sub>) and fauna/bird correction factor in the form of species diversity (Simpson's Diversity Index) [6]. Observations on bird fauna in the Bukit Buhunuah area were based on the large number of birds found and the diverse sounds of birds. Each was applied separately, namely for the correction factor for tree vegetation diversity and the correction factor for bird fauna diversity.

The dominance index ( $\lambda$ ) was calculated to obtain the Simpson's diversity index (SDI) value for tree vegetation and bird fauna (Formula 5 and 6).

$$\lambda' = \frac{\sum_{i=1}^S ni (ni-1)}{n (n-1)} \quad (5)$$

$$SDI = 1 - \lambda' \quad (6)$$

Description :

- $\lambda'$  = Dominance index  
 $SDI$  = Simpson's diversity index  
 $S$  = Number of species  
 $Ni$  = Number of individuals of type  $i$   
 $N$  = Number of individuals of all species

The range of values on the Simpson index is 0 - 1; the closer to zero the value of  $\lambda'$  of a community the lower the diversity. Furthermore, the correction factor is calculated using the Formula 7 [4].

$$Cf = 1 - \frac{Mi}{Mt} \quad (7)$$

Description :

- $Mi$  = Real condition on the variable  
 $Mt$  = Maximum limit on the variable

Effective Carrying Capacity is the result of a combination of the real carrying capacity with the management capacity of the tourist area, as described by Formula 8.

$$ECC = RCC \times MC \quad (8)$$

ECC is the Effective Carrying Capacity. RCC is the Real Carrying Capacity. MC is the management capacity of the area. This last parameter is approached through the capacity of the management staff in the tourist area [6].

$$MC = \frac{Rn}{Rt} \times 100\% \quad (9)$$

Description :

- $Rn$  = Number of existing management staff  
 $Rt$  = Number of management staff required

### 3. Results and Discussion

#### 3.1 Physical Carrying Capacity (PCC)

The PCC is the maximum number of visits to a site that is limited by the time and area needed by a tourist to travel while still obtaining satisfaction per person for camping activities of 90 m<sup>2</sup>. The duration of the visit is 1.4 hours per day with a maximum number of tourists of 11 people/day [4]. Physical support is influenced by the Bukit Buhunuah camping area of 721.67 m<sup>2</sup> obtained from GPS results by making polygons and tracks in a flat camping area at an altitude of 375 masl (Table 1).

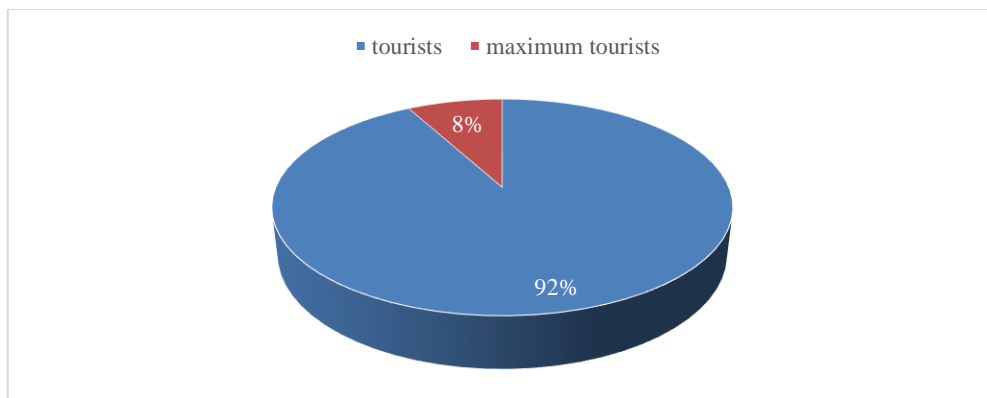
**Table 1.** Average duration of tourist visit in Bukit Buhunuah

Visit Duration (Hours)	Category Value Single Value (Hours)	Number of Travelers	Value (Hours)	Average Visit (Hours)
12-13	12.5	10	125	2.08
15-16	15.5	32	496	2.58
16-17	16.5	20	330	2.75
17-18	17.5	53	927.5	2.92
20-21	20.5	5	102.5	3.42
23-24	2.5	7	164.5	3.92

Total	106	127	2,146.5	17.67
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The PCC showed the camping area is physically able to accommodate a total of 11 people/day, with reference to the number of tourists at the formation and inauguration of the POKDARWIS, which was attended by approximately 127 people, with a calculation of the rotation factor (Rf) value obtained from the tourist opening period within 24 hours. The opening period (24 hours) is divided by the average time value of visits per day of 17.67, thus obtaining a rotation factor (Rf) value of 1.4 hours.

The PCC of the Bukit Buhunuah camping area is influenced by the value of the rotation factor, and the area needed by a tourist to the top is 90 m<sup>2</sup> [3]. The results showed physical carrying capacity of Bukit Buhunuah has exceeded the maximum capacity of the visitor number. Percentage comparison of the number of tourists in the physical carrying capacity of the Bukit Buhunuah campsite area of 11 people/day (8%) while the number of tourists at the POKDARWIS formation and inauguration event was 127 people/day (92%) can be seen in (Figure 2).



**Figure 2.** Diagram *Physical Carrying Capacity (PCC)*

The solution is to minimize excess carrying capacity by expanding the camping area or limiting the number of tourists according to the existing physical carrying capacity, especially during peak visiting seasons/big days, especially in the Bukit Buhunuah camping area. The use of carrying capacity standards at a tourist location can have a positive impact in preventing activities that are detrimental to tourism development [11]. Carrying capacity that exceeds the limit if left unchecked will be detrimental to the sustainability of a tourist attraction. This will also have an impact on the environment and ecosystem in the tourist area. Sustainable tourism aims to revive and maintain the positive impacts of tourism development while still managing and minimizing the negative impacts caused.

### 3.2 Real Carrying Capacity (RCC)

The RCC is the number of tourists allowed to visit tourism with several correction factors as a barrier. The number of tourists that can be accommodated in a tourist area with a correction factor (Cf) is based on the characteristics of the area applied to PCC, without damaging the environment and ecosystems in the area [12]. The results of the calculation of the five correction factors, namely, slope (Cf<sub>1</sub>), soil sensitivity to erosion (Cf<sub>2</sub>), climate (rainfall) (Cf<sub>3</sub>), flora (trees) (Cf<sub>4</sub>), and fauna (birds) (Cf<sub>5</sub>) can be seen in (Table 2).

**Table 2.** Real Carrying Capacity (RCC) of correction factor value

No.	Correction Factor	Mi	Mt	Correction Factor Value
1	Slope correction factor (Cf <sub>1</sub> )	80	100	0,28
2	Correction factor for soil sensitivity to erosion (Cf <sub>2</sub> )	60	75	0,20
3	Climatic correction factor (rainfall) (Cf <sub>3</sub> )	0,1304	7	0,98
4	Tree vegetation correction factor (Cf <sub>4</sub> )	0,8689	1	0,13
5	Bird animal correction factor (Cf <sub>5</sub> )	0,0362	1	0,96

The RCC and PCC have the same value of 11 people/day. The number of tourists that can be accommodated in a tourist area with a correction factor (Cf) is based on the characteristics of the area applied to PCC, without damaging the environment and ecosystems [13]. The real support value in the Bukit Buhunuah campsite

tourism area is 11 people/day. This value shows the capacity of tourists capacity by considering physical and biophysical environmental factors that can visit the Bukit Buhunuah natural attractions.

### 3.3 Slope Correction Factor ( $Cf_1$ )

Land slope is a limiting factor in real carrying capacity. The result was a slope of the tourist track data on Bukit Buhunuah from the top hills to the foothills. The data was obtained from observation and measurement of the contour map. It can be more clearly seen in the slope track table of the Bukit Buhunuah tourist hiking trail, which is obtained from the calculation of the contour map and the results of the measurement of the Klinometer tool at Bukit Buhunuah, Sanggau Regency. The slope track and slope class of klinometer calculation is shown in Table 3. It showed the same results with the slope track and slope class using contour maps (Table 4).

**Table 3.** Calculation using clinometer of the slope track in the Bukit Buhunuah tourism hiking trail

No	Track Foothills (masl)	Slope (%)	Slope Class	Value	Description
1	85	20	3	60	Somewhat Steep
2	100	38	4	80	Steep
3	200	34	4	80	Steep
4	300	20	3	60	Somewhat Steep
5	375	20	3	60	Somewhat Steep

**Table 4.** Calculation using contour map of the slope track in the Bukit Buhunuah tourism hiking trail

No	Track Foothills (masl)	Slope (%)	Slope Class	Value	Description
1	85	15	3	60	Somewhat Steep
2	100	36	4	80	Steep
3	200	38	4	80	Steep
4	300	23	3	60	Somewhat Steep
5	375	23	3	60	Somewhat Steep

The variable value of slope on the Bukit Buhunuah tourist track has a slope class of 28%, included in the classification of slope class 4 (steep category) with a value of 80 as the real condition on the variable ( $M_i$ ), while the maximum variable ( $M_t$ ) on the slope correction factor is 100. The slope correction factor based on the calculation shows a value of 0.2. The land slope correction factor is a limiting factor. The steeper the tracks, the greater the energy and time required by tourists.

### 3.4 Climate Correction Factor (Rainfall) ( $Cf_3$ )

The results of the calculation of rainfall in Sanggau Regency for the last 10 years (2013-2022) are in Table 5 using the Schmidt-Ferguson ratio ( $Q$ ) formula. The average dry month rainfall is 1.2 mm, and the average wet month rainfall is 9.2 mm. Rainfall in Sanggau Regency for the last 10 years (2013-2022) according to the rainfall classification is included in the type of rainfall (A) with very wet rain properties, so that tourist comfort while traveling or doing activities is less effective, so tourists are advised not to visit during the rainy season.

The calculation of the rainfall correction factor for the Sanggau district obtained a value of 0.981. The real condition on the variable ( $M_i$ ) is 0.1304, while the maximum variable ( $M_t$ ) on the climate correction factor (rainfall) is 7. The higher the rain intensity, the greater the impact on visitor discomfort while traveling, so there will be fewer tourist activities that visitors can enjoy in the tourist area [4].

**Table 5.** Rainfall in Sanggau Regency in the last 10 years (2013-2022)

Year	Jan	Feb	Mar	Apr	Mei	Jun	Jul	Agu	Sep	Okt	Nov	Des
2013	58,5	16,5	108,5	64	110,5	123,5	40	89	30	190,5	133,5	158,5
2014	53	41,5	82	73	94,5	71,5	3	84	54,5	39,5	158,5	285
2015	166	60	236,5	437,5	325	177	83	164,5	31,5	188,5	244,5	361
2016	292	338	249	476	507	391	450	157	289	224	326	439
2017	324	361	290	612	208	142	138	332	263	287	649	634
2018	213	119	161	435	550	209	67	32	238	321	261	288
2019	303	327	207,5	335	227	248	218,5	31	159,5	205,5	223	355,5
2020	205	199	240	245	275	143	148	60	76	116	139	117
2021	186	112	89	131	109	131	116	139	142	125	126	139
2022	115	89	99	150	125	119	78	111	154	169	105	195

Source: BMKG - Mempawah Climatology Station

### 3.5 Tree Vegetation Correction Factor ( $Cf_4$ )

The results of the IDS calculation in (Table 6) obtained the value of the tree vegetation correction factor ( $Cf_4$ ). Observations were made in the land cover with the number of observation points made as many as 5 points (foothills and at an altitude of 100, 200, 300, and 375 masl). Each altitude on the Bukit Buhunuah hiking trail was 0.8689 as the real condition on the variable ( $M_i$ ), while the maximum variable ( $M_t$ ) on the tree vegetation correction factor was 1. The calculation of the tree vegetation correction factor for the Bukit Buhunuah hiking trail was 0.13.

**Table 6.** Observation of Tree Vegetation Types of the Buhunuah Hill Hiking Trail

Individual number	Local Name	Scientific Name	Family	Total
1	Jengkol	<i>Pithecellobium jiringa</i>	Fabaceae	9
2	Karet	<i>Hevea brasiliensis</i>	Euphorbiaceae	45
3	Mangga	<i>Mangifera sp.</i>	Anacardiaceae	2
4	Sukun	<i>Artocarpus sp.</i>	Moraceae	2
5	Akasia	<i>Acacia sp.</i>	Fabaceae	4
6	Durian	<i>Durio zibethinus</i>	Bombacaceae	1
7	Kaliandra	<i>calliandra sp.</i>	Fabaceae	7
Total				70

### 3.6 Birdlife Correction Factor ( $Cf_5$ )

The results of the IDS calculation in (Table 7) are obtained from the results of the birdlife vegetation correction factor ( $Cf_5$ ). Observations were made at each station/observation point with a total of 5 observation points (foothills, altitudes of 100 MDPL, 200 MDPL, 300, and 375 masl); each altitude on the Bukit Buhunuah hiking trail was 0.0362 as the real condition on the variable ( $M_i$ ), while the maximum variable ( $M_t$ ) on the tree vegetation correction factor was 1. The calculation of the Birdlife vegetation correction factor for the Bukit Buhunuah hiking trail was 0.96.

**Table 7.** Observation of Birdlife Vegetation Types of the Bukit Buhunuah Hiking Trail

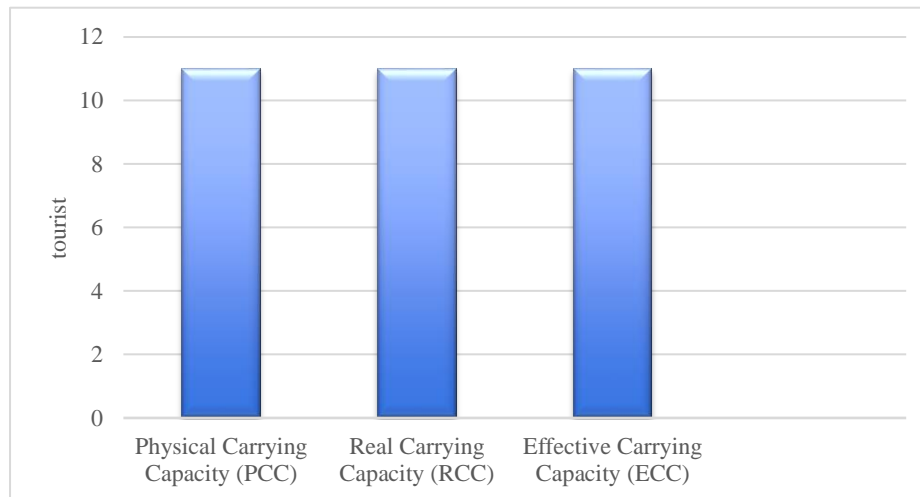
No Individu	Local Name	Scientific Name	Famili	Total
1	Kucica Kampung	<i>Copsychus saularis</i>	Muscicapidae	2
2	Murai	<i>Copsychus sp.</i>	Muscicapidae	1
3	Walet	<i>Collocalia sp.</i>	Apodidae	214
4	Elang	<i>Nisaetus sp.</i>	Accipitridae	1
Total				218

### 3.7 Effective Carrying Capacity (ECC)

The ECC is the maximum number of tourists that can be accommodated by Bukit Buhunuah tourism at a certain time by considering correction factors and management capacity (MC), namely the availability of managers (POKDARWIS). The ECC showed the number of tourists that can be served optimally; both the



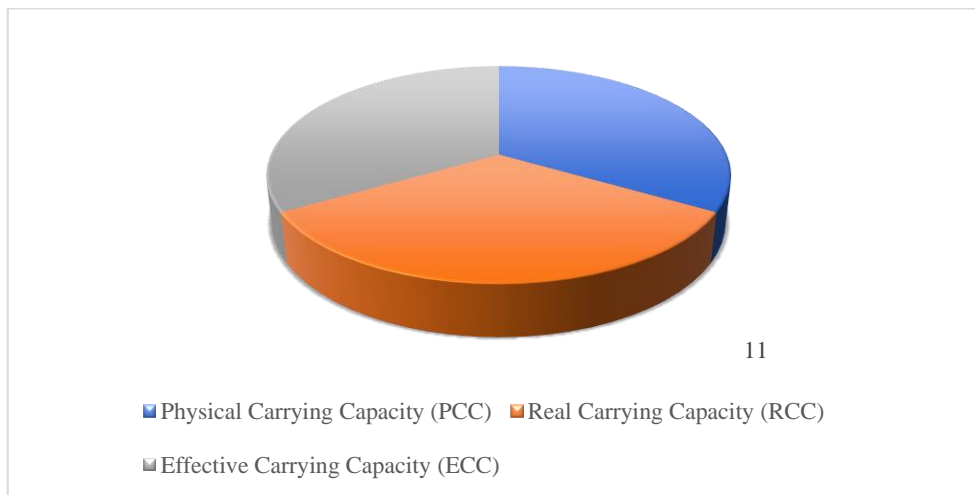
human resources owned by the manager and the activities of tourists do not disturb or damage the ecosystem in the tourist area [16]. All members of the Bukit Buhunuah tourism management consist of 25 people. The calculation results of the ECC value, tourism Bukit Buhunuah for the camping area, is 11 people/day. The ECC of Bukit Buhunuah had the same value as the PCC and RCC. The value was 11 people/day. The ECC value is shown in Figure 3.



**Figure 3.** Graph *Effective Carrying Capacity* (ECC)

### 3.8 Tourism Support Capacity of Bukit Buhunuah

The carrying capacity of the tourist attraction environment is the ability of a tourist attraction to accommodate the number of tourists visiting a tourist area in a certain unit of time. Assessment of carrying capacity is done by comparing PCC, RCC, and ECC with the number of tourist visits per day by the equation  $PCC > RCC$  and  $RCC \geq ECC$ . The results of the calculation of PCC, RCC, and ECC in the Bukit Buhunuah camping area obtained the equation: The carrying capacity value of the Bukit Buhunuah camping area,  $PCC = RCC = ECC$  ( $11 = 11 = 11$ ), means optimal power. The research results can be seen in (Figure 4), showing the carrying capacity of the Bukit Buhunuah campground area has a balanced carrying capacity or optimal carrying capacity.



**Figure 4.** Graph of carrying capacity of Bukit Buhunuah camping area

## 4. Conclusion

The assessment results of Bukit Buhunuah carrying capacity tourism have an optimal value. There are three factors for carrying capacity value analyzed. They are PCC for the camping area of 11 people/day; PCC is influenced by the Bukit Buhunuah camping area of 721.67 m<sup>2</sup>, and the data shows the area needed by a tourist to get tourist satisfaction is 90 m<sup>2</sup> camping. The RCC value of Bukit Buhunuah is 11 people/day, with a correction factor by considering physical and biophysical environmental factors that can visit natural attractions, namely slope ( $Cf_1$ ) of 0.2, soil sensitivity to erosion ( $Cf_2$ ) of 0.2, climate (rainfall) ( $Cf_3$ ) of 0.981,



flora (trees) ( $Cf_4$ ) of 0.13, and fauna (birds) ( $Cf_5$ ) of 0.96. The ECC value of the camping area is 11 people/day, indicating the number of tourists that can be served with optimal human resources with 100% area management capacity (MC). This total value was calculated by the equation  $PCC = RCC = ECC$ , which signifies the best carrying capacity value to accommodate the amount of arriving tourists.

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