To Determine the Carrying Capacity of Ecotourism Sites in Kullu District of Himachal Pradesh

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Abstract: Ecotourism is "Environmentally responsible visit to natural areas, in order to enjoy and appreciate nature that promote conservation, have a low visitor impact and provide for beneficially active socio-economic involvement of local peoples." Ecotourism can have a negative impact on the natural resources on which it relies, especially if the operation isn't up to par. Estimating the carrying capacity of secure places is critical to ensuring that they can handle scenarios of visit that are economically, socially, and environmentally viable. Carrying capacity is an approach developed in engineering and geological fields to handle issues such as pollution, population growth, and land degradation. The maximum number of a certain type of living creature that can survive in a given circumstance is referred to as carrying capacity. Five ecotourism sites in kullu district of Himachal Pradesh were purposively selected for the assessment. The given study stated that carrying capacity of the sites ranged from 14-50 visitors per day. Maximum carrying capacity was at Gushaini (50) followed by Jibhi (14), Mungla (17), Dehori (29) and Manali (39) visitor/day. The actual number of tourists visiting the sites per day was well within the permissible limits. The study indicated that if the tourist inflow rate remain same the carrying capacity of different sites projected to exhaust within the next 33 to 40 years, due to increasing visitor inflow rate, scarcity in water, energy consumption and inadequate infrastructure. Accordingly Jibhi will exhaust its carrying capacity by the year 2052 followed by Mungla, Dehori, Manali, Gushaini. Among them Gushaini was most sustainable site. It can be concluded that though there is a good quality of soil and water resources, as each site has tourist inflow in normal range. In future the increase in visitor inflow reduces the carrying capacity of the site and hence threatens the sustainability.

Keywords: Ecotourism, Tourist, Carrying capacity.

Introduction

The term ecotourism first came in the late 1980s, as there was an increasing worldwide concern for sustainability practices in regard to ecological systems, extending to limiting the degenerative effects of tourism on the environment. Ecotourism is defined as "responsible travel to natural areas supporting the flora, fauna and conserve the environment to sustain the well-being of the local people and involves interpretation and education" TIES (2006). Ecotourism was launched in India when the World Tourism Organization declared 2002 the International Year of Ecotourism as part of the United Nations National Environmental Program. Tourism, India's third most important business sector has historically played a significant role in the Indian economy, contributing 6.23 percent of the country's GDP Honey (2008). Ecotourism is now regarded as one of the world's most rapidly increasing markets. Ecotourism is anticipated to account for 5% of the worldwide industry by 2024, three times faster than traditional tourism. The growth of the global market is because of changing consumer patterns. Nowadays tourists are becoming environment conscious, respecting local culture and thus are becoming "greener" Sharpley (2006). For developing countries like India, ecotourism serve as an ideal industry for fostering economic growth and conservation Tiwari and Abrol (2015). The carrying capacity of a site is defined as the maximum number of visitors that can visit without causing severe environmental deterioration or a significant reduction in the quality of the visitor experience. All numbers produced in excess of the carrying capacity are obviously subject to loss Maithieson and wall (1982). Carrying capacity is a notion that represents the need to keep development and activities at a level that is both environmentally and socially sustainable, as well as actions that cause environmental deterioration Getz. (1982). The carrying capacity for tourism refers to the maximum number of visitors that a certain place can accommodate, and it is calculated using three levels of analysis: physical carrying capacity (PCC), real carrying capacity (RCC), and effective carrying capacity (ECC) with $PCC > RCC > ECC$. The PCC of a site is determined by the amount of visitor space available.

The RCC is estimated using a set of correction factors that are specific to each site and can affect its carrying capacity. Finally, the site's ECC takes into account the site's management capacity (MC) i.e., the level of management that can be provided with the infrastructure and personnel available. Carrying capacity is distinctive to each site and must be calculated separately for each public usage location. It is usually determined by a critical factor, such as a location or a condition, whose restrictions can result in a lower carrying capacity Cifuentes (1992). According to the World Trade Organization, the total number of tourists worldwide is predicted to reach 1.6 billion by 2020 Honey and Rome (2000). Tourism is the world's greatest employment, directly and indirectly employing almost 200 million people and accounting for roughly 10% of all occupations. Himachal Pradesh is the largest state in northern India's mountainous Himalayan region. It provides a variety of tourism activities, including hiking, trekking, rock climbing, rappelling, angling, ice skiing, paragliding, zorbing, mountain biking, fishing, camping, river rafting, yoga. Himachal Pradesh forest covers nearly two-thirds of the state's 55,673-square-kilometer land area and is crucial to the region's environmental and economic well-being and act as a store house of rich biodiversity.

Kullu is an open valley with panoramic views and towering hills covered in deodar and pine trees, and is coupled with Manali as a popular tourist destination. It is situated at an altitude of 1,279 meter above mean sea level it is a nature lover's paradise and known as one the most popular tourist spots in Himachal Pradesh Nag (2013).

Materials and methods

Location

The research was carried out in the Kullu district of Himachal Pradesh, in India's northwestern Himalayan area. Kullu is a hilly and mountainous tract that is located between the latitudes of $31^o21'$ N and $32^o59'$ N, and the longitudes of $76^o49'$ E and $78^o59'$ E, with altitudes ranging from 1200 to 4800 metres above mean sea level. The district's overall geographical area is 5503 square kilometres, or 3.92% of the state's total area, and it is ranked 12th among the districts. High steep mountainous topography, rivers, rivulets, and valleys characterize the district.

Climate

Kullu has a chilly, arid climate that ranges from sub-temperate to temperate. The area receives modest rain, most of which falls during the monsoon season. Snowfall falls on the upper hills of the district during the winter, which serves as a major supply of fresh water for the region's Beas River. The highest temperature ranges from 15.8^oC to 32.8^oC , while the minimum temperature ranges from 7^oC to 21.1^oC Anonymous (2009).

Site Selection

A number of ecotourism sites are running on Public Private Partnership (PPP) mode as designated by the state's Forest Department. A survey was conducted in the regions to identify the ecotourism activities. Five sites were chosen in order to achieve the objectives of study.

Carrying Capacity Assessment

Tourism Carrying Capacity (TCC)

It refers to the maximum number of individuals who can visit a tourist attraction at the same time without damaging the physical, economic, or socio-cultural landscape or lowering visitor comfort to an unacceptable degree. In the current study, Cifuentes (1992) devised a system for determining the carrying capacity for tourism in protected areas was used. The PCC, RCC, and ECC are defined in this methodology as follows:

Physical Carrying Capacity

The maximum numbers of individuals who can fit on the given site at one time and still allow them to be able to move.

$$PCC = A \times \left(\frac{v}{A}\right) \times R_f$$

Where A is the available area (m^2),

$\frac{v}{A}$ = D is the tourist density (tourists/m2)

R_f = Rotation factor (No of visits/day)

Real Carrying Capacity

The maximum number of visitors a site can handle is referred to as its Real Carrying Capacity. It is computed by multiplying the PCC by a set of correction factors that are specific to each location. Environmental and social variables were employed as corrective factors in this study, as mentioned below.

Correction Factors

$$C_{fn} = 1 - \frac{M_L}{M_T}$$

Where, C_{fn} is limiting value

M_L Is number of days of limiting factor each year

M_T Is number of days that ecotourism sites are open every year (365)

Environmental Variables:

Precipitation (C_{f_1}):

Rainfall more than 29 mm is considered as limiting factor for tourism. An average of five years was calculated for the number of days with rainfall greater than 29 mm per year for the mid hill region of Himachal Pradesh (Pooni and Baskar, 2015).

Number of days with precipitation more than 29 mm in year (M_L) = 8

Total number of days in a year (M_T) = 365

$$C_{f_1} = 1 - \frac{8}{365} = 0.978$$

Very hot days (C_{f_2}):

Temperature more than 34° C is considered as limiting factor for tourism. An average of five years was calculated for the number of days with temperature more than 34° C per year for the mid hill region of Himachal Pradesh. (Pooni and Baskar, 2015).

Number of days with temperature more than 34° C in a year (M_L) = 6

Total number of days in a year (M_T) = 365

$$C_{f_2} = 1 - \frac{6}{365} = 0.983$$

Very cold days (C_{f_3}):

Temperature less than 3^oC is considered as limiting factor for tourism. An average of five years was calculated for the number of days with temperature less than 3^oC per year for the hill region of Himachal Pradesh. (Pooni and Baskar, 2015).

Number of days with temperature less than 3^oC in a year (M_L) = 52

Total number of days in a year (M_T) = 365

$$C_{f_3} = 1 - \frac{52}{365} = 0.857$$

Social variable (C_{f_4}):

To avoid group disturbance and provide a quality experience for visitors, the number of tourists occupying the site is always less than the total capacity available in the site. Therefore, even if a site can accommodate 5 groups according to its infrastructure, it will take only 3 groups at a time.

Number of groups actually accommodate (M_L) =3

Total number of groups that can be accommodate in the site (M_T) = 5

$$C_{f_4} = 1 - \frac{3}{5} = 0.4$$

To calculate RCC, multiply the PCC by the limiting factors using the formula given below.

$$RCC = PCC \times C_{f_1} \times C_{f_2} \times C_{f_3} \times C_{f_4}$$

Effective Carrying Capacity:

Given the site's capability to accommodate visitors, ECC is the maximum number of visits that can be allowed. The ECC was calculated by comparing the RCC with the protected areas' management capacity:

$$ECC = RCC \times MC$$

Management Capacity (MC)

The ideal MC describes the optimum conditions for developing the activities that are planned for a specific protected area (Maldonado, 2005). Infrastructure, equipment, and personnel were the variables employed in determining MC in this study since these three characteristics are directly connected with visits and can be measured. In this study, the method proposed by (Maldonado, 2005) to calculate management capacity was applied. Infrastructure and equipment variables were valued using three basic criteria: quantity, status, and functionality. These factors were subjectively rated and quantified using a 1 to 5 scale, with 1 being not satisfactory and 5 representing very satisfactory. The following ratings were given based on the analysis of questionnaire based survey.

- **Infrastructure:** It consists of the number of accommodations available in the form of tents, cottages, etc., in the sites. It was rated on the basis of its amount, status and functionality.

- **Amount:** It was used to quantify the total number of accommodation available in the site; sites having more accommodations have a higher rating as compared to the site with fewer of them.
- **Status:** It was used to quantify the different types of accommodation. For example, similar type of accommodation was rated lower than the one with different classes like tents, deluxe cottages etc.
- **Functionality:** It was used to quantify whether the infrastructure served the purpose of ecotourism. Rooms with more amenities and power consumption were rated lower than the ones with basic amenities.

The following rating scales were formed keeping in mind the data collected from the ecotourism sites:

Table 1: Rating for the variables of infrastructure

Rating	**Variables of infrastructure**		
	Amount (No of activities)	**Status**	**Functionality**
1	1-5	Similar types of Accommodation	Power point + source of light + fan + heater + geyser + AC
2	6-10	2 types of Accommodation	Power point + source of light + fan + heater + geyser
3	11-15	3 types of Accommodation	Power point + source of light + fan + heater
4	16-20	4 types of Accommodation	Power point + source of light + fan
5	>20	5 types of Accommodation	Power point + source of light

Infrastructure management component was calculated as:

$$\frac{Amount + Status + Functionality}{3 \times Highestrating} \times 100$$

Personnel:

The following criteria were used to evaluate the number of personnel like, level of education, years of experience in the region, levels of satisfaction with working conditions and training received. For each category 1 to 5 rating was assigned, (1 = not satisfactory, 5 = very satisfactory). Rating was assigned on the basis of number of people employed, education qualification, field experience, training received and level of satisfaction of the workers.

The following rating scale was kept in the mind while collected data from the ecotourism sites.

Table 2: Rating for variables of personnel.

Ratings	Variables of personnel			
	Number Personnel	**Educational Qualification**	**Experience (years)**	**Training received**
1	-	Illiterate	1 year	No
2	-	Below Metric	2-4	-
3	<20	Metric	5-7	-
4	20-25	10+2	8-10	-
5	>40	Graduate and above	>10	Yes

Overall rating for,

$$\text{Educational qualification} = \frac{\sum(\text{No. of employees} \times \text{Rating as per Qualification})}{\text{Total number of respondents}}$$

$$\text{Experience of the employees} = \frac{\sum(\text{No. of employees} \times \text{Rating as per Experience})}{\text{Total number of respondents}}$$

$$\text{Training received:} = \frac{\sum(\text{No. of employees} \times \text{Rating as per Training})}{\text{Total number of respondents}}$$

Satisfaction of the employees: Similar rating (4) was given for this parameter to all personnel of the sites due to their similar positive response.

The following formula was used to calculate the management capacity of ecotourism sites as arithmetic mean of these variables: infrastructure, equipment, and personnel:

$$\text{MC} = \frac{\text{Infrastructure} + \text{Equipment} + \text{Personnel}}{3}$$

Results

Carrying Capacity of Ecotourism Sites

The Physical, Real and Effective carrying capacity was calculated by using different formulae and the results were presented in table 3.

Table 3: Sitewise physical, real and effective carrying capacity tourist inflow in Kullu district of Himachal Pradesh.

Sites	Physical carrying capacity (visitors per day)	Real Carrying capacity	Effective carrying Capacity
Manali	1048	345	38
Mungla	380	125	17
Jibhi	569	187	14
Dehori	1068	351	29
Gushaini	976	321	50

Maximum Physical Carrying Capacity (1068 Visitor/day) was recorded at Dehori and minimum (569 visitor/day) at Mungla site. The Effective Carrying Capacity ranged from 14 to 50 visitors per day. Highest effective carrying capacity was observed (50 visitor/day) at Gushaini followed by Manali, Dehori, Mungla and lowest (14 visitor/day) at Jibhi. The correction factors precipitation, very hot days and very cold days are essential, as they influenced the flow of people. Similar results were showed by (Sayan and Atik, 2011). While investigating visitation in Turkey's Termessos National Park. They stated that the number of visitors to the park is dependent on the season and weather conditions. In this study, we found that the social correction factor had the most impact on the total RCC because it was the most limiting factor (0.4) for all ecotourism sites, leading to a fall in the number of daily visits. The trials in the protected area of La Tigra National Park, Honduras, followed the same pattern (Maldonado and Montagnini, 2005). The Real Carrying Capacity and Effective Carrying Capacity values of the selected sites showed a significant variation. This may be affected by poor management techniques at the site. Infrastructure, equipment, and the strength of staff employees must all be improved in order to boost the carrying capacity of the sites. The data in Table 3 revealed that Effective carrying capacity of the ecotourism sites was higher than the actual number of visitor per day. During peak season maximum occupancy (82.35%) was recorded at Mungla and minimum (42%) at Gushaini. Occupancy at site Jibhi, Manali, Gushaini was found to be 78.61, 61.54, and 51.72 percent respectively.

Table 4: Sitewise effective carrying capacity and actual number of tourist inflow in Kullu district of Himachal Pradesh.

Sites	ECC (Visitors/day)	Actual number of Tourist inflow per day	Occupancy (%)
Manali	39	24	61.54%
Mungla	17	14	82.35%
Jibhi	14	11	78.57%
Dehori	29	15	51.72%
Gushaini	50	21	42.00%

Graphical presentation through bar charts

Fig: 1,2,3,4 and 5 depicts site-specific bar charts for Physical, Real and Effective Carrying Capacity.

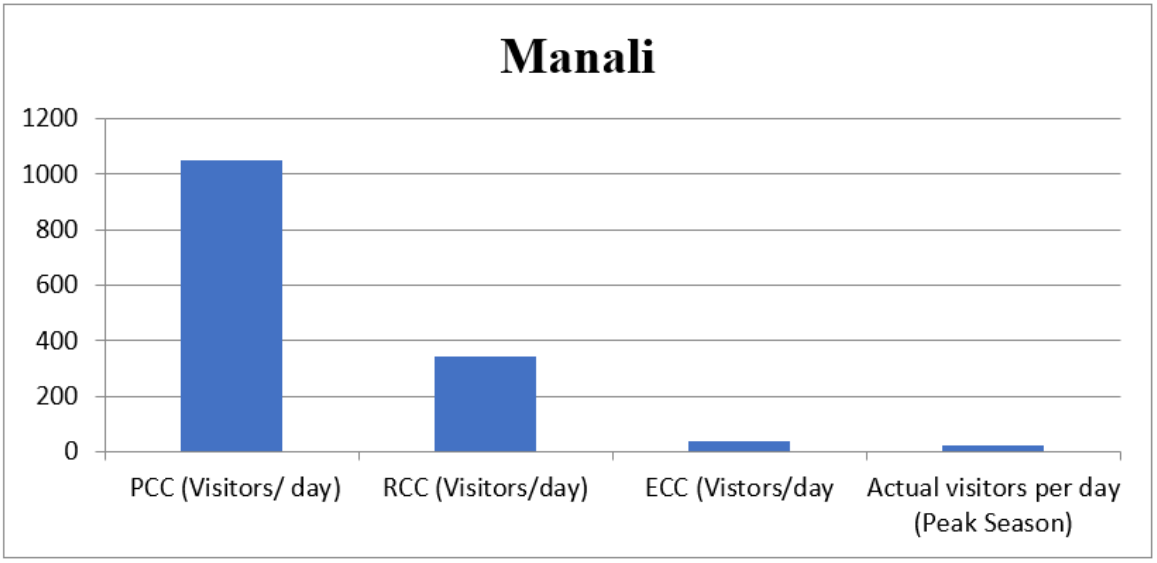

Fig.1: Sitewise physical, real and effective carrying capacity tourist inflow at Manali.

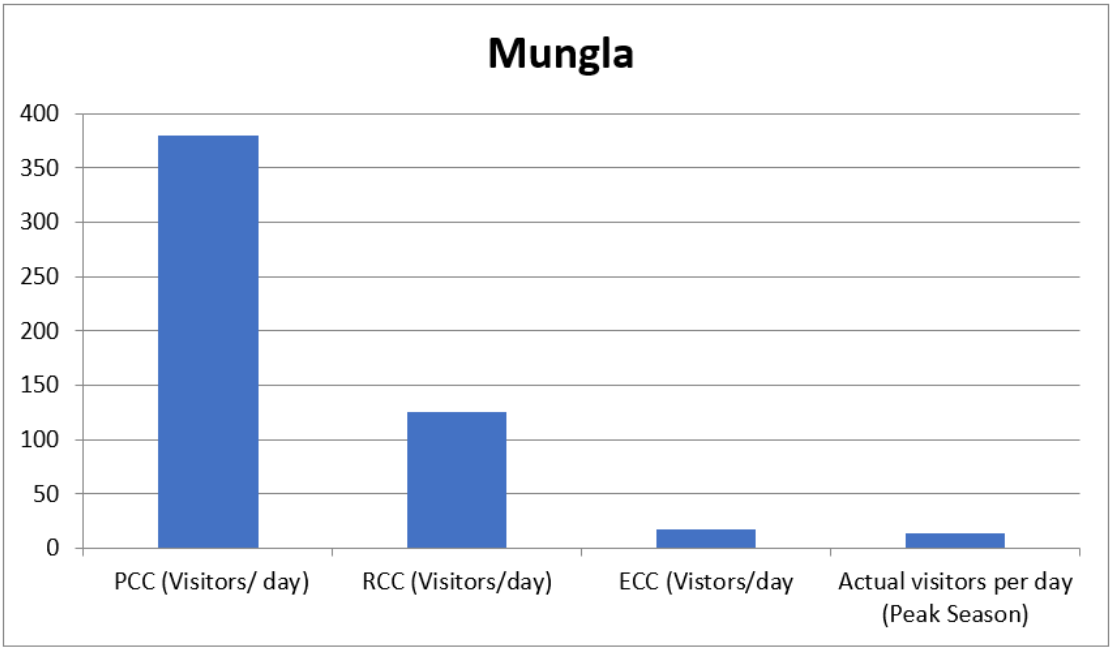

Fig.2: Sitewise physical, real and effective carrying capacity tourist inflow at Mungla

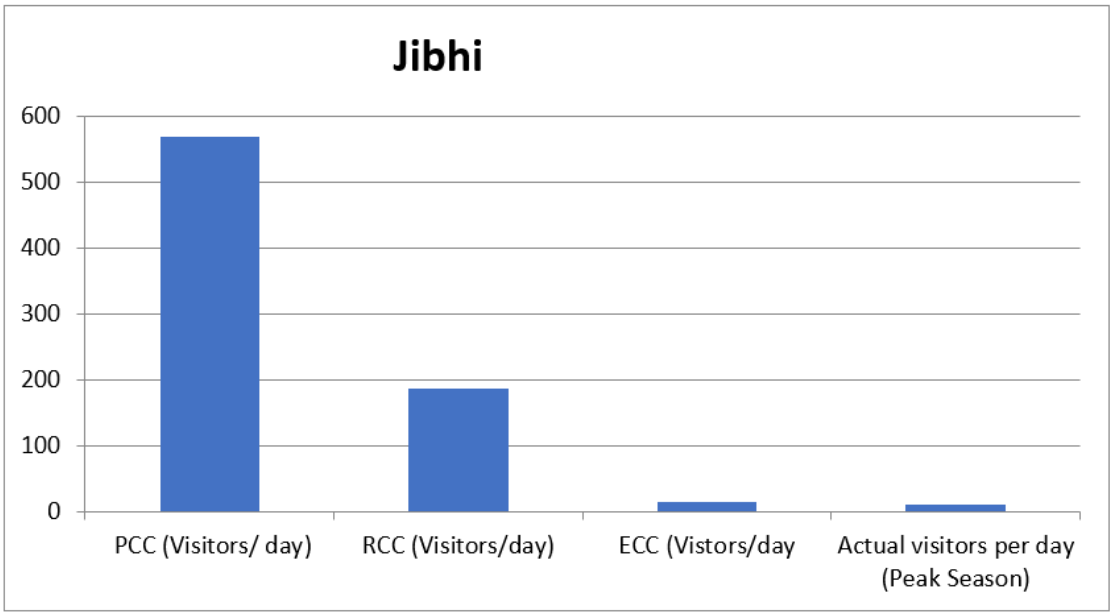

Fig. 3: Sitewise physical, real and effective carrying capacity tourist inflow at Jibhi.

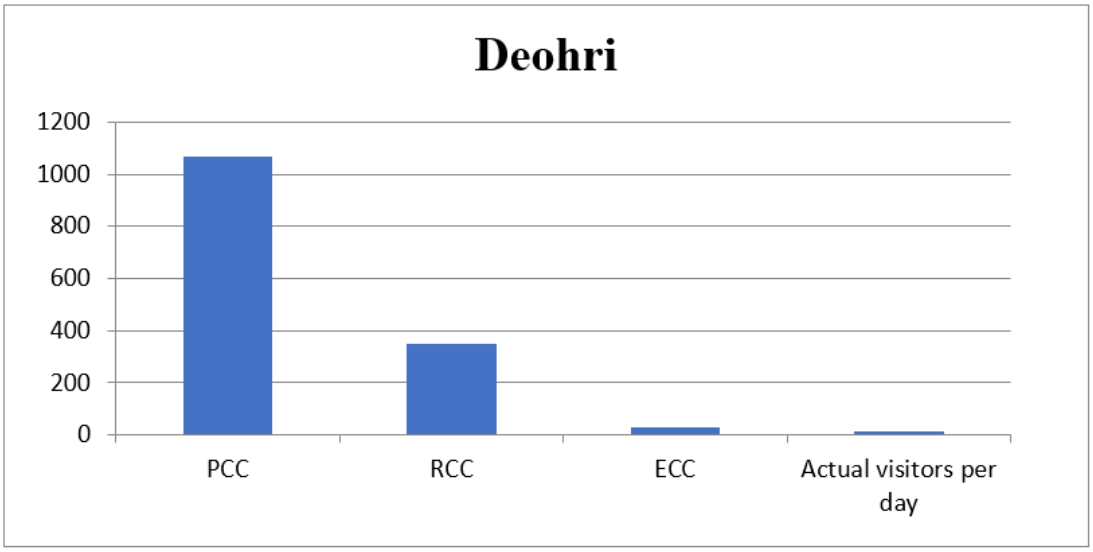

Fig.4: Sitewise physical, real and effective carrying capacity tourist inflow at Deohri.

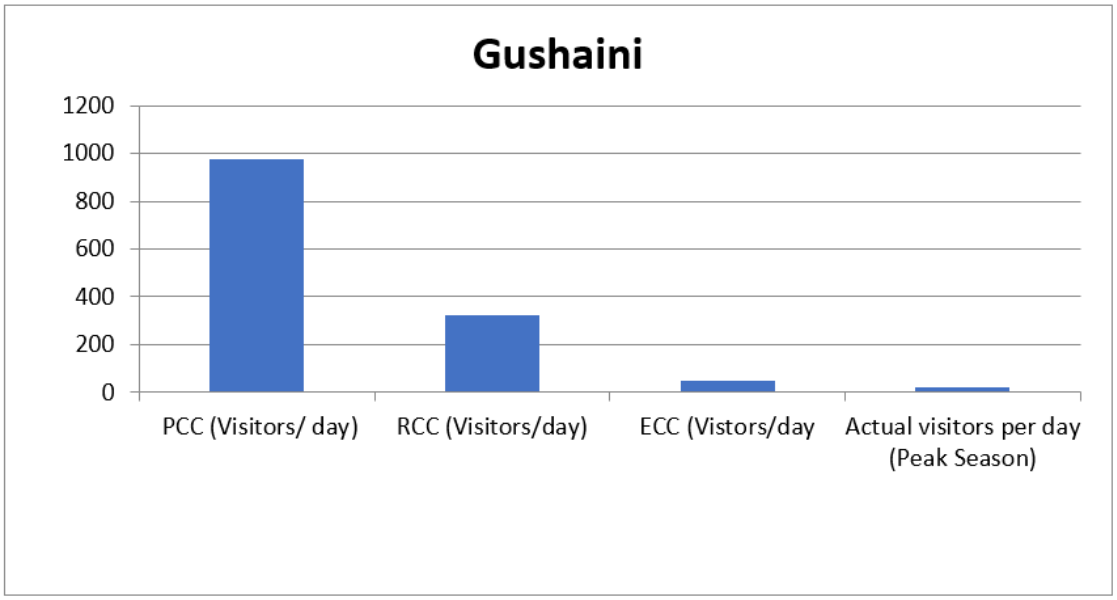

Fig.5: Sitewise physical, real and effective carrying capacity tourist inflow at Gushaini.

Tourist Influx Trend:

To Calculate the Tourist Influx trend data for the year 1997 to 2017 was obtained from the tourism Department of Himachal Pradesh. Then the growth rate inflow of tourism was estimated. It was observed that with time scale the tourist rate was also increased with time scale. It was found about 8.4 per cent (fig 6). It was inferred from table 5 that with same rate of tourist inflow at different studied sites, Gushaini will take 49 year (2068) to exhaust its carrying capacity followed by Manali (2065), Dehori (2061), Mungla (2054) and Jibhi (2052) year respectively.

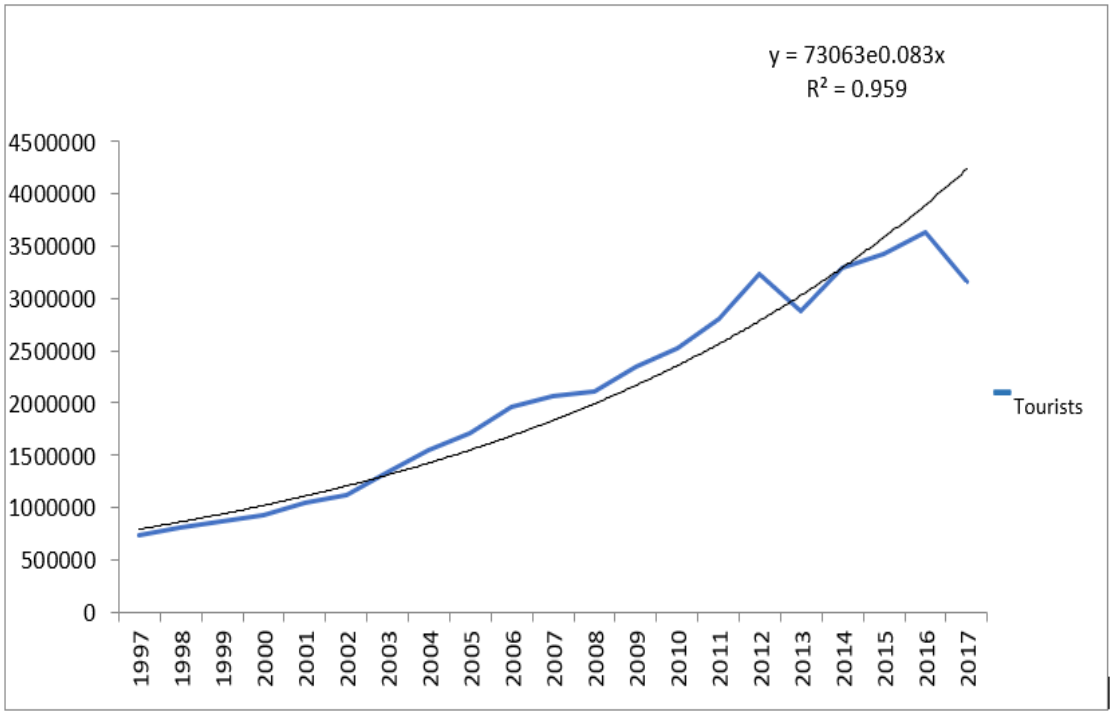

Fig.6: Tourist influx trends in Kullu district of Himachal Pradesh (1997-2017)

Projections for exhaustion of carrying capacity of sites:

Table 5: Projected time span for exhaustion of carrying capacity for the ecotourism sites in Kullu district of Himachal Pradesh.

Ecotourism site	Exhaustion of the carrying capacity (years)	Year
Manali	46	2065
Mungla	35	2054
Jibhi	33	2052
Dehori	42	2061
Gushaini	49	2068

Conclusion

Effective carrying capacity was higher than the actual number of visits on average basis. The effective carrying capacity ranged from 14 to 50 visitors per day. Maximum carrying capacity 50 visitors per day was recorded in Gushaini followed by Manali, Dehori, Mungla, Jibhi with respective values of 39, 29, 17 and 14 visitors per day respectively. It can be inferred that present situation is good in each site but with increase in tourist rate per year the carrying capacity of the ecotourism sites will be exhausted within next 30-35 years. Essential steps have to be taken before the tourists, start to exert pressure on the natural resources of the nearby area. The real and effective carrying capacities of the locations were significantly different. To bridge the gap between these two, the sites must have to increase their carrying capacity by improving proper management technique like incorporating better infrastructure, equipment and by increasing their staff members.

Conflict of Interest

We have no conflicts of interest to disclose.

Data Availability Statement

The datasets generated during and/or analysed during the current study are available in the krishikosh repository, https://krishikosh.egranth.ac.in/handle/1/5810132985.

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