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Analysis of the Carrying Capacity and Environmental Capacity of the Bukit Tangkiling Natural Park

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Abstract

The Bukit Tangkiling Park area was determined based on the Decree of the Minister of Agriculture of the Republic of Indonesia number: 046/Kpts/Um/1/1977 on January 25, 1997, with an area of 533 Ha. Bukit Tangkiling Nature Park has sloping lowlands, undulating to hilly terrain, and very steep slopes of 2% to 45% at 25 to 170 metres above sea level. Year-to-year tourism increases. An increase in tourist visits can damage natural resources and the environment by exceeding the carrying capacity and capacity of the environment. Cifuentes (1992)'s method is used to calculate the natural tourist environment's carrying capacity in protected areas. The assessment to determine the maximum number of visits to a tourist area is based on the physical, biological and management conditions in the tourist area by considering three main aspects; physical carrying capacity (PCC), real carrying capacity (RCC) and effective carrying capacity (ECC). The research was conducted with the aim of analyzing the value of the effective carrying capacity (ECC). The maximum number of tourists that can visit the Bukit Tangkiling Natural Tourism Park without disrupting the ecology. PCC = 219.063, RCC = 5.475, MC = 0.9, ECC = 4,927 people/day. ECC of 353 people/day. This value is less than the Nature tourist Carrying Capacity Value and does not harm the environment of the natural tourist region. This allows Bukit Tangkiling Park growth.

Keywords: carrying capacity, natural tourism park, local wisdom.

Introduction

Tourism has become an industry that contributes to rapid economic growth in various aspects, namely employment opportunities and increasing living standards through the creative economy business sector (Yakup, 2019). Tourism is a prime mover for other sectors to drive

the people's economy. Development and tourism development programs play a very important role in the economic development strategy of a country or region (Nandi, 2016). This is because the contribution of the tourism sector to national economic development according to Spillane (1994) can be measured easily from various benchmarks. Where the most important thing is regarding the contribution to the balance of payments, national income (GDP), job creation and other follow-up sectors from the tourism sector.

Efforts to develop tourist objects must take into account the impacts that arise for the preservation of tourist objects and the preservation of environmental functions in tourist areas. Tourism development must always pay attention to the preservation of environmental functions, if not carried out it will have an impact that will actually bring losses to the tourist area, namely in the form of environmental damage to the tourist area which can cause no tourists visiting the tourist area (Widyastuti, 2010). Development that is only oriented towards improving people's welfare turns out to have an impact on the environment, both in the short term and in the long term. Tourism development has a negative impact on the tourism environment. The main problem that needs to be answered is how the development of tourism and the preservation of environmental functions around tourist areas can be carried out properly, oriented towards efforts to preserve tourist objects and preserve environmental functions.

Palangka Raya City as the capital of Central Kalimantan Province with an area of 2,678.51 km2 (267,851 Ha) is located on 2 (two) rivers, namely the Kahayan River and the Rungan River. Palangka Raya City is located in the Kahayan Watershed area, administratively the City of Palangka Raya is divided into 5 Districts with 30 Villages. The population of Palangka Raya City in 2015 amounted to 259,865 people, in 2016 it increased to 267,757 people and in 2017 it increased again to 275,667 people (BPS Kota Palangka Raya, 2018) with an uneven population distribution, most of which are concentrated in Jekan Raya District 134,086 and 90,084 people in Pahandut District and the rest are scattered in Sabangau District, Bukit Batu District and Rakumpit District. (Bappeda City of Palangka Raya, 2018).

Tourist destinations in Palangka Raya City are culinary tours, riverside tours and nature tours. Nature tourism, one of which is the Bukit Tangkiling Natural Tourism Park, has enchanting natural beauty, has a diversity of flora and fauna, enriched with a variety of local cultures, is a special attraction for visiting tourists. (Ripparkot, 2017). Domestic tourists (wisnus) visited the city of Palangka Raya in 2013 as many as 205,668 people and in 2016 there were 352,504 people. In 2013 there were 12,677 foreign tourists (tourists) and 20,496 in 2016 (Disbudpar Palangka Raya, 2018). This data shows that both visits by Wisnus and foreign tourists to Palangka Raya City have increased quite significantly. The increase in tourist visits must receive attention regarding the carrying capacity of tourist areas at certain times, the number of tourist visits can be a trigger for damage to the natural environment.

Availability of natural resources, diverse local wisdom, unique geography, potential human resources. How can developers, business people, business people, communities and government work together to develop ecotourism well. If ecotourism is able to be developed optimally, rural areas and underdeveloped areas that have tourism potential can improve their economic and social levels.

The increasing number of tourist visits to Palangka Raya City can have both positive and negative impacts on natural resources and the environment. An increase in the number of visits has the potential to exceed the carrying capacity and capacity of the environment. The carrying capacity of the tourism environment is influenced by 2 (two) main factors, namely tourist destinations and biophysical environmental factors of tourism locations. 1) The purpose of tourists is to get recreation. So with recreation people want to re-create or restore their strength, both physical and spiritual. 2) Biophysical factors that affect the strength or fragility of an ecosystem will greatly determine the size of the carrying capacity of tourist attractions. Tourism development planning must pay attention to carrying capacity based on tourism objectives.

The biophysical factors that affect the carrying capacity of the environment are not only natural factors, but also man-made factors. For example, there are residential villages near tourism sites where the waste is disposed of directly or carried by currents to locations that can reduce the carrying capacity of the tourism environment.

The research was conducted with the aim of analyzing the value of effective carrying capacity (ECC) and environmental carrying capacity for the Bukit Tangkiling Nature Park area, Palangka Raya City. Central Kalimantan Province, Indonesia.

Literature Review

Ecotourism can be defined as travel to natural areas to study the culture and history of formation/natural phenomena and the environment, with the aim of preserving the integrity of ecosystems without changing them, while creating beneficial economic opportunities for local communities. Another definition defines ecotourism as nature-based tourism which involves education and interpretation of the environment/nature, and is managed in an ecologically sustainable manner (Tiyasmono et al., 2019). The concept of ecotourism emphasizes the conservation, social and economic aspects of the surrounding community, is an implementation of sustainable tourism and is included in sustainable development or sustainable development which is the concept of development. Tourism development requires the synergy of all stakeholders in developing ecotourism. Limited budget, facilities and infrastructure, road access and transportation to potential tourist sites, limited human resources and local wisdom in empowering local communities, still receive little attention and are obstacles in supporting ecotourism sustainability.

Strong and sustainable regional economic development can be used as a combination of the utilization of natural resources, society and government which can be done by developing a sustainable tourism sector or ecotourism (Sustri, 2009). The concept of ecotourism (ecotourism) emerged as a result of the increasing number of visitors to tourist attractions where the impact reduces the beauty of tourist attractions.

A strong ecosystem has a high carrying capacity, that is, it can receive tourists in large numbers, because it is not easily damaged and can recover quickly from damage (low sensitivity, high resilience). Such ecosystems are generally found at low altitudes, flat or sloping, high temperatures and fertile soils. Conversely, crater ecosystems in high mountains

are examples of tourist areas that have a low carrying capacity. Low temperatures, infertile soil and the presence of toxic gases, including sulfur fumes, make the ecosystem fragile. If damage occurs, trees and other plants will recover very slowly due to low temperatures, infertile soil and toxic gases (Soemarwoto, 1997).

Research Method

The research location is in the Bukit Tangkiling Nature Park, Bukit Batu District, Palangka Raya City as presented in Figure 1.

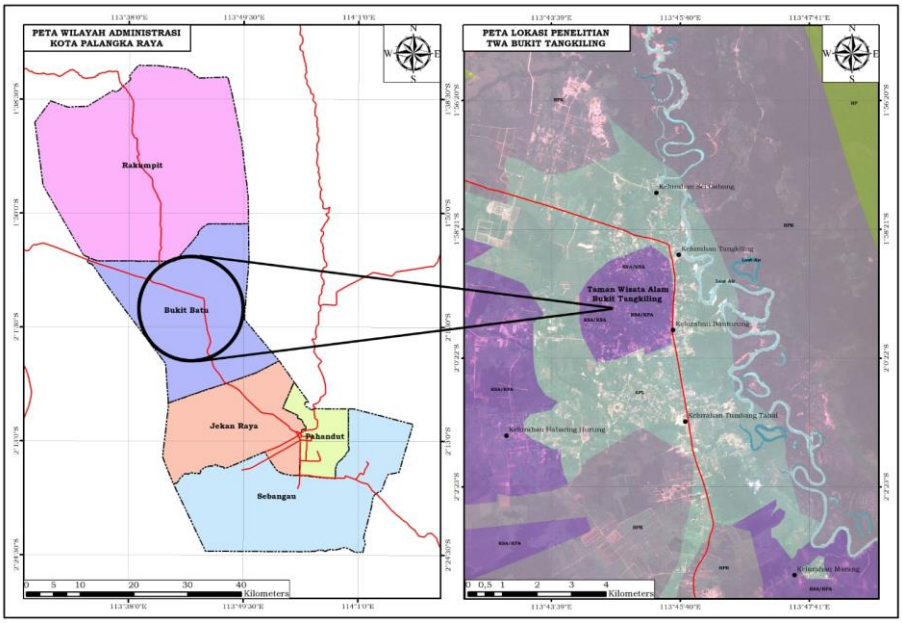

Figure 1. Location Map of TWA Bukit Tangkiling

The research was conducted for 6 (six) months. The methods used for measurement and data analysis are as follows:

a. Assessment of Environmental Carrying Capacity

The assessment of the carrying capacity of the natural tourism environment in protected areas refers to the formula for calculating the carrying capacity of tourism developed by Cifuentes (1992). This assessment is to determine the maximum number of visits to an area which is based on physical, biological and management conditions in the area by considering three main aspects: physical carrying capacity (Physical Carrying Capacity/PCC), real carrying capacity (Real Carrying Capacity/RCC) and carrying capacity. effective carrying capacity (ECC) (Zacarias et al, 2011). The formula used in calculating the carrying capacity of the tourist environment is based on the Cifuentes (1992) method modified by Douglass (1975) research by Fandeli & Muhammad (2009) as follows:

$$PCC = A \times 1 / B \times Rf$$

PCC is the physical carrying capacity (Physical Carrying Capacity), namely the maximum limit of visits that can be carried out in one day;

A is the area used for tourism;
B is the area needed by a tourist to travel while still obtaining satisfaction (a picnic activity with a value of B is 65 m^2);
Rf is the rotation factor.

The real carrying capacity formula in Zacarias et al. (2011) refers to the formula of Cifuentes (1992) is as follows:

RCC = PCC* x Cf_1 x Cf_2 x ..... x C*fn

RCC is the real carrying capacity (Real Carrying Capacity), which is the maximum number of visitors who can visit certain tourist sites based on correction factors according to local biophysical characteristics;
PCC is physical carrying capacity (Physical Carrying Capacity);
Cf...Cfn are correction factors of the environmental biophysical parameters of a tourism area.

To calculate the Cfn correction factor using the following formula (Zacarias et al, 2011) as follows:

***Cfn* = 1 - (Mn / Mt)**

Cfn is the n^{th} correction factor with respect to the n^{th} component data; Mn is the actual state of the calculated fn variable; Mt is the maximum limit on the fn variable.
The correction factor from the biophysical aspect of the environment is identified as a limiting factor on tourist visits in tourist areas as well as the satisfaction and comfort of tourists moving freely.

The calculation of this correction factor is based on the formula used in the research on the carrying capacity of the tourist environment by Siswantoro (2012) and Sustri (2009) which is as follows:

Rainfall (Cf$_1$)

The rainy season affects tourism activities in TWA Bukit Tangkiling where in months with high and a lot of rain intensity it tends to affect the number of tourist visits that come. The calculation of the rainfall correction factor according to Sustri (2009) is based on the Rainfall Index (CH Index) for 10 years by comparing dry months and wet months using the equation:

Rainfall Index = Σ Wet Months : Σ Dry Months

Slopes (Cf$_2$)

The slope correction factor according to Siswantoro (2012), the assessment is carried out using a scoring system on slope class criteria in area segments that are actively passed by tourists with reference to the slope class classification in SK. Minister of Agriculture No.837/KPTS/UM/11/1980 in Muta'ali (2012).

The assessment of the slope correction factor in TWA Bukit Tangkiling is carried out by taking points on the field that represent the topographic slope conditions in each space that is frequently visited by tourists and measuring the slope then calculating the average score.

Soil Erosivity (Cf_3)

Tourist areas with high soil sensitivity mean that they have a high rate of erosion or landslides. The calculation of the erosivity correction factor according to Siswantoro (2012) is assessed in terms of the sensitivity of soil erosion based on the type of soil using the Erosion Degree Index according to Muta'ali (2012).

Vegetatation (Cf4) and Birds (Cf5)

Vegetation correction factors (Cf4) and (Cf5) were calculated using the Simpson Diversity Index (IDS) (Sustri, 2009; Siswantoro, 2012), with the formula:

IDS = 1 – λ

Effective carrying capacity is a result of a combination of real carrying capacity with tourism area management capacity, with the following formula:

ECC = PCC x MC

ECC is the effective carrying capacity (Effective Carrying Capacity); PCC is physical carrying capacity (Physical Carrying Capacity); MC is an area management capacity.

Parameter MC approach through the capacity of management officers in tourist areas, using the formula (Siswantoro, 2012):

MC =Rn : Rt x 100%

Rn is the number of existing management officers; Rt is the number of management officers needed.

b. Assessment of Stakeholder Perceptions of the Sustainability of Ecotourism.

Assessment of Stakeholder Perceptions of the Conservation of Natural Tourism in the City of Palangka Raya uses SWOT Analysis (Quantitative Descriptive). The primary data obtained from the respondent's questionnaire is qualitative data, the results of the questionnaire are tabulated and quantified to facilitate analysis.

The data obtained from the questionnaire is data in the form of intervals that measure levels from very good (positive) to very bad (negative). The Likert scale is used to measure attitudes, opinions and perceptions or responses of respondents about social phenomena (Sugiyono, 2006).

For the purposes of quantitative analysis, answers can be given a score, for example Strongly agree/very knowledgeable/very positive given a score of 5; Agree/know/positive is given a score of 4; Disagree/know enough/never/negative were given a score of 3; Strongly disagree/don't know/never get a score of 2; and a score of 1 for neutral / mediocre.

Based on the results of the tabulation of answers to the questionnaire, a descriptive

analysis of stakeholder perceptions of the Conservation of Natural Tourism in TWA Bukit Tangkiling, Palangka Raya City, can be carried out. The results of the tabulation are included in the SWOT matrix from internal factors and external factors. The internal factor is in the form of strength obtained from the perception of the respondents' positive assessment of the provision of natural tourism facilities and services. While the internal factors in the form of weaknesses obtained from the perception of the respondents' negative judgments.

Optimization analysis using the S–O Strategy which is a combination of strengths and opportunities is an attempt to take advantage of available opportunities. Meanwhile, to overcome weaknesses, the W-O Strategy is used, which is a combination of weaknesses and opportunities by mobilizing resources to seize opportunities. Furthermore, the S-T Strategy is a combination of Strengths and Threats/Challenges (Treats) used to explore strengths in order to be able to overcome threats/obstacles/challenges. The W-T strategy is a combination of weaknesses and threats/challenges, namely efforts to overcome weaknesses by mobilizing resources to seize opportunities.

Result and Discussion

a. The value of the Environmental Carrying Capacity of TWA Bukit Tangkiling

Calculation of the Environmental Carrying Capacity Value of the Bukit Tangkiling TWA, seen from the index value of each correction factor as shown in Table 1 and Table 2.

Table 1. Correction Factor Value in Determining the Carrying Capacity Value

Variable (Correction Factor)	Parameter	Index Value (x 100 %)	Correction Factor Value
Biotic (ECC Correction Factor)	Tree Diversity (Simpson Diversity Index)	0.314	0.686
	Bird Diversity (Species Density, Simpson Diversity Index)	0.188	0.812
	Long-tailed Monkey Mating Disturbance Rate Index	1	0
Abiotic (ECC Correction Factor)	Landscape Potential (Index Bureau of Land management)	0.78	0.22
	Slope (Slope Index)	0.50	0.5
	Type of soil to erosion sensitivity	0.53	0.47
	Rainfall (Q Value Index; Dry/Wet Month)	0.1320	0.868

Source: Primary data processed

PCC = 5,330,000 x 1/65 x 2.67
= 5,330,000 x 0.015 x 2.67
= 5,330,000 x 0.0411
= 219,063

RCC = 219,063 x 0.686 x 0.812 x 0.22 x 0.5 x 0.47 x 0.868

= 5,475

MC = 9/10 x 100 %

= 0.9

ECC = RCC x MC

= 5,475 x 0.9

ECC = 4,927 people per day

Table 2. Number of Visitors to TWA Bukit Tangkiling

Year	Month												Number	Average per day
	Jan	Feb	Mar	Apr	May	Jun	Jul	Augus	Sept	Oct	Nov	Des		
2016	11035	6860	8917	6964	7981	7542	9748	8107	9212	4780	3440	11	84597	234.992
2017	20111	11756	13195	14354	14426	17322	14940	15445	7121	5657	6335	4721	145383	403.842
2018	15143	4978	5759	5488	5454	10557	12543	7374	7463	6296	5874	19143	106032	294.533
2019	6465	4760	9044	5402	9417	20332	10050	5208	3009	2333	2200	0	78220	217.278
2020	24822	11081	5018	0	0	0	0	4700	15900	12900	17300	10800	102521	284.781
2021	10409	11540	6664	6500	5000	16404	5300	0	8035	13638	22894	19456	125840	349.556
2022	50142	17218	25567	35763	26108	18204	13902	10334	9257	10613	13254	17646	248008	688.911
												Total	890601	**353.413**
												Avg.	127229	-

Source: Processed from secondary data.

The results of PCC calculations are 219,063 people, RCC are 5,475 people per day. So the value of Effective Carrying Capacity (ECC) is 4,927 people per day. The average number of visitors per day for the 2016 - 2022 period is 353 people. This calculated value is much smaller than the Effective Carrying Capacity (ECC) value in tourist areas of 4,927 people per day and does not cause disturbance to the ecosystem in this area. This condition is an opportunity for the development of TWA Bukit Tangkiling.

b. SWOT Analysis of the Potential for Nature Tourism Development

Based on the determination of the value of the carrying capacity of the Bukit Tangkiling TWA nature tourism, the number of tourists is in the range of 1,002 people per day. This number has not exceeded the average tourist visit per day, which is 940 people. This means that the carrying capacity of natural tourism is still an opportunity to be developed and maintained so that it remains within that range. According to Ramly (2007), tourism is an important and strategic economic sector in the future. Identification and planning for the development of the tourism industry needs to be carried out in a more detailed and mature manner. The development of the tourism industry is also expected to be able to support the costs of efforts to preserve nature, biological wealth and cultural wealth. The development of tourist areas is an alternative that is expected to be able to encourage both economic potential and efforts to preserve the environment. Furthermore, based on the results of the assessment of the carrying capacity of natural tourism and the results of the tourist perception questionnaire, street vendors and managers, the potential and opportunities for developing natural tourism in TWA Bukit Tangkiling can be formulated in a SWOT analysis study.

Strength

The test results for all questionnaire instruments, for the following parameters, obtained r-count > r-table values, all of these instruments were declared valid. The factors tested include Population growth in Palangka Raya City, Growth in community income. Knowledge about nature increases. There are regional and national meetings that bring participants to DTW Alam TWA Bukit Tangkiling. Prices or entrance fees are considered cheap. The community always maintains forest and land preservation. The community has never hunted protected animals in the DTW. The image of the community around the DTW is that they are hospitable

Weakness

Lack of tourist attractions such as arts (cultural) performances, Road directions and distance from city to DTW are incomplete, DTW promotions are not maximized, Do not have special tourism transportation to DTW, Do not have complete information about types of DTW tourism such as black water, bird species, etc., Articles about DTW have not been evenly distributed regionally and nationally, Security officers are still considered lacking, Communication in certain places is not optimal, Human resources, especially guides, are still limited.

Opportunity

The government is trying to increase PAD through tourism, Information technology via the internet is getting more sophisticated, Communities around the DTW want to participate in implementing tourism activities, Daily community activities show local wisdom, The distance from the city of Palangka Raya to the DTW is relatively close, Legal instruments act decisively, if there is destruction of forests and land around the DTW.

Challenge

Implementers in the regions have limitations in carrying out regional and central government policies, not all communities are involved or can be accommodated in the DTW so that social jealousy arises, visitors do not all understand local wisdom around the DTW, there is competition for other DTWs, both regional and national, incessant modern art (music, creative dance) will be able to set aside local wisdom. Forest and land fires are still common. Communities outside the DTW still often hunt protected animals.

The data obtained shows that the average value of Strength; Very High (4.5) and Weakness; Very Low (4.3). The meeting point of strength and weakness lies at (4.5 - 4.3) = 0.2. While opportunities; included in the very high category (4.5) and a threat; very low (4.4) with the cut point (4.5 - 4.4) = 0.1 is in Quadrant I as shown in Figure 2.

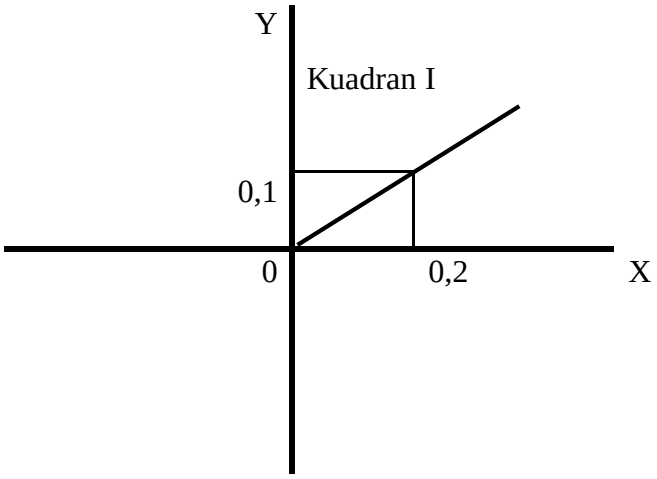

Figure 2. SWOT Analysis Quadrant

Opportunities and strengths owned by TWA Bukit Tangkiling can be utilized for its development by implementing strategies to support aggressive growth policies.

Conclusion

The PCC calculation results are 219,063 people and the RCC calculation results are 5,475 people per day, while the Effective Carrying Capacity (ECC) value is 4,927 people per day. The average number of visitors per day for the 2016 - 2022 period is 353 people, this value is much lower than the Effective Carrying Capacity (ECC) value in tourist areas of 4,927 people per day, because tourist visits do not exceed the carrying capacity and carrying capacity of the area. does not result in disturbance of the ecosystem in the tourist area of Bukit Tangkiling Nature Park, this condition is an opportunity for the development of a tourist area. The results of the SWOT analysis obtained that the intersection point is in Quadrant I, which means that the opportunities and strengths possessed by TWA Bukit Tangkiling can be utilized for its development by implementing a strategyto support aggressive growth policies. The results of the research serve as materials for further study on the carrying capacity and capacity of the tourist environment in the Bukit Tangkiling Nature Park. For the manager as a reference in taking policies to develop the Bukit Tangkiling Natural Tourism Park.

Declaration of conflicting interest

The authors declare that there is no conflict of interest in this work.

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