

## Assessment of Physical Carrying Capacity of Braham Sarovar: A Religious Place in Kurukshetra City, Haryana

Ravinder J\*

Department of Geography, Kurukshetra University, Kurukshetra, Haryana, India

### Abstract

Assessment of tourism carrying capacity is essential to regulate and manage the visitors. The uncontrolled tourism activity is a major concern for the authorities to manage religious destinations. In the recent past, world has faced many miss-happening on religious destinations. Therefore, the present study tries to estimate the physical carrying capacity of Braham Sarovar, a very famous religious destination in Kurukshetra, Haryana using both primary and secondary data sources. Paper has adopted different methodologies suggested by International Union of Conservation of Nature and Natural Resources (IUCN), Indian Road Congress (IRC), Ministry of Urban Affairs and Employment, India. Beside that GIS approach is used to establish a framework for assessment of the study area. Present study has identified the maximum number of pilgrims that Braham Sarovar conserves which is about 5,67,534 persons per day on any specific occasion. The destination has adequate space for parking but lack sufficient number of toilet and need to ensure availability of large number of such public conveniences of temporary nature during big events like sun eclipse.

**Keywords:** Physical carrying capacity; International union of conservation of nature; Natural resources; Land use; Land cover

### Introduction

Tourism and travel is one of the world's largest sector due to the globalization of capitalism and advances in transportation and communications technology [1,2]. It offers a great opportunity for diversification and especially religious places; it is also to be a vehicle of additional earning [3]. In India, it is a big industry with their religious and spiritual values and also has enormous economic impacts but the continuously unregulated tourism has increased the pressure or adverse impacts on many religious destinations and also creates many socio-economic, cultural and environmental problems which are affecting pilgrim's interest in those places [4]. The unplanned exploitation of resources is destroying the basic functionalities of ecosystem and creates a risk of losing destinations recovery capacities [5] and these effects are normally associated with the number of pilgrims that visit certain destination. The concept of carrying capacity is most important in tourism planning [6]. In fact, it gives an idea of the threshold of tourists/pilgrims that can be accepted at a destination [7]. The concept of carrying capacity has become more important because world has faced many tragedies at famous religious destinations such as Nainadevi, Kedarnath and Mecca. Kurukshetra is associated with *Mahabharata* (a holy war between Kaurav and Pandav) and '*Geeta Updesha*', the sermon given by lord Krishna; has indisputable pilgrim's potential and demand is continuously growing due to its unique ethnic and mythological backgrounds. Therefore, the study evaluates the physical carrying capacity of Braham Sarovar, a religious lake in Kurukshetra city of Haryana where about half a million people visit on a specific occasion like Sun-eclipse.

### Area of study: Braham sarovar

Kurukshetra is a city in the state of Haryana, India. It is also known as Dharmakshetra ("Holy Place") which is a land of pilgrimage and it revered all over the country for its great historical and religious importance. People from various parts of the world come here for salvation on various festive occasions. According to Hindu mythology, it is believed that Braham Sarovar is created by the creator of this universe lord Brahma and it is also mentioned in the eleventh century

AD memoirs of AL-Beruni, called Kitab-ul-Hind. Braham Sarovar covers a geographical area of 11,41,054.74 m<sup>2</sup> and is located on coordinates 29°96' N and 76°83' E (Figure 1).

According to the Puranas, Kurukshetra is a region named after King Kuru, the ancestor of Kauravas and Pandavas, as depicted in epic Mahabharata. The importance of the place is attributed to the fact that the Kurukshetra War of the Mahabharata was fought on this land and the Bhagavad Gita was preached here during the war when Lord Krishna found Arjuna in a terrible dilemma.

Peoples come to take a holy bath at Braham Sarovar on the occasion

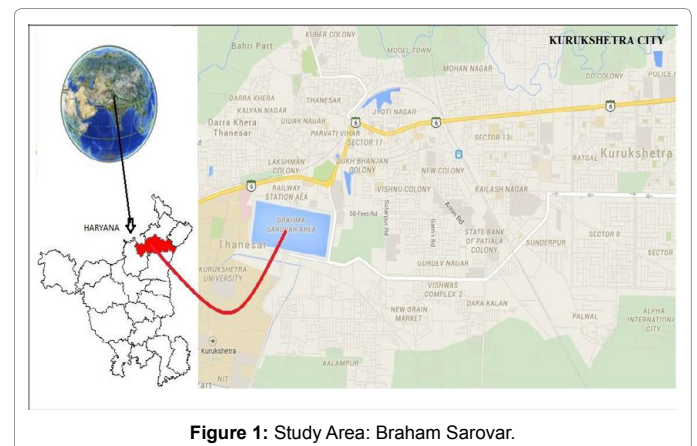


Figure 1: Study Area: Braham Sarovar.

\*Corresponding author: Ravinder J, Research Scholar, Department of Geography, Kurukshetra University, Kurukshetra, Haryana, India, Tel: 09416191112; E-mail: [ravinderjangra13@gmail.com](mailto:ravinderjangra13@gmail.com)

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of 'Somavati Amavasya' (Sacred No-Moon day that happens on a Monday) and on Sun-eclipse believed that bath in holy sarovar free from all sin and cycle of birth-death. Over half a million pilgrims come here occasionally and create an overburden's and mismanagement on destinations. Big concentration of local, national and international tourists is also observed on most auspicious occasion *Gita Jyanti*, celebrations held in the last week of November or the first week of December at the premises of Braham Sarovar which is well known.

## Objective

The main objective of this paper is to evaluate the physical carrying capacity of the Braham Sarovar, a holy lake in Kurukshetra city and tries to develop a strategy to initiate a tourism surveillance system.

## Database and Methodology

Study area is very rich in pilgrim's tourism both in terms of destinations and types. The detailed analysis of its aspects is done by using both primary and secondary data sources. An unstructured questionnaire was designed using simple random purposive sampling of 50 pilgrims. Secondary data such as number of toilets, bathrooms, drinking water points and sweepers are collected from the Kurukshetra Development Board (KDB) and the estimated number of pilgrim's visiting the destination are collected from the district administration, Kurukshetra. The standard norms of parking, toilets and footpath are collected from Indian Road Congress (IRC) and the guidelines for community toilets from Ministry of Urban Affairs and Employment, Government of India. Quickbird imagery is used for preparing the land use for the year 2014 to derive physical carrying capacity of the destination.

**Quantitative analysis:** To estimate physical carrying capacities, mathematical formulas suggested by International Union of Conservation of Nature and Natural Resources (IUCN) are used as given below [6,8-11]:

**Physical carrying capacity:** It is maximum number of tourists who can physically fit into a specific area over a given time.

$$PCC=A \times V/a \times Rf$$

Where;

A=Area suitable for tourism (m<sup>2</sup>)

V/a=Appropriate space for displacement of tourists/tourist density (tourists/ m<sup>2</sup>)

Rf=Rotation factor (number of visits per day)

**Area suitable for tourism (A):** A is determined by particular conditions of the considered area. In any conservation area, the available area can be estimated from the total area where tourists can do camping.

**Appropriate space for displacement of tourists (V/a):** The area needed for a tourist who can undertake activities comfortably. The data is collected through field survey during *Geeta Jyanti*.

**Rotation factor (Rf):** It is the number of permissible visits over a specified time (Usually calculated by daily open hours) and calculated through dividing the amount time usable in day for visitors on the mean time of a visit.

**Duration of usability:** It explains the number of visiting hours per day to the tourist destinations which results the field survey based on

the questionnaire and interviewing with the tourists, local people and the authorities.

**Visit duration:** It is the average time required by tourists for touring and visiting various attractions of the region and it expressed by;

$$Rf=\text{Open period}/\text{average time of visit}$$

In present study, **Open period**=11 hours per day (Average annual time between sunrises and sunsets, mostly on No Moon day and Peak time (main timing of bathing on No moon according to the pastor).

## Result and Discussion

Tourism is one of the fastest growing sectors of economy world over and pilgrimage tourism is one of the major components of that in India. Large number of people travels to such destinations to satisfy their appetite for obeisance or submission to god. Sometime congregation of such people creates chaos resultant into tragedy hence arise the need to evaluate the capacity of such religious destinations. Simultaneously, there is need to evaluate availability of basic services namely toilet, accommodation, food joints and parking of vehicles for the safety and convenience of the visitors.

## Land Use/Land Cover

The total area of the Braham Sarovar is 11,41,054.74 m<sup>2</sup>. Figure 2 demonstrate the land use/land cover map of destination and its surrounding area. Categories are identified for the estimation of carrying capacity. Only those zones of destination which are used by pilgrims for their religious purposes during the occasions are considered. Area under the deep water zone is around 4,11,766.23 m<sup>2</sup> which is 36.08 percent of the total destination area. During the occasion of No-Moon, shallow water zone of 36, 846.58 m<sup>2</sup> area provide an ideal place to pilgrim's for dipping. There are also 20 separate covered dipping zones constructed for women pilgrims which cover 5, 373.75 m<sup>2</sup> which is 14.58 percent of the total shallow zone. Roofed zone covered 19,986.72 m<sup>2</sup> area which is divided into many cells. Each of these cells is covered from three sides and front remains open facing the Sarovar (lake). The size of each cell is 3.1×5 m<sup>2</sup> and is mainly used by Babas/Saints for their stay during the occasion. A big area of 1,13,047.07 m<sup>2</sup> is under parks which are built around the roofed zone forming the outer periphery of the destination (Table 1). This zone is primarily used for recreational

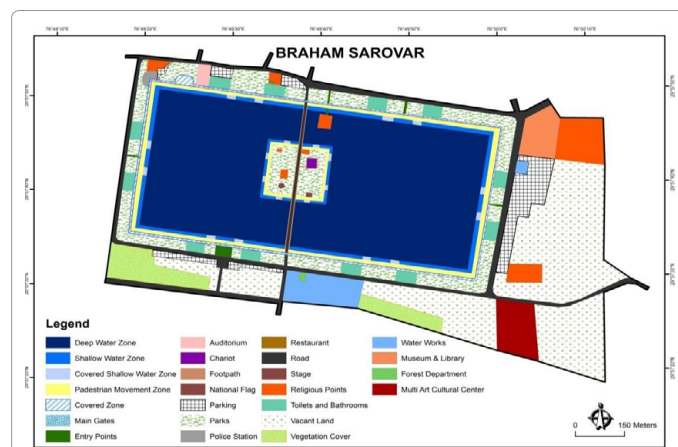


Figure 2: Braham Sarovar: Land use Land cover.

**Source:** Quickbird satellite imagery, 2014 like a famous chariot made of eight metals showing lord Krishna giving sermon 'The Gita Updesha' to Arjuna during the famous Mahabharata war, lord Hanuman temple.

and comfort by pilgrims and they take rest here for short period of time.

A religious point *Dropadikund* is located near the center of the Braham Sarovar and foremost point, the lord Shiva temple is located about 100 feet from the bank of the sarovar in the deep water zone in north direction and is joined by an arch with pedestrian zone. A circular road is constructed around the sarovar to manage the traffic problems during the important occasions and to manage the big rush of pilgrims; there are nine gates for entry/exit (Brahma sarovar disaster management plan). For the management, especially for security purpose, a police station is established at the north-west corner of the Braham Sarovar.

### Assessment of physical carrying capacity

The total area of the destination where pilgrims do camping is 6,65,040.25m<sup>2</sup> (Table 1). If the carrying capacity of Braham Sarovar is determined by a maximum number of visitor's presence at one point of time, it can help in management of the crowd during important events by limiting the number of visitors. Required data like time and space were collected through field visits and interview of 50 pilgrims/visitors in November, 2014 during the occasion of *Geeta Jyanti* (Table 2).

To evaluate the physical carrying capacity of those zones which are used by pilgrims on different occasions, formulas applied by IUCN as mentioned in methodology is adopted for each zone separately (Table 3). Accordingly, physical carrying capacity was calculated for different zones such as shallow water zone, covered shallow water zone, pedestrian movement zone, covered zone and parks zone as 3, 24, 249; 44,112; 1,30,242; 27,481 and 41,450 persons/day respectively. Thus, the maximum number of pilgrims that Braham Sarovar physically conserves is about 5,67,534 persons per day. Comparatively, KDB estimates the upper limit of pilgrims of around 4-5 lakh in a big fair (Figure 3).

Sr. No.	Land Use	Area (m <sup>2</sup> )	Sr. No.	Land Use	Area (m <sup>2</sup> )
1	Deep water zone	411761.23	14	Multi art culture center	21434.66
2	Shallow water zone	36846.58	15	Parks	113047.07
3	Covered shallow water zone	5373.75	16	Police station	1634.60
4	Pedestrian Movement zone		17	Restaurant	160.61
5	Covered zone	19976.72	18	Road	78383.96
5.1	Cell size under covered zone	3.1 × 5	18.1	Dividing Road of Braham sarovar	3975.35
6	Main gates	275.25	18.2	Circular road	74408.61
7	Entry points	2809.37	19	Stage	279.72
8	Auditorium	2863.61	20	Religious Points	33052.21
9	Chariot	936.96	20.1	Temples in BS	2936.64
10	Footpath	2829.07	20.2	Temples in Outer periphery	30124.57
11	National flag	268.26	21	Toilets and bathrooms	26750.74
12	Parking	36512.47	22	Vacant Land	220714.89
12.1	Attached parking	5286.71	23	Vegetation Cover	37123.94
12.2	Road cross parking	31226.76	24	Museum and Library	16356.69
13	Forest Office	536.72	25	Water Works	23742.78
Total					1141054.74

Table 1: Braham sarovar: Land use/Land cover. Source: Quickbird satellite imagery.

Zones	Usage	Average Space (m <sup>2</sup> )	Average Time
Shallow water zone	Bathing	2.5	30 minutes
Covered shallow water zone	Bathing for Females	2	40 minutes
Pedestrian movement zone	Walking	2	2 hours
Covered zone	Staying	4	2 hours
Parks zone	Relaxation	10	3 hours

Table 2: Braham sarovar: space and time for different zones. Source: Field survey and questionnaire, 2014 use of covered zone (only by ladies) need more time for bathing due to congestion of entry/exit points and space.

Zones	Derived PCC(A×V/a×Rf)	Carrying capacity (Diurnal)
Shallow water zone	36846.58×1/2.5×11/30÷60	3,24,249
Covered shallow water zone	5373.75×1/2×11/40÷60	44,112
Pedestrian movement zone	47360.77×1/2×11/2	1,30,242
Covered zone	19986.72×1/4×11/2	27,481
Parks	113047.07×1/10×11/3	41,450
		total= 5,67,534

Table 3: Braham sarovar: carrying capacity estimation.



Figure 3: Braham Sarovar: On the Occasion of "SomavatiAmavassya".

Source: Field Survey.

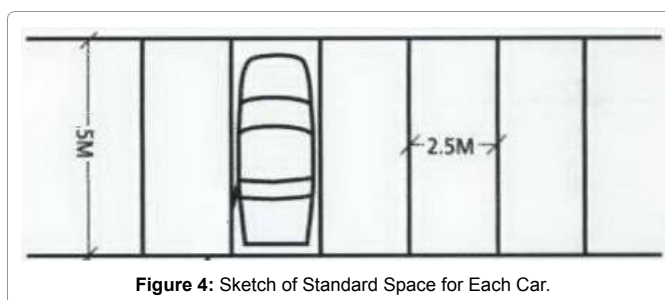


Figure 4: Sketch of Standard Space for Each Car.

### Parking capacity

Large gathering of tourists during specific auspicious occasions usually creates traffic chaos in the city. Hisar-Yamunanagar road is the life line of the city. Most of the traffic plying between these two cities also passes through this route. However, construction of the flyover on Bram sarovar Bye-pass road has relived some of this load. Moreover, increase in number of vehicles on important events creates additional demand for parking. Therefore, parking space is also one of the major problems on such religious spots. The standard size of a car parking by IRC norms is approximately 5 metres by 2.5 metres with suitable clearances all round (Figure 4).

In the context of Braham Sarovar, destination has sufficient space for parking. Table 4 gives an estimation of space required for a specific vehicle type to calculate the carrying capacity of the destination. The destination provide parking space for one type of vehicles are 2920 (car and taxis), 1489 (LGV), 948 (MGV/HGV), 651 (container), 868 (coaches and buses) and 1521 (light buses) per day at a time.

### Toilet capacity

Toilet is most essential basic facilities to serve the needs of every passerby. There is large share of floating population on any religious occasion on the destination. The details of public utilities or facilities on destination are given in Table 5. Around 23 blocks of toilets and bathrooms are made for pilgrims, separate for both ladies and gents, 22 of these blocks are made along the covered zone/cell and 1 is made at the center of the destination for the visitor's convenience.

Present study has adopted guidelines by ministry of urban affairs and employment for the calculation of requirement of toilet seats, bathrooms and urinals (Table 6). According to the carrying capacity, destination should have 5655 toilets (permanent or temporary), 8217 bathrooms and 1015-1692 urinals to fulfill the demand of pilgrims at peak events. Presently, these are 270 and 350 respectively. Further, there are 172 bathrooms for males and females separately and 100 urinal points. Many temporary toilets are installed at open spaces in east direction nearby Braham Sarovar during the main occasions. Thus it requires additional 5055 toilets, 7763 bathrooms and 1035-1791 urinals of temporary nature on any major event like solar eclipse or *Somvati Amavassaya*.

### Footpath capacity

Braham Sarovar is divided into two equal parts by a road which egress through the center of the destination (Figure 2). This road has around 2.5 metres footpath on both side. The guidelines given by IRC: 86-1983 are considered for calculating the carrying capacity of this footpath. Since there is no restriction on the movement in the Braham Sarovar premises, pilgrims are freely to move in any direction. Therefore, 2400 persons can move per hour in both directions per 2.5 metre width of footpath.

### Makeshift arrangement for basic services

Present study tries to identify some suitable sites which can be used for mentioned purposes as depicted in Figure 5. Study tries to define thresholds of destination for tourism sustainability. The surrounding vacant lands have an important role at a religious place for better management to avoid miss-happenings and for smooth movement and pilgrim's comfortable stay at destination.

In the north direction, a big space of 58,140.3 m<sup>2</sup> area named as theme park (shown with yellow colour) can be used for medical facilities, temporary huts and provision for food or free community lunch, locally called as *bandaras*. To accommodate pilgrims, temporary settlements i.e. tents and temporary toilets should be developed nearby destination and study purposed adjoining open space of 1,09,672 m<sup>2</sup> (show with orange colour) in eastern direction to the destination. It is also appropriate location for parking ambulance and fire brigade vehicles. VIP parking should be in south direction which provides

Types of parking space	Parking Standard in Metres				Parking Space of Braham Sarovar				Total capacity of specific vehicle types
	Length	Width	Minimum headroom	Total (L×W)	Attached		Road-cross		
					Area (m <sup>2</sup> )	Carrying capacity	Area (m <sup>2</sup> )	Carrying capacity	
Private cars and taxis	5	2.5	2.4	12.5	5286.71	422	31226.76	2498	2920
Light Good Vehicles (LGV)	7	3.5	3.6	24.5		215		1274	1489
Medium/Heavy Good vehicles(MGV/HGV)	11	3.5	4.7	38.5		137		811	948
Container vehicles	16	3.5	4.7	56		94		557	651
Coaches and buses	12	3.5	3.8	42		125		743	868
Light buses	8	3.0	3.3	24		220		1301	1521

Table 4: Braham sarovar: carrying capacity estimation of parking. Source: Calculated as per IRC Norms.

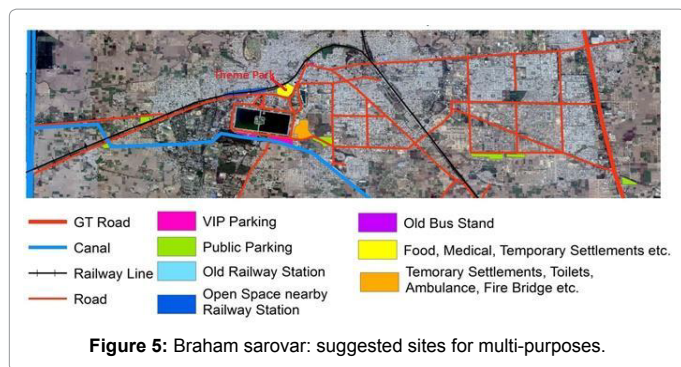
Facilities	Quantity
Total ladies toilets	350
Total ladies bathrooms	172
Total gents toilets	270
Total gents bathrooms	172
Total urinal	100
Total drinking tap water point	55
Total water cooler	7
numbers of workers(sweepers)	67
pump house	3

Table 5: Braham sarovar: numbers of facilities. Source: Kurukshetra Development Board.

Type of toilets and Recommended areas	Toilets seats	Bath units	Urinal units
Public toilet (may be used at all hours)	one seat per 100 users/day	one seat per 70 users/day	one unit per 300-500 users/day
Optimum Size (mm)	900×1200	1050×1200	575×675

Table 6: Norms for toilets and bathrooms.

Source: Guidelines for Community Toilets, 1995, Ministry of Urban Affairs and Employment, Government of India destination has large number of permanent toilets facilities both for males and females separately.



sufficient space with an area 72,875.1 m<sup>2</sup>. There is need for extra public vehicle parking (mainly buses) and it should be far away from the destination's periphery area to avoid congestion in the city. Study purposed different locations on Kaithal road and Pehowa road in western direction, nearby vegetable market (*sabji-mandi*), nearby HUDA sectors and on national highway 1 in eastern direction as shown by green colour in Figure 5 to relieve the traffic jam situation on big occasion.

## Conclusion

The concept of carrying capacity is a useful approach for sustainable tourism management and assessment and implementation of carrying capacity is particularly important for Braham sarovar. Unique mythological background made it one of the most attractive destinations of India and a huge number of pilgrims visit this destination during sun-eclipse. The physical carrying capacity of the destination is 5,67,534 persons and around 2,920 cars at a time which provide a good parking capacity. Basic facilities of a destination like toilets, water, accommodation, security and the like are sufficient at this place for normal days but need to install more such facilities of

temporary nature to fulfill peak demand during important events like sun eclipse.

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