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Sustainable Agritourism in Support of Environmental Sustainability in Rural Areas: A Case Study of Agritourism at Sirahkencong, Ngedirengggo Village, Blitar Regency, East Java, Indonesia

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Abstract

Perseroan Terbatas Perkebunan Nusantara PTPN XII Bantaran administers an afdeeling (a Dutch post-colonial administrative area) focused on one specific business expansion, Agritourism Sirah Kencong. The agritourism area is an excellent destination where a tea plantation landscape stretches up to 55.28 Ha. This tourism object is located 1,179 meters above sea level and is a hydrological footing area. The current research is aimed to: 1) analyze the capacity of the environmental carrying capacity of Agritourism Sirah Kencong; 2) analyze the correlation of environmental sustainability of Agritourism Sirah Kencong; 3) scrutinize the associations between environmental carrying capacity and environmental sustainability in Agritourism Sirah Kencong. Results uncovered that: physical carrying capacity (PCC) contributed to as many as 11,091 tourists per day; real carrying capacity (RCC) 220 per day; and effective carrying capacity (ECC) 174 per day. Following with the assessment, the carrying capacity of Agritourism Sirah Kencong showed similar carrying capacity levels, indicating PCC>RCC>ECC, which means that the board of administrators could still work on ameliorating the number of tourists until the stipulated score limit. However, the maximum number of tourists had ever reached a total of 5,027, which exceeded the limit number of real carrying capacity (RCC) and effective carrying capacity (ECC). In addition, the environmental sustainability of Agritourism Sirah Kencong was assessed based on several indicators, including cleanliness, health, safety, and environmental sustainability (CHSE), and obtained satisfactory recommendation from the certification audit team for CHSE of the Ministry of Tourism and Creative Economy (KEMENPAREKRAF). Furthermore, the research revealed that environmental carrying capacity and sustainability were closely interlinked to ecotourism as it required the tourists' support for the actualization of sustainable tourism.

Keywords: environmental carrying capacity, environmental sustainability, sustainable tourism

INTRODUCTION

Tourism, as one of the supporting sectors for economic development, can openly contribute to an area expansion and create a sustainable environment. For worse things, it may cause degradation. Tourism expansion must be consistent with the principles of sustainable development and environmental knowledge [1]. A tourism object, as a footing area, is required to be simultaneous. Dimensions of sustainable development include three components, namely social, economic, and environmental, which must stay present all of the time to support socio-economic development.

Agritourism Sirah Kencong has vegetative diversity, such as banyans, calliandra, jungle bananas, Daemonorops rubra, pines, elephant grass, amethyst flowers (forget-me-not), jungle fern, and bamboos. In addition, there are also some faunas that people can see in Agritourism Sirah Kencong, such as wild chickens, civet cats, long-tailed shrikes, sooty-headed bulbuls, squirrels, turtledoves, porcupines, and butterflies. In addition, Agritourism Sirah Kencong, located in the same area as Bantaran, is also a garden unit under the authority of Perkebunan Nusantara (PTPN) XII Kebun Bantaran LLC of Wonosari and Gunung Gambir. Kebun Bantaran Afdeeling Sirah Kencong is operated as a unit for the tea processing business and is set to be an agritourism area.

Agrotourism is generally located in a rural area, serving as an agricultural landscape attraction. [2] found a back-to-local trend, with agriculture and farming areas becoming the stars of tourism objects. Ecotourism and agritourism are the most current and favorite destinations that can be offered to people. These days, agritourism has become the favorite, indicated by the hype amidst the communities, like what occurs at Agritourism Tea Plantation in

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Wonosobo, under a satisfaction rate of 2.67 on average and categorized as good [3]. Similarly, the number of tourists in Agritourism Sirah Kencong always increases yearly. Thus, it is of essence to anticipate overcapacity. In addition, overcapacity could result in environmental degradation, possibly ruining the agritourism ecology [4]. However, overcapacity, also known as over-tourism, has been found to have occurred in Agritourism Sirah Kencong, indicated by the increase of tourist visits by 18% in 2020 (with 16,293 tourists in total). Environmental loads, in general, must be preserved to sustain nature as it genuinely is.

Policies for a tourism expansion are crucial in order to preserve the stability of tourism activities and environmental sustainability. Nonetheless, if agritourism is only focused on efforts for making environmental sustainability real (conservational and ecological protection), the number of tourists will get flattened, sooner or later [5] [6]. One of the most possible solutions in response to the threat is by defining the limit number of tourists based upon the ecological state and management competency.

Administrators of Agritourism Sirah Kencong have designed a regulation to limit the maximum number of vehicles that are allowed to enter the tourism place by 2,500 vehicles/day. It is decided such a way due to the limited area functional for a parking lot. In addition, the area condition that is so steep also becomes another determining factor of it. Relevant with the condition, estimating the carrying capacity of the agritourism area is needed besides exploring the correlation of carrying capacity and environmental sustainability.

According to previous research [7] , through optimalization of tourism expansion prioritizing the stability of environment and tourism activities, tourism area preservation could be more definite and sustainable. [8] suggested that his research had proved that the absence of human resources, by quality and quantity, would interfere the sustainability of tourism activities.

Another thing to do is designing analyses for environmental preservation and tourism carrying capacity due to the fact that natural stability is so connected with a number of environmental issues [9]. The current research is different from the previous, especially in terms of method used. In fact, causal loop diagram was occupied in order to scrutinize and study about the relationship of carrying capacity and environmental preservation based on the previous study [10].

Basically, an expansion of tourism attraction for agritourism can be designed well to save the ecological function and sustainability by limiting its maximum number of tourists by not exceeding the set carrying capacity [11]. Further, indicators of environmental carrying capacity are based on three elements: physical carrying capacity, real carrying capacity dan effective carrying capacity. Those indicators play an important role in defining the parameter to set up the maximum limit of tourists who are allowed to visit a tourism object in one certain time. In this case, a biophysical state and human resources are vital elements that can contribute to the environmental sustainability.

The current research was mainly aimed at: 1) analyzing environmental carrying capacity of Agritourism Sirah Kencong; 2) analyzing environmental sustainability in Agritourism Sirah Kencong; 3) analyzing the relationship of carrying capacity and environmental sustainability. In addition, the current research is also expected to be meaningful as a reference to estimating the environmental carrying capacity and sustainability in Agritourism Sirah Kencong area based on the certification of *Rainforest Alliance*. Besides, the results are supposed to be relevant as an input to stipulate any policies for sustainable development in Agritourism Sirah Kencong area.

MATERIALS AND METHOD

1. Research Design

A quantitative research approach was employed to carry out the research using explorative research. The explorative analysis is research intended to explore problems in-depth [12]. Research exploration, in other words, discusses a correlation between carrying capacity and environmental sustainability. In addition, research data were collected through observation at the agritourism area and interviews with the administrators. Further, the research took place in the Agritourism Sirah Kencong area, and the location was defined using purposive sampling. The basis for the location selection was the highest accessibility of natural tourism objects in Blitar Regency, which, in this case, was Agritourism Sirah Kencong's tea plantation.

Research was carried out by, in advance, measuring environmental carrying capacity and sustainability of agritourism area by the indicator of (PCC/*Physical Carrying Capacity)*, (RCC/ *Real Carrying Capacity)*, and (ECC/*Effective Carrying Capacity).* Cifuentes method (1992) [13] was used by means of scoring technique. Environmental

sustainability assessment was based on the audit results on some core aspects, such as cleanliness, health, safety, and environment sustainability (CHSE) retracted from the Ministry of Tourism and Creative Economy (KEMENPAREKRAF) in 2021. In addition, the carrying capacity and environmental sustainability would be analyzed using descriptive method. Correlation between carrying capacity and environmental sustainability of Agritourism Sirah Kencong would be assisted by the use of CLD (Causal Loop Diagram) in order to scrutinize cause and effect of carrying capacity and environmental sustainability as the research variables. According to Masitoh (2020) [14], as a part of CLD, System Dynamic model served to help describe facts of sustainable conservation.

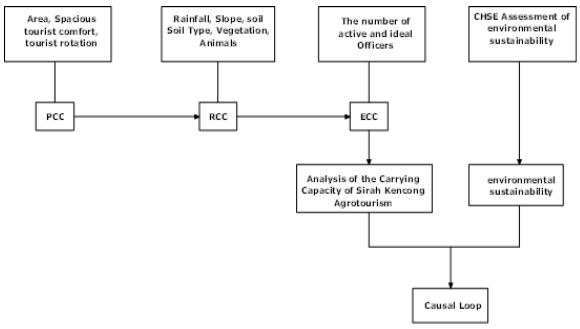

Diagram 1. Research stage flowchart

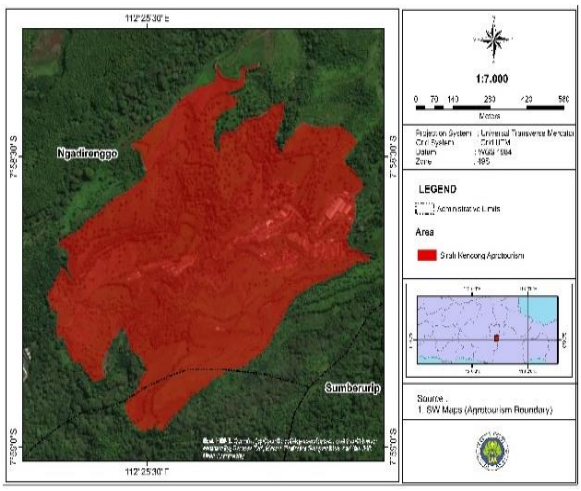

Figure 1. Research target location map

2. Data Collection

Data were collected using the following method:

a. Observation/Field Survey

Investigating, observing, or having a look for inspection are referred to as observation. This sort of method is focused on data collection or selection by alert, in-depth, and systematical inspection on particular research subjects and/or objects [15]. Observation, for the research, was conducted by a direct visit to the target location in order to observe the live condition of the tea plantation of Agritourism Sirah Kencong. Further, the main research focus was to estimate the area of the tourism spot by tracking using a particular application called *swmaps*.

b. Interview

Administrators of Agritourism Sirah Kencong were the informants of the current research. The informants officiated the Plant Assistant (ASTAN) of *Afdeeling* Sirah Kencong and Assistant for Processing Engineering (ASTEKPOL) positions. In taking the information, the *afdeeling*'s clerk was there to help. Purposive sampling technique was applied in this research [16]. The technique was selected based on a particular consideration that experienced informants were crucial to ensure that answers and information that would be obtained could totally meet the qualifications and requirements for the research problems formulated by researchers. In addition, data obtained from the interview included: the number of staffs, total of visits, CHSE audit report, and *Rainforest Alliance* certification.

3. Data Types

The research was executed based on different data, including primary and secondary data, as follows:

a. Primary Data

Primary data of the research included: (1) the tourism area for estimating physical carrying capacity (PCC); (2) average time of the tourist visit per day for estimating physical carrying capacity (PCC); (3) length of operation time per day for estimating physical carrying capacity (PCC); and the number of support staffs for estimating effective carrying capacity (ECC).

b. Secondary Data

Secondary data obtained consisted of statistical and spatial data. The statistical data, in fact, were in the forms of: (1) rainfall information based on data from BMKG Karang Ploso and Public Work (PU) Office of Blitar Regency for estimating real carrying capacity (RCC); (2) data of tourist visits to Agritourism Sirah Kencong from 2017-2020 that could be taken from the administrator team to indicate physical carrying capacity (PCC); (3) CHSE audit report that showed indicators and assessment for Agritourism Sirah Kencong; (4) Rainforest Alliance certification in the forms of (a) index of animal and vegetative diversities for estimating real carrying capacity (RCC), (b) Standard Operational Procedures for waste

management in order to analyze environmental sustainability. In addition, spatial data were taken based on (1) DEMNAS (Digital Elevation Model and National Bathimetry) INA-Geoportal for indicating the slope map in the estimation of real carrying capacity, and (2) digital map of soil type from BALITBANG to indicate the soil sensitivity to erosion for real carrying capacity (RCC).

Table 1. Descriptions of Variables

No	Variable	Sub Variable	Indicator	Measuring Method	
1.	The carrying capacity of the tourist approach	PCC	The area used	$PCC = A \times \frac{1}{B} \times Rf$	
			Spacious comfort		
			Rotation Factor		
		RCC	Rainfall	Indeks CH = $\frac{\sum Dry\ Month}{\sum Wet\ Month}$	RCC = PCC x Cf_1 x Cf_2 x ..... x Cfn
			Soil Sensitivity to Erosion	Map Making and Scoring	
			Slopes	Map Making and Scoring	
			Vegetation Diversity	Shannon-Wiener Index $H' = -\sum (piLn.pi)$	
			Animal Diversity		
		ECC	Number of active and ideal management officers	$ECC = RCC \times MC$	
2.	Environmental Sustainability		Use of environmentally friendly equipment and materials	*Interview with managers (sourced from Kemenparekraf, 2020)*	
			Efficient and healthy use of water and energy sources in order to maintain the balance of the ecosystem		
			The processing of waste and liquid waste is carried out in a thorough, healthy and environmentally friendly manner		
			The environmental conditions are beautiful and comfortable, either naturally or with technical engineering		
			Monitoring and evaluating the implementation of guidelines and SOPs for the Implementation of Cleanliness, Health, Safety and Environmental Sustainability		

Source: *processed by researchers, 2022*

4. Data Analysis Method

1. **PCC (*Physical Carrying Capacity)*** constitutes the accumulation of maximum access that can be accommodated per day [7]:

$$PCC = Ax\frac{1}{B}x\ Rf$$

Descriptions:
A = area of tourism object
B = tourist comfort-zone area around the tourism object per m² (swimming needing 27 m²; picnic 65 m²; and camping 90 m²)
**Zones for tourist pleasure*
Rf = visit number exchange per day
Rf = average total of tourist visits since opening period

2. **RCC (*Real Carrying Capacity*)** is defined as a maximum limit number of visitors/tourists who are permitted to enter an exact tourism area based on local biophysical features that also appear as a correcting factor [7]. RCC, according to [17], is referred to the Cifuentes formula (1992) [13] as follows:

$RCC = PCC$ x Cf_1 x Cf_2 x ..... x Cfn

Descriptions:
Fn = an n^{th} component that indicates a correcting factor

$$Fn = \frac{Mn}{Mt} \times 100$$

In addition, the correcting factor F_n can be estimated using the following formula [36]:

$Cfn = 1 - (Mn/Mt)$

Cfn indicates an n^{th} correcting factor related to the n^{th} component. In fact, the real condition estimated based on Variable *fn* was Mn, while Mt served to be a maximum limit for Variable *fn*. The correcting factor in Agritourism Sirah Kencong, in addition, were identified as a restrictive factor to the tourism activities based on environmentally-biophysical aspect, especially in respect of tourist satisfaction and moves.

A specific formula was operated to study environmental carrying capacity for tourism as an estimation to define the correcting factors as used by [7] research at Buper (camping ground) Palutungan tourism attraction (with modifications by writers). The formula, in addition, would be customized with the one operated by [18]. Points that follow are a number of limiting factors used to estimate environmental carrying capacity at Agritourism Sirah Kencong, complete with several biophysical factors that were already identified.

a. Rainfall (F_1)

Rain chiefly contributed to tourist activities at Agritourism Sira Kencong area. During the rainy season, rainfall was relatively high, which vividly affected the number of tourist visits. Rainfall, as a correcting factor, was estimated based on rainfall index by comparing wet and dry months under a formula of:

$$\text{CH Index} = \frac{\sum Humid\ month}{\sum Dry\ month}$$

Table 2. Types of Climates Based on Schmidt Ferguson Classification

Climate Types	Criteria	Mt
Very wet	0 < Q < 0.143	7
Wet	0.143 < Q < 0.333	
Fairly wet	0.333 < Q < 0.600	
Fair	0.600 < Q < 1.000	
Fairly dry	1.000 < Q < 1.670	
Dry	1.670 < Q < 3.000	
Very dry	3.000 < Q < 7.000	
Extremely dry	7.000 < Q	

Source: [19]

b. Soil sensitivity (F_2)

Soil sensitivity in a tourism area was found to bring about effects on tourism activities. Soil with high sensitivity to erosion would be highly prone to landslide [7]. Furthermore, estimation of the correcting factor was assessed based on the soil types in accordance with Decree of the Minister of Agriculture No. 837/Kpts/UM/11/1980 as enacted

in [20]. In fact, soil types can be defined through map making about soil types to determine scores.

Table 3. Levels of Soil Sensitivity to Erosion

No	Types of Soil	Description	Level Score
1	Alluvial, Gray Hydromorphic Glei Planosol Soil, Groundwater Literia	Insensitive	15
2	Latosol	Fairly Sensitive	30
3	Brown Forest Soil, Non-calcic Brown, Mediterranean	Less Sensitive	45
4	Andosol, Laterite, Grumusol, Andosol, Vertosol	Sensitive	60
5	Inceptisol, Entisol, Regosol, Litosol, Organosol, Rendzina	Very Sensitive	75

Source: Decree of the Minister of Agriculture No. 837/Kpts/UM/11/1980 enacted at [20]

c. Slope (F_3)

A scoring system was run for slope correction based on the criteria enacted in the Decree of the Minister of Agriculture No.837/Kpts/UM/11/1980 as in [20]. Scores were defined by map making and based on the area classifications.

Table 4. Slope Levels

Slope	Level	Level Score
0-8 %	Flat	20
8-15 %	Sloping	40
15-25 %	Fairly Sloping	60
25-40 %	Steep	80
40%	Very Steep	100

Source: Decree of the Minister of Agriculture No. 837/Kpts/UM/11/1980 in [20]

d. Vegetation (F_4) and Faunas (F_5)

Assessment of vegetative and fauna diversities found in Agritourism Sirah Kencong was operated by means of a specific formula, Shannon-Wienner Diversity Index [8]:

$H' = -\sum (piLn.pi)$

Shannon – Wienner Diversity is represented by index criteria of [21]:

H 1 : low diversity level

1 < H < 3 : fair diversity level

H 3 : high diversity level

Table 5. Assessment of correcting factors

No	Variable	Mt	Reference
1	Rainfall Index	7	Schmid - Ferguson cited in Lucyanti (2013)
2	Soil Sensitivity Index	75	Decree of the Minister of Agriculture No. 837/Kpts/UM/11/1980
3	Slope Index	100	Decree of the Minister of Agriculture No. 837/Kpts/UM/11/1980
4	Vegetative Diversity Index	7	Barbour et al (1987) cited in Tuwo (2011)
5	Fauna Diversity Index	7	Barbour et al (1987) cited in Tuwo (2011)

Source: [8]

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

ECC stands for effective carrying capacity, and MC is management capacity of the tourism area. Estimation regarding the aspect was based on the number of administrator staffs employed in the area, which indicates a final parameter that defines environmental carrying capacity by means of Cifuentes method [7]:

ECC = RCC × PCC

$$MC = \frac{Rn}{Rt}$$

Descriptions:

Rn= the number of existing administrator staffs

Rt = the finest/most suggested number of staffs

4. **Causal Loop Analysis**

The analysis was aimed to elaborate cause-and-effect relationship in several subsystems [22]. Causal loop model, therefore, was implemented to scrutinize relationships that occurred amongst variables [23]. Environmental carrying capacity and sustainability of Agritourism Sirah Kencong were set up as the current research variables.

RESULTS AND DISCUSSIONS

Environmental Carrying Capacity of Agritourism Sirah Kencong

World's Tourism Organization (WTO) referred sustainable tourism to as any of tourism activities that attempted to sustain the integrity of culture, ecological process, natural diversity, and life support system by the completion of economic, social, and esthetic demands [24]. Environmental stability around the target area must be contrived for tourism product development planning [25]. In addition, sustainable tourism is referred to as a

current tourism demand without eliminating or absconding the demands of the next generation [26]. As a consequence, it is of immense urgency to analyze environmental carrying capacity based on specific dimensions, such as physicality, reality, and effectiveness at Agritourism Sirah Kencong.

Table 6. Environmental Carrying Capacity of Agritourism Sirah Kencong

Variable	Indicator	Result	Interpretation
Carrying Capacity	PCC	11,091 tourists/day	PCC > RCC > ECC = Ideal
	RCC	200 tourists/day	
	ECC	174 tourists/day	

An ideal tourism area was supposed to meet the requirement of PCC > RCC > ECC. This was in line with research conducted by [18] suggesting that analysis of tourism carrying capacity was carried out by comparing assessment results generated in the previous research (PCC, RCC, and ECC) that had met the requirement of: PCC > RCC and RCC > ECC. Moreover, the analysis results would be set as the standard to define the carrying capacity in a target area of the research, Kebun Raya Cibodas.

Relevant with research of Rusdianto (2019) [19], the results of estimated carrying capacity at Agritourism Sirah Kencong presented in Table 6 had indicated that the area could accommodate tourists effectively alongside their activities by the criterion of PCC > RCC > ECC. In other words, levels of carrying capacity in Agrotourism Sirah Kencong did not exceed the limit value. If PCC > RCC > ECC was found, so the environmental carrying capacity of a tourism object could be considered fine. In other words, administrators could still strive for enlarging the number of tourists to reach the top limit. However, if ECC was higher than RCC, while the RCC higher than PCC, it could be concluded that the area had exceeded the maximum limit of carrying capacity.

Extending the number of tourists would give impacts to environment due to the augmentation of loads and physical pressure upon the carrying capacity [27]. Ecological capacity, in this case, was set up as a parameter. It was referred to a number of tourists that could be ideally accommodated by a natural tourist attraction alongside their tourism activities. If the limit was exceeded, habitat, floras, alongside faunas would be seriously endangered. In addition to the number of tourists, carrying capacity was also influenced by the transportation infrastructure, tourism facility expansion, burdens to natural resources, devastation, and wild habitat pollution alongside other waste pollutions. In fact, carrying capacity could be flattened or distracted; The main reasons of which were humans and the technology advancement. The least number of tourists at Agritourism Sirah Kencong occurred in 2018, with a total of 1,712. The number was less than the maximum number of tourists stipulated by the administrator team, 2,500 tourists/day. In other words, such a finding was already positive to environmental carrying capacity, but it could not contribute to optimum income that could be attained by the administrator team as well as local societies. Further, the number of tourists during 2017-2022 is presented in the table below, while 2023-2026 data indicate the results of projection.

Table 7. Projection of the Number of Tourists in Agritourism Sirah Kencong

Year	Number of Visits
2017	50,080
2018	61,739
2019	74,178
2020	102,130
2021	63,684
2022	90,642
2023	92,668
2024	92,308
2025	91,088
2026	103,021

Excessive number of tourists in the future can be a serious threat for ecosystem biodiversity and existing historical site legacy. In this case, the historical site is referred to as Candi Sirah Kencong considered a cultural heritage and preserved by Office for Cultural Heritage Preservation (BPCB) of East Java. Good tourism expansion is supposed to be based on ecological dimensions, i.e., disaster, natural diversity, social construction, and local culture. The tourism expansion, in addition, can be optimized through facility development and management by the creation of environmentally-friendly products. Moreover, the environmental condition, with its natural resources, can be fully sustained and changed to be more sustainable environment. The following table indicates details of carrying capacity in Agritourism Sirah Kencong:

Table 8. Estimation of normal visit rates

Duration of Visit	Single Score Category (hour) (a)	Number of Tourists (b)	Score a X b	Visit Time Average (hours)
1-2 hours	1.5	16	24	
3-4 hours	3.5	22	77	
5-6 hours	5.5	17	93,5	
Total		55	194.5	3.536

The area of Agritourism Sirah Kencong constituted 55.28 Ha equal 552,800 m^2, while the area of the comfort zones varied, i.e., 90 m^2 for picnic and 65 m^2 camping. The object started for operation from 06.00-17.00 Western Indonesian Time (WIB), or basically, it was operated for 11 hours long. The visit time average per day reached 3.536 based on the estimation shown in Table 8.

Table 9. Estimation of Physical Carrying Capacity (PCC)

A	B	R*f* (hours)	PCC (tourists/day)
552,800 m^2	155 m^2	3.11	11,091

Based on Table 9, it is indicated that Agritourism Sirah Kencong could accommodate a total of 2,500 tourists per day in maximum, based on the actual number of tourists per day. The number could still be lower than the estimated version of its physical carrying capacity, which could make it for 11,091 tourists/day. The maximum number of tourists set by the administrator team was within the carrying capacity of Agritourism Sirah Kencong based on the physical parameter. It was because physical capacity reflected an area's limit, indicating the maximum number of tourists that could be fully accommodated by the area [28] [4].

The characteristics of tourism activities at Agritourism Sirah Kencong also influenced the number of visits to the site. The activities, further, could be differentiated based on the visit periods, including low and peak seasons. The peak visits for tourists occur during holiday seasons, such as New Year (December and January), Independence Day (August), and school holidays (June/July).

Table 10. The number of tourists at Agritourism Sirah Kencong 2017-2020

Month	2017	2018	2019	2020
January	5,841	7,169	10,965	12,097
February	3,816	2,800	4,836	3,807
March	3,566	2,540	3,215	22,10
April	3,887	3,743	4,589	0
May	1,594	3,791	2,337	0
June	1,251	8,161	12,963	0
July	11,241	7,929	8,846	0
August	2,774	4,752	2,313	12,842
September	4,573	2,961	4,297	17,528
October	4,059	3,799	4,990	21,566
November	2,210	3,852	5,756	18,371
December	5,268	10,242	9,071	13,709
Total	50,080	61,739	74,178	102,130

The tourist visit's significant inflation was noticeable based on Table 10, which showed that particular months, such as January, June, July, and December, were the seasons of long holidays. The number of tourists from 2017 to 2018 facilitated as many as 11,659 people or more and less than 23%. Yet, the following year, the number decreased 3% to 780 people. From 2019 to 2020, tourists increased by 18%, as many as 16,293 people. Different from the previous years, ahead of 2020, Indonesia suffered from serious impacts of the Covid-19 pandemic. The effects also brought about a consequence to the area of Agritourism Sirah Kencong, by the closure of the site to the public for more and less 4 months, starting from April to July 2020. However, the number of visits had risen due to society's desire for natural-life vacations after the end of social restrictions (PPKM). Consequently, the administrator team could monitor the number of visits on certain days, such as holidays, feast days, and high season, to diminish environmental devastation.

Table 11. RCC (Real Carrying Capacity) Estimation

No	Indicator	Description	Variable Score (Mn)	Maximum Limit (Mt)	Correcting Factor Score (Cfn) 1-(Mn/Mt)	Reference	RCC
1	Rainfall Index (Cf1)	Wet Climate Type	0.333	7	0.952	Schmidt-Ferguson cited in Aryanto et al (2016)	220
2	Soil Sensitivity to Erosion Index (Cf2)	Andosol (Sensitive)	60	75	0.2	Decree of the Minister of Agriculture No. 837/Kpts/UM/11/1980	
3	Slope Index (Cf3)	Steep	80	100	0.2	Decree of the Minister of Agriculture No. 837/Kpts/UM/11/1980	
4	Vegetative Diversity Index (Cf4)	Species Diversity	1.56	7	0.777	Borobudur et al (1987) cited in Aryanto et al (2016)	
5	Fauna Diversity Index (Cf5)		2.31	7	0.670	Borobudur et al (1987) cited in Aryanto et al (2016)	

The analysis had shown that restrictive factors to environmental carrying capacity were related to biophysical aspects, e.g., rainfall, slope, vegetative and fauna diversities. Regarding RCC, the score reached 220, which means that Agritourism Sirah Kencong accommodated a total of 220 people per day. In terms of real carrying capacity, Agritourism Sirah Kencong was categorized into "dangerous" level, which was basically indicated by physiographical criteria, like wet rainfall, soil prone to erosion, and dominantly steep slope. The correcting factors resisted tourists from visiting the site as comfort and satisfaction aspects was lowered [29]. Further, vegetative diversity around the site owned a number of floras, e.g., banyans, calliandra, jungle banana, *Daemonorops rubra* (rattan), pine, elephant grass, amethyst (forget-me-not), jungle fern, and bamboo. In addition, fauna diversity attracted tourists with a number of kinds of animals, e.g., wild chickens, civet cats, long-tailed shrikes, sooty-headed bulbuls, squirrels, turtledoves, porcupines, and butterflies. Biodiversity around the target area could be categorized in "fairly diverse" level. The correcting factor, in addition, could be the main reason to elevate tourists' pleasure.

Table 12. ECC (Effective Carrying Capacity) Estimation

The Number of Administrator Team (Rn)	The Most Suggested Number of Administrator Team (Rt)	MC	ECC
22	28	0.79	174

According to the ECC results shown in Table 12, it is evident that the administrator ability to manage the destination site was not optimal yet. The EEC score was influenced by the capacity of the administrator team in a tourism object. The number of staffs was 22 people, in this case, including ticketing, parking-men, villa managers, café staffs, and creative team. In fact, based on the interview, the ideal number of administrator team was supposed to be 28 people, so as to make the MC score 0.79. The ECC score after estimation constituted 174 tourists/day, which means that the site could accommodate the tourists in a total of 174 per day based on the management capacity aspect. The result number of staffs was not ideal yet, so it represented less effective for the team to give services to 2,500 tourists per day in the weekend. Policies on management based on tourism carrying capacity must be evaluated and be implemented, which is expected to result in positive outcomes, especially on tourists' comfort and satisfaction.

1. Environmental Sustainability at Agrowisata Sirah Kencong

CHSE regulation is a set of policies enacted by the Ministry of Tourism and Creative Economy as guideline for entrepreneurs and/or administrators (guide) for tourism business, tourism destination and tourist attractions, as well as local guides to adapting to new customs so as to guarantee some aspects for tourists, including cleanliness, health, safety, and environmental sustainability [30]. The policy of CHSE certification to health protocols at public facility was considered a strategical plan to

support the promotion of tourist attractions, not based only on quantity, but quality instead [31].

Table 13. CHSE Assessment at Agritourism Sirah Kencong by KEMENPAREKRAF for Environmental Sustainability

CHSE Dimension	Environmental Sustainability
Indicator Total	13
Uncompleted Indicator	1
Number of assessments	12
Percentage (%)	92.31
Interpretation	Satisfactory

Table 13 demonstrates the results of CHSE assessment for environmental sustainability. By the data, Agritourism Sirah Kencong could reach the satisfactory level by the rate of 92.31%. In addition, tourist participation was based upon the indicator of water- and energy-saving attempts, while the other dimension, human resources, based on the staff's assessment about regulations of environmental sustainability had met the vital requirements at the site, already. Attempts by the administrators for environmental sustainability, in addition, included making posters to stop people from hunting and illicitly seeing after wild animals, banning people for littering in rivers, stipulating the top-limit use of pesticide, prohibiting people for illegal logging, and preventing people for devastating cultural heritages (one of which Candi Sirah Kencong) as shown in Figure 2.

Figure 2. Prohibition of Devastating a Cultural Heritage and Illegal Hunting around the Area of Agritourism Sirah Kencong
Source: researcher documentation, 2022

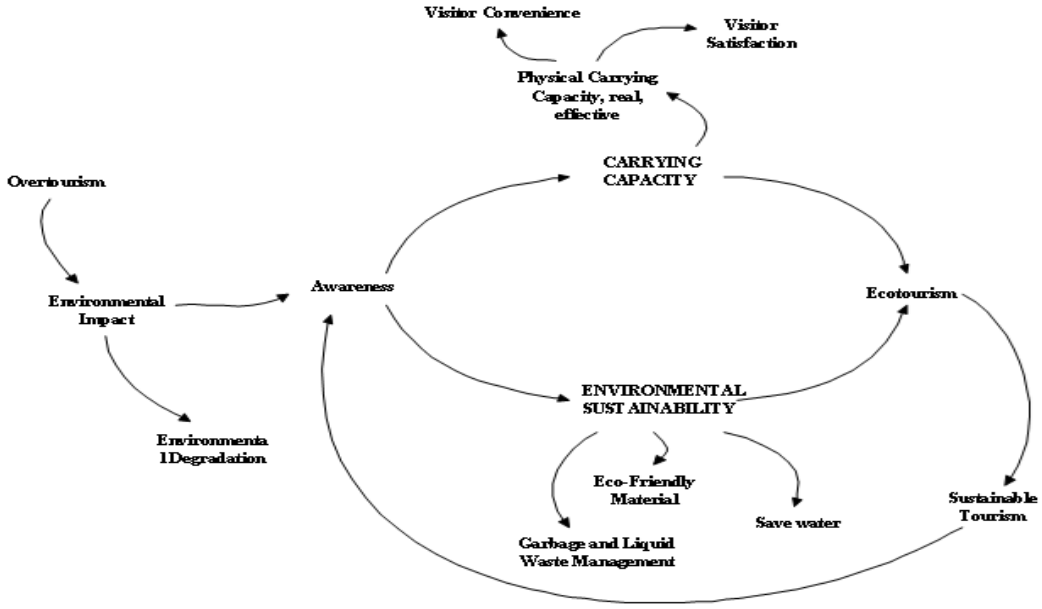

Figure 3. Causal loop diagram illustration for carrying capacity and environmental sustainability at Agritourism Sirah Kencong

2. Causal Loop Diagram (Correlation between Carrying Capacity and Environmental Sustainability at Agritourism Sirah Kencong)

The correlation mentioned above between carrying capacity and environmental sustainability showed that the environment mattered since its quality could be why tourists were attracted to the place. On the other hand, the threat could result in environmental degradation, which might endanger the existence of living species. Further, expansion of tourism objects with an unorganized plan would cause overcapacity, and exceed the limit of tourism carrying capacity [32]. For those reasons, to raise people's awareness of the adverse effects of tourism on the environment, developing a sustainable environment must be initiated [33]. One of the possible attempts was to take care of the environmental carrying capacity.

Carrying capacity contributed to assessing an area based on physical, real, and effective aspects in accommodating tourists. In this case, the carrying capacity of Agritourism Sirah Kencong was mainly influenced by such factors as rainfall, slope, soil sensitivity to erosion, and biodiversity. The area was under a wet climate, located 1,179 meters above sea level. Consequently, rain fell almost every day during the rainy season. Regarding slope, the site's construction was categorized as "steep" and "very steep". By details, the tourist area was steep by a slope rate of 25%-40%. In addition, the site was erected on Andosol dan Latosol soil categories based on data of digital BALITBANG's map. The Latosol soil consisted of Ordo Inceptisol and subgroup Andic Eutrudepts, while Ordo Andosol and subgroup Typic Hapludands were subsumed into Andosol. Andosol is basically a type of soil found in between 0-3500 meters above sea level, flat spanning to mountain area, created in volcanic area, and expanded by volcanic ash materials so as to make the pH level typical to acid soil, with high cation exchange capacity (KTK) Munir (1996) as cited in (Tangkas, 2017) [34]. Subgroup Typic Hapludands and Andic Eutrudepts constituted a soil taxonomy based on USDA (United States Department of Agriculture) in 2014, while the name of andosol was in accordance with the Decree of the Minister of Agriculture No. 837/Kpts/UM/11/1980. In fact, the three abovementioned factors had caused Agritourism Sirah Kencong to be categorized as an area with high sensitivity to erosion, which appeared as a resistive factor to prevent tourists from visiting the area. In addition to the resistive factor to the tourist convenience, the agritourism area was found to possess natural potentials, both in terms of vegetation and faunas, with fair level based on Shannon Wiener Diversity Index. It was these natural diversity potentials that would become a determinant factor to attract tourists.

An attempt to sustain the local environment could be possibly by the use of environmentally-friendly materials, such as for the porcupine home site, bambooed-made plane site, and woodened guitar-shaped stage. Obviously, materials used for those sites were so environmentally friendly, but they were also quite fragile, especially bamboos. Wood for the guitar- and love-shaped stages could bear with the fragility in more and less 2-3 years, depending on the wood type. High rainfall level caused the wood easier to be fragile. Even so, the administrator team was so immediate to fix up or to reconstruct new sites in case of damages, which would, at the end, deal with maintenance cost.

Another thing for the sake of environmental sustainability was by doing preservation on the growth of vegetation that served to be a protector of the tea plant. The protective plant, in this case, referred to mahogany tree (*Swietenia mahagoni*). It helped maintain land conservation, shade the tea plants and minimize land degradation. If it was logged, the Rainforest Alliance certification would be threatened.

In 2021, the administrator team moved to using unused and rarely new materials, like scrap iron. The use of such materials was also based on the safety standards by restricting the number of visitors who could take selfies at the plane-shaped site, by a maximum of seven people. In addition, it was equipped with an appeal in the form of posters as safety became one of CHSE assessment aspects. Efficiency of the use of water apart from its exclusion in CHSE assessment was also included for Rainforest Alliance Certification assessment. It was indicated by the lower number of wastes of machine and vehicle washing generated from the factory in the previous year. Another strategy to do was limiting the use of water, like turning off the water in the pool (so it did not keep flowing), turning off faucets as they were used only when needed, and controlling the water reservoir not to be overlimit.

Sustainability in the research target location was also listed at the RA certification, namely mechanisms for waste and liquid-waste management system according to the Standard Operational Procedures (SOP) of the management of PTPN XII for liquid waste. Waste management, also known as Waste Water Treatment (WWT) constituted a system of management for liquid

waste generated from processing machine wash of the factory. Processed liquid waste was sent to the garden once a week, while the settling tanks were drained or cleaned up once per six months. The second waste management was for pesticide waste. Ahead of being transferred to the main warehouse, it was washed three times in a special washing spot for pesticide containers, and was drained to prevent any contamination of pesticide waste. Next, the third management system was for factory waste. The waste was in the form of tea dust collected in the prepared shelter every day. The waste would, further, be decomposed for the tea plantation around the factory's agritourism area. Further, medical waste management system was also provided to prevent any contamination of medical waste. The waste was delivered once a month to IPSRS, or Hospital Waste Management Installation. To the next management system for livestock waste, the waste was collected every day in a shelter hole ahead of its processing of the making of agricultural land compost. The last waste management system was aimed to control household and tourism wastes, managed by trash bins, separated into inorganic and organic. The collected organic waste was used as materials for organic fertilizer, while the inorganic waste would be sent to Wlingi's District Final Waste Disposal Site (TPSA) on every Monday. Efforts made by the administrator teams of Agritourism Sirah Kencong in sustaining the environment were relevant with [9] statement that efforts to keep environmental stability, from low to high, were in support of environmental sustainability so as to make the environment stay unthreatened. In sum, all those efforts were subsumed as sustained environment and environmental sustainability.

Public awareness of the carrying capacity and environmental sustainability would shape the concept of environmentally-based tourism. According to [35] suggested that in the combination of tourism needs and environmental sustainability development, a new concept would emerge as it was also known as "ecotourism." Ecotourism is supposed to minimize the consequences caused by visitors on habitats and wildlife to ensure the sustainability of natural resources. It is ecotourism concept that will convert tourism products into sustainable tourism. Zamfir & Corbos, (2015) [36] suggested that whole resources can be managed through sustainable tourism to meet the demands and to maintain the cultural integrity, biodiversity, ecological dimensions and living systems. Thus, sustainable tourism can be defined as a form of tourism that emphasizes current conditions and future impacts (in particular dimensions, such as economic, social and environmental) and meets numerous requirements expected by the tourists, industries, local people and society. According to [37], in addition, averred that cooperation that includes the governments and private sectors is needed for sustainable tourism development in order to foresee and anticipate any environmental damages before everything is too late.

CONCLUSIONS

Agritourism Sirah Kencong is one of several sustained tourism supporting environmental sustainability in a rural area. According to physical carrying capacity (PCC), it could accommodate 11,091 tourists per day. In terms of real carrying capacity (RCC), as many as 220 tourists came to visit the site. Meanwhile, for effective carrying capacity (ECC), it reached 174 tourists per day. Regarding carrying capacity estimation, in general, Agritourism Sirah Kencong possessed a typical carrying capacity of PCC>RCC>ECC, which articulated an ideal condition and could allow the administrator team to increase the number of tourists until reaching a score limit. Environmental sustainability assessed based on CHSE indicators of Agritourism Sirah Kencong had been scored for satisfactory category by the audit team for the CHSE certification (including cleanliness, health, safety, and environmental sustainability aspects) released by the Ministry of Tourism and Creative Economy (KEMENPAREKRAF). Support elements of environmental sustainability at Agritourism Sirah Kencong included using environmentally friendly materials, water-saving procedures, and waste and liquid-waste management systems. In addition, environmental carrying capacity was a determinant factor for comfort and satisfaction for tourists. Moreover, environmental carrying capacity and sustainability are closely related to ecotourism as a beginning to create sustainable tourism. In the future, the administrators can pay attention to the agritourism carrying capacity, not only on the physical but also real and effective carrying capacity aspects, to make a more sustained and conducive ecosystem in the target location.

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