RESEARCH ARTICLE

TOURISM CARRYING CAPACITY ASSESSMENT FOR LEH TOWN OF LADAKH REGION IN JAMMU AND KASHMIR

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ARTICLE INFO	ABSTRACT
	The growth and expansion of tourism are a complex phenomenon and requires multiple pronged approaches to study its various dimensions to consider sustainability limits. Leh district in the state of Jammu and Kashmir, India is blessed with adventurous topography, rugged terrain, narrow valleys, high altitude lakes, lofty mountain peaks, extensive glaciers, unique wildlife and traces of original Buddhist culture are mostly confined to this region. In this entire vast area of wilderness only this town has been equipped with all modern facilities therefore it used as the base camp by the ever-increasing tourist flow. Over the year's tourism activities in Leh town have been growing rapidly as a result the local population of the town is outclassed by the number of tourists most of year. The magnitude of anthropogenic pressure goes beyond the natural coping capacity of the town because of huge amounts of ground water extraction and the generation of enormous quantity of solid and liquid waste. Currently the town does not have a proper drainage and solid waste management system resulting in various social and environmental concerns which has threatened the whole tourism industry and hence the livivelihood of the local residents is at stake. Therefore, appropriate planning measures are needed to prevent further degradation of quality of tourism. The objective of this article is to develop a methodology to assess the growth limits of tourist destinations by establishing various mathematical formulae to calculate carrying capacity of several tourism activities. The results of this study could be used as the preliminary benchmarks for sustainable tourism planning for the town.

INTRODUCTION

In recent decades the growth and expansion of the tourism industry is a highly complex experience which needs a multiple descipilanary approach to study (Ritchie and Crouch, 2004). There are many authors who described the evolution and development of tourism. In this regard, Jafari (2001) describes his four platforms based on advocacy, cautionary, adoption and knowledge for understand tourism development. Later on, two additional platforms (sustainability and ethics), were included by Mac Beth (2005). So far as the concept of sustainability is concerned, it refers to a political concept which is a complex one and is associated with limited growth, due to some implications on economic development the idea of the limit is usually avoided. The debate on the limits of growth in tourism sector has started in 1930s (Saveriades, 2000). In this direction the first experiments were conducted in the

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1960s in a natural parks inside the United States. In 1980s, the main focus was on analyzing the impact of tourism and on reducing the negative effects through the modification of tourism policies (Gossling and Hall, 2005). When the concept of sustainable development arose in relation to tourism in 1990s, this concept was related to the carrying capacity because the idea of sustainability implies a limit and both concepts share the same difficulties so far as the formulation of the ideas, practices, utility and diversity of types (Saarinen, 2006). The problem has not arrived at because the prevailing economic ideology denied the existence of limits. Within the concept of carrying capacity the study of limits has a long tradition in geography, sociology, forest sciences, and biology (McCool and Lime, 2001) for a particular destination it provides specific answers, as reported by Cifuentes *et al.* (1999) in Costa Rica's Protected Natural Areas. There are many definitions and opinions on carrying capacity (Garrigos Simón, Narangajavana, & Palacios Marques, 2004; Saarinen, 2006). Some definitions focus on biophysical and resource thresholds while as others are more behavior oriented and
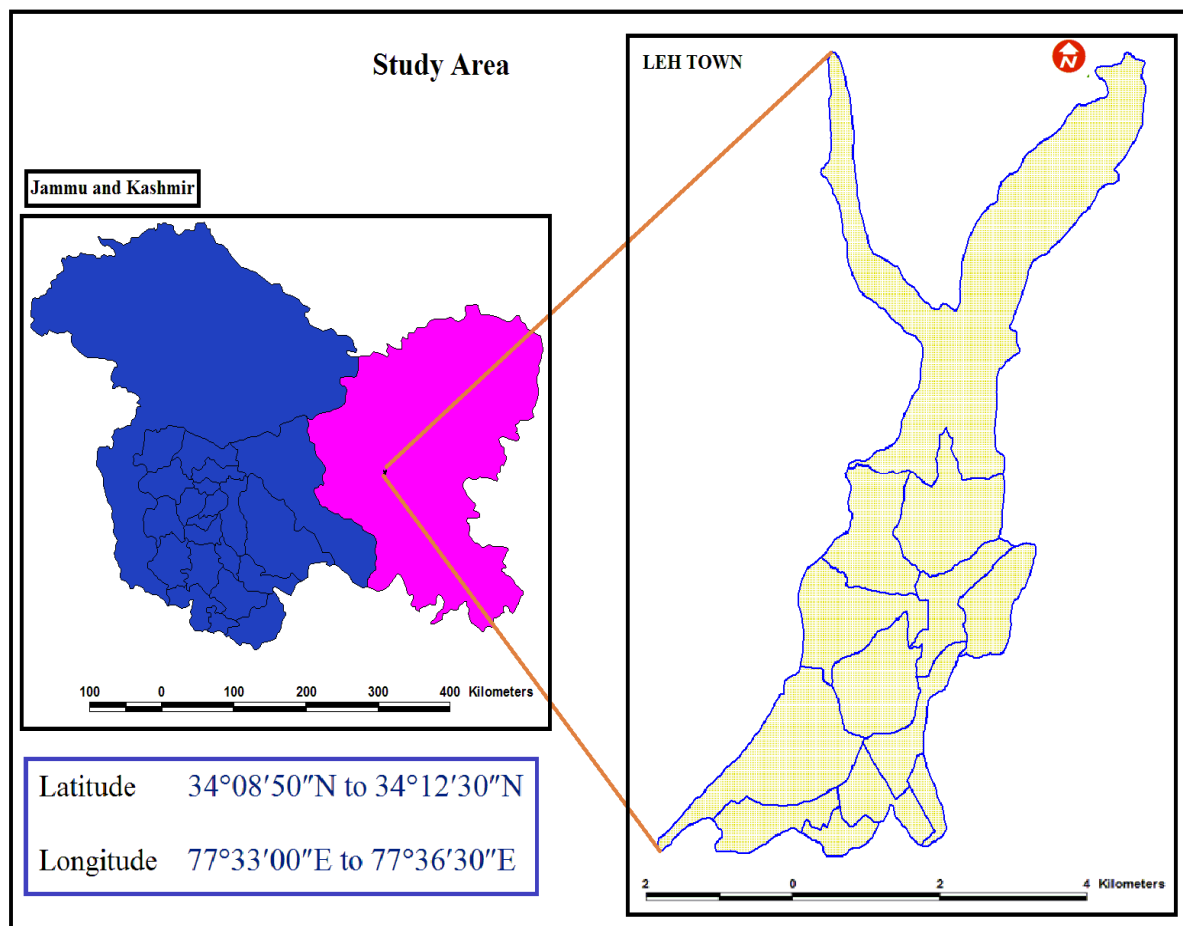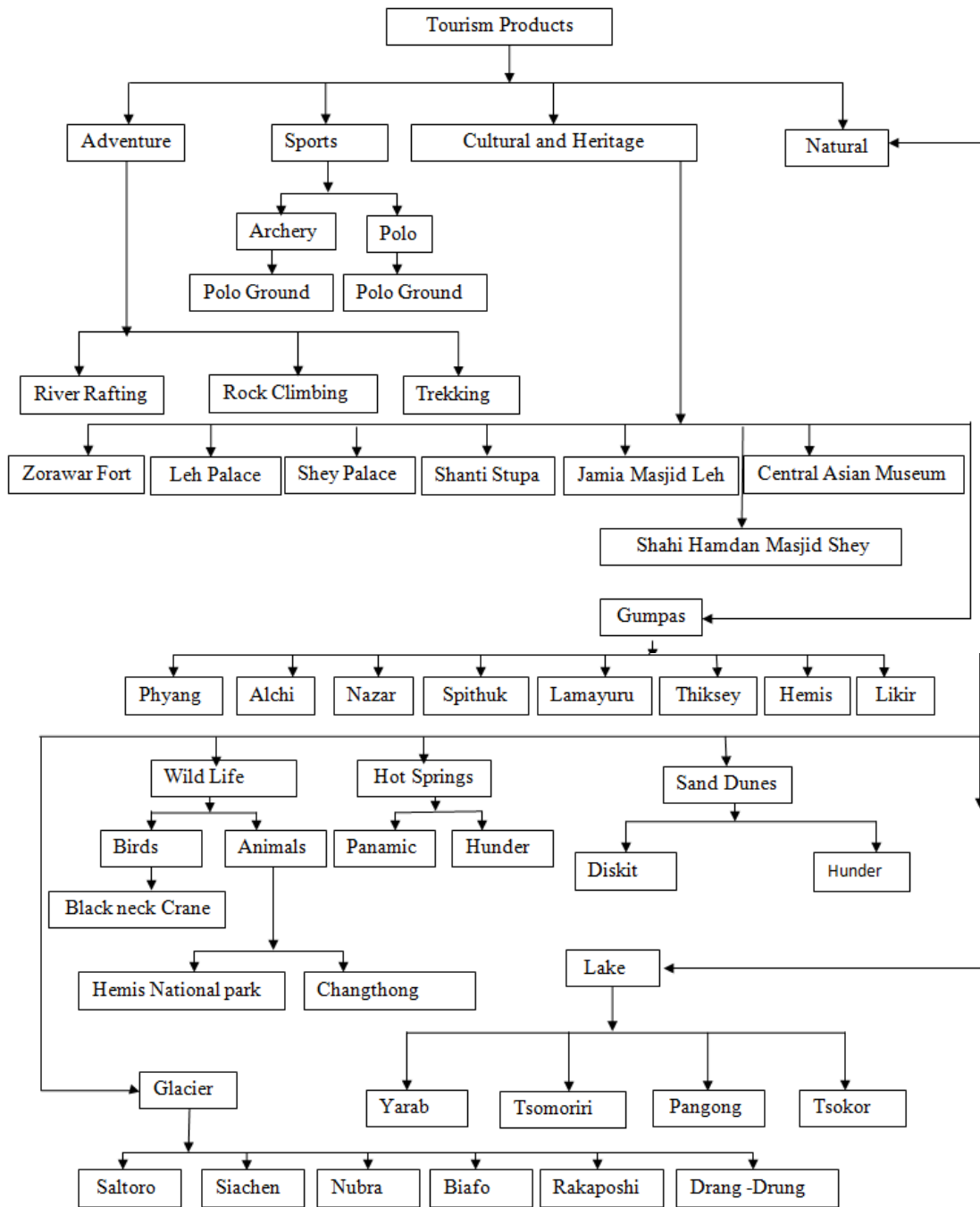
reflect the quality of the recreational experience, (Saveriades, 2000). The World Tourism Organization defines carrying capacity as "the maximum number of people that can visit a tourist destination at the same time, without causing destruction of physical, economic or social-cultural means and an unacceptable reduction in the quality of the satisfaction of visitors" (PAC/RAC, 2003). Thus, different types of carrying capacity limits exist for different types of study. The threshold established by residents and tourists is different, and both differ from ecological limits. This was reason that for a magic number which was not possible has obstructed the development of the concept of carrying capacity for a long time, the proposal for the use of alternative tools, such as visitor experience and resource protection and 'limits of acceptable change' (McCool & Lime, 2001). There is an interest in presenting theoretical and practical advances in scientific research for example, the systematization that Saarinen (2006) applied to sustainability limits, proposing three approaches that have guided studies according to different epistemological perspectives and different ontological ideas. They are, carrying capacity based on resources protection, developer's perspective based on changes in tourism activities and the community based traditions of sustainability focus on the selection of limits through the participation of share capital. The aim of this article is to develop and apply a methodology to assess the growth limits of tourist destinations. This method is then applied to management and planning. There are two developments in this research, the first one is related to the fact that the application is not restricted to either a nature reserve, which is protected by the policy or to an island, which is geographically controlled at entry and exit points.

The study focuses on an open mountainous area based on mass tourism. The Second one, this new way of assessing growth limits uses a flexible formula adaptable to other areas also, e.g., rural, natural, and urbanized depending on the impacts generated by the tourism and the objectives specified by destination managers. The investigation also presents an answer to Saarinen's (2006) conceptual reflections and contributes to an experimental approach for proposed growth limits and formulates fundamental principles. The main aim of the present study is to devise a methodology for the calculation of the carrying capacity of the mountain areas especially for Leh town.
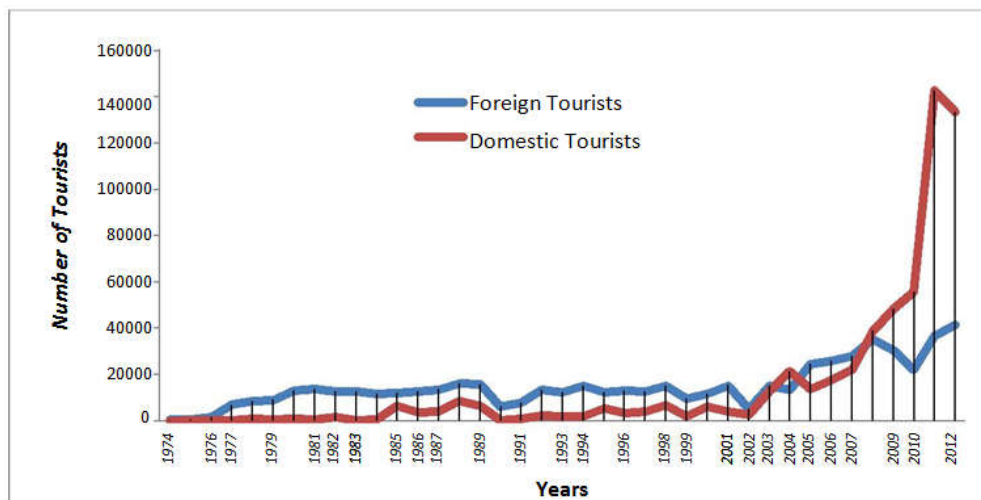
Study Area

Leh town is situated between 34°08′50″ to 34°12′30″ North latitude and 77°33′00″ to 77°36′30″ East longitude and altitude ranging from 3100 to 3600 meters above sea level. The town is situated on the right bank of Indus River. The town has a population of 30870 (Census 2011), covers an area of 9 Square Kilometers (Municipal Commute Leh 2011). The climate of Leh (Ladakh) is not only arid due to lack of precipitation, but it is very cold in winter, while as summers are generally warm. There is a huge diurnal range of temperature, which is an inherent characteristic of desert climate, the average monthly minimum temperature is about -15.39°C in January, and while as the average maximum monthly temperature is 25.08°C in the month of August (DHAR 2012). The Leh town was founded by Sengee Nemgyal in the 17th century (Janet Rizvi 1996). Leh was an important halt point of the historical Silk Road.

Growth of Domestic and Foreign Tourist flow

Source:-Department of Tourism Leh.

The tourism driven urbanization is a recent phenomenon in Leh and hence fragile landscape is being deteriorated by resultant economic activities. As such the town has become vulnerable to various risks like ground water depletion, shrinkage of agriculture land and food security on account of shifts in land use.

Tourism Potential of Leh

Leh is a remote area of Jammu and Kashmir State; this area remains cut off from the rest of the world for almost six months in a year. Leh is culturally rich, traditions and rituals have remained intact to a large extent. This area is still in its originality in all spheres of life. This region is rich in its architecture, their monasteries, housing patterns, food habits, and the dress and clothing patterns. Besides the natural landscapes, which are favourable for mountaineering and trekking, this cold desert area distinguishes itself from the rest of the region. These features attract tourists from the whole world to see the culture of this remote area which is still preserved in its original, to analyse how people in these areas having high altitude without sufficient water and food and cold climatic conditions live. They come to observe how they preserved their culture till now, what they eat, what they wear and more importantly how they celebrate their festivals.There are some famous tourist places like Leh Palace, Shanty Stupa, Central Asian Museum, Jamia Masjid, Old historic buildings, Stupas, Monasteries, Forts, etc. Few of the tourist products are outside the Leh town which includes important tourist destinations like monasteries, lakes, landscapes which add to the beauty of the whole region of Ladakh. The tourism products which are having the great tourism potential are mentioned below.

Growth of Tourist Arrivals

After opening for tourists, Tourism is rapidly transforming Ladakh region, the number of both international and national visitors were rapidly rising every year, e.g. from 527 tourists in 1974 to over 179491 tourists in 2011 with 55685 domestic tourists and 22115 international tourists. Since only in 1990 there has been a sharp decline in the tourist flow because of disturbances in Kashmir valley. But from 1991 tourist flow to Leh shows an increasing trend. There are two major dips in 1999 because of Kargil war and in 2002 after 11 September 2001 and parliament attack.

As the in the above figure shows from 2002 onwards the rate of increase in tourist inflows rises significantly, in case of both foreign as well as domestic tourists. The even steeper increase after 2006 is attributed to the large increases in the inflow of domestic tourists. This sudden increase in Indian tourists could be due to a number of factors like the increase in services consumption by the rising Indian middle class, an increase in the number of flights to Leh, the introduction of tour packages from online travel companies such as *Makemytrip.com* and perhaps most visibly due to the increasing number of Indian films being shot in the different tourist locations in Ladakh. The more than two-fold increase in tourist flows from a total flow of 77,800 tourists in 2010 to 179,491 tourists in 2011 is attributed by many to the extremely successful 2009

Bollywood film *3 Idiots*, parts of which were shot in Ladakh. In addition, the flash floods of August 2010 in Ladakh led to a slight fall in tourist inflows in that year, but could also have played an important part in garnering an increased number of tourists the following year in support of the local economy. The above figure also depicts the downward trend in the foreign tourist arrivals during 2008-10 which can be attributed to the 2008 global financial crisis. However, Indian tourist arrivals continued to increase during this period as the Indian economy was still able to grow since it is not as depend on global flows of trade and capital as most other countries.

Need and importance

Leh is emerging as one of the important tourist towns on the famous silk route. Leh is a cold desert climate, which has not allowed to develop any economic activity properly; like agriculture, has not flourished except some parts of the town and adjoining areas which is the main economic activity of our country. But the tourism is slowly developing there as a main economic activity. As the entire district is blessed with adventurous topography, rugged terrain, narrow valleys, high altitude lakes, lofty mountain peaks; extensive glacier, unique wildlife and traces of original Buddhist culture are now confined this region only. In this entire vast area of wilderness only Leh town has been equipped with all modern facilities therefore it used as the base camp by the ever increasing tourist flow. Leh being now the hub of tourism has experienced a phenomenal increase in tourist flow over the years. The total number of tourists visited Ladakh in the year 1985 was 18911 which increased to 179491 in 2011. At the same time, the number of tourist infrastructure including hotels, restaurants and guest houses have also increased at a rapid pace. The changing lifestyle of its dwellers, growth of tourist infrastructure has resulted in the exploitation of the environment, social and cultural values. As a result, during peak tourist season the local population of the town 30870 out classed by the number of tourists. The magnitude of anthropogenic pressure goes beyond the natural coping capacity of the town because a huge amount of ground water extraction, quantity of solid and liquid is enormous. Currently town does not a drainage system for laid waste nor has proper solid waste management as a result various social and environmental concerns have taken birth. Sustainable tourism development is a positive approach intended to reduce the tension and friction created by the complex interaction between various components of the tourism industry, viz visitors, the environment and the communities. It is an approach, which involves working for the long term viability and quality of both natural and human resources (Gupta and Dikshit, 2003). Sustainable tourism development can be thought of as meeting the needs of present tourist and host regions, while protecting and enhancing opportunities for the future (Brundland report, 1987). According to a Global 90s conference on sustainable development, the management of tourism should be such a way that it fulfils economic, social and aesthetic needs while maintaining cultural integrity, essential ecological process, biological diversity and life supporting system. The present study is undertaken to develop a methodology to assess the growth limits of tourist destinations by establishing various mathematical formulae to

calculate carrying capacity of several tourism activities quantitatively. The results of this study could be used as the preliminary benchmarks for sustainable tourism planning for the town.

Objective

The main aim of the present study is to devise a methodology for the calculation of the carrying capacity of the Himalayan tourist town of Leh.

MATERIALS AND METHODS

The material and the data regarding the present work were collected from both primary as well as secondary sources. The primary data was collected during the field survey through a questionnaire. Three questionnaires were devised for this purpose, so that the clear picture of the tourism industry of the area regarding its carrying capacity will come out. The first questionnaire was related to know the perception of the tourists regarding the facilities available as well as the behaviour of the host population towards them. The second questionnaire was related to know the perception of the local population towards the tourism benefits well as the losses and the third one was related to the infrastructure in which the researcher was trying to know about the facilities available for tourists at different places and in different accommodation units. This whole data was collected through 1500 questionnaires, 500 each category. Apart from this the secondary data was collected from literature survey as well as from the different departments working in the area like census, meteorological, transport, tourism etc. the whole data set was initially analysed through the quantities techniques. The methodology used in the present study for the calculation of the carrying capacity of the Leh town is basically a modification of the some of the formulae of Cifuentes and Ceballos – Lascurain used for the calculation of the carrying capacity of the Phyang region of the Vietnam. The tourism carrying capacity of the Leh town calculated through the below mention mathematical formulas

I. Calculation of User Density

This was done by calculating the following:

a) Resident Population Density (βRP): This was deriving by dividing the existing resident population of the tourist town by its area in hectares excluding the agriculture land, wasteland and plantation area.
= 30870/294
= 105 P/ (ha.)

b) Domestic Tourist Density (βDT): This was derived as follows:

Step 1. Domestic Tourist Arrival (TD): Domestic tourist arrivals during peak season (days) was determined
Domestic tourist arrival during peak season (days) =116449

Step 2. Domestic Tourist Stay Days in Peak Seasons (TDSP): Domestic tourist arrival was multiplied by average number of days of tourist stay at that tourist town.

TDSP = TD * Stay Average Days
=116449*3
=349347

Step 3. Average Number of Tourist Staying Per Day during Peak Season (αDSP):
This was evaluate by dividing the number of tourist stay days per season by the number of days comprising the peak season

αDSP = Stay Average Days / Days Peak Season

=349347/120
=2911

Step 4. Domestic Tourist Density (βDT): This was evaluated by dividing Average number of tourist staying per day during peak season by area of tourist town in hectares excluding the agriculture land, waste land and plantation area.

βDT = αPS / Area
= 2911/294
= 10

c) Foreign Tourist Density (βFT): This was derived as follows:

Step 1. Foreign Tourist Arrival (TF): Foreign tourist arrivals during peak season (days) was determined
Foreign tourist arrival during peak season (days) = 28368

Step 2. Tourist Stay Days in Peak Seasons (TFSP): Foreign tourist arrival was multiplied by average number of day of stay for tourist at that tourist town.

TFSP = TF * Stay Average Days
= 28368*5
= 141840

Step 3. Average Number of Tourist Staying per Day during Peak Season (αFSP):
This was evaluating by dividing the number of tourist stay days per season by the number of days comprising the peak season.

αFSP = Stay Average Days / Days Peak Season
= 141840/120
= 1182

Step 4. Foreign Tourist Density: This was evaluated by dividing Average number of tourist staying per day during peak season by area of tourist town in hectares excluding the agriculture land, waste land and plantation area.
βFT = αPS / Area
= 1182/294
= 4.0

Aggregate Peak Tourist Density (APTD) = Domestic Tourist Density +Foreign
Tourist Density
APTD = βDT + βFT
= 10 + 4
= 14

Global Tourism Organization defines the carrying capacity as follows: a certain level of use by visitors in an area who can accumulate in a certain time and place (Buckley, 1999). In tourism development planning, for carrying capacity of two main elements are considered, including a moral element that determines the quality of the experience achieved by the visitors or tourists, and biophysical element which determines natural and physical quality of the recreational area considering the manner of tourists? Accordingly, three kinds of carrying capacity have been considered, including physical carrying capacity (PCC), Real carrying capacity (RCC) and Effective carrying capacity (ECC) in introducing the methodology by International Union for Conservation of Nature and Natural Resources to estimate carrying capacity of natural areas for tourism purposes (Worboys *et al*., 2005; Zeng, 2007).

II. Physical Carrying Capacity (PCC)

Definition: PCC is the maximum number of tourists that can physically fit into or onto a specific area, over particular time: The physical carrying capacity of Leh Town was determined by the equation

$$PCC = A*D*Rf$$

Where PCC is the physical carrying capacity, A is the size of the tourist area or the area available for recreation, D is tourist density (tourists per hectare) and Rf is the rotation factor. The total area available for tourist activities in Leh town is 294 hectares, while the tourist density was 14 persons per hectare. The rotation factor is calculated as the ratio of open hours for recreation and the duration of the visit. For Leh town the value of rotation factor is 1. Therefore the physical carrying capacity of the town was calculated as 4116 persons per day.

III. Effective Real Carrying Capacity (ERCC)

Definition: ERCC is the maximum number of tourists that is permitted by the local conditions and management capacity without influencing the tourists' demand:

$$ERCC = PCC - Cf1 - cf2 - cf3 - \ldots - cfn)$$

Where ERCC is the effective real carrying capacity, PCC is the physical carrying capacity and Cf (corrective factors or limiting factors) are factors, which have a negative impact on tourism activities and assessed by limiting threshold, which used for identifying the impact level of a factor (%):

$$ERCC = PCC \ x \ 100 - cf1/100 \ x \ 100 - cf2/100x \ldots ..x \ 100 - cfn/100$$

The correction factors is determined by using the Equation
$$Cfx = 1 - (Lmx/Tmx)$$

Where Cfx is the correction factor of variable x, Lmx is the limiting magnitude of variable x and Tmx is the total magnitude of variable x. Considering that tourism is dependent upon the physical, economic and social attributes, four correction factors were considered for this study because of their limiting power in the tourism activity, faculty of analysis and because of enabling the measurement of the sustainability level of a tourist destination. These are weather, infrastructure, transport and waste management limiting factors. In which the condition of the infrastructure, transport and the waste management were evaluated on the bases of the perception of the tourists as well as the local people

Weather Limiting Factor: - During the year, the climate of the area remains very cold, almost five months (from November- March) and limited the number of tourists.

Almost no tourists, who were asked, want to visit this place during this period. Therefore, weather factor was taken as a limiting factor:

Lm: 150 days (five months Nov- March)
Tm: 365 days (one year)
Limiting factor for weather (Cf1):
Cf1= 150/365= 0.41 (41.09%)

Transport Limiting Factor: The questionnaire was used for transport availability and quality assessment. The respondent chosen for the survey was the tourists.

Unavailability of transport is a problem with the high altitude that is why transport is taking as a limiting factor.

Cf2= Number of respondents satisfy with transport/ Total respondents survey
= 70/200= 0.35 (35%)

Accommodation Limiting Factor: The questionnaire was used for Accommodation availability and quality assessment. The respondent chosen for the survey was the tourists. The accommodation sector of this area is not up to the standard of the developed nations. That is why the accommodation is taken as a limiting factor.

Cf3 = Number of respondents satisfy with the accommodation facility/

Total number of the respondent's survey.
= 72/200- 0.36 (36%)

Waste Management Limiting Factor

The questionnaire was used for assessment of waste management system. The respondent chosen for the survey was the tourists.

The Leh is a tourist town; with the increase in the number of tourists, the production of waste also increases, which results the accumulation of waste on the roadsides producing a foul smell unbearable for some of the tourists. Therefore, waste management system taken as a limiting factor.

Cf4 = Number of respondents satisfy with waste management system/ Total number of respondents.

Cf4 = 88/200= 0.44 (44%)

RESULTS AND DISCUSSION

The effective real carrying capacity of the tourist destination has been estimated 566 visitors /day. It was found that tourist flow is well below carrying capacity at Leh during the months of November to April. The present threshold of carrying capacity has been applied for seven months from November to April. Host of controlling parameters including the level of tourist infrastructure development in consonance with the native ecological concerns for ensuring the sustainability of tourism development determines however, the threshold was flexible as its range. The concept of carrying capacity is a complicated one which shows the relationship between visitor and environmental conditions. It means that, increase of the number of visitors causes the occurrence of more damaging environmental impacts such as soil compaction, reduced soil surface and vegetation density. Gradually, social aspects of carrying capacity, such as experience and quality of visiting were considered. For instance, we can mention to the initial understanding of carrying capacity in recreational areas which can be estimated by ecological view and based on resources degradation, but it was found very soon that, human values must be considered in this view seriously. This theory was based on this matter that, by increasing of visitors in a region, not only the quality of natural resources is affected, but also recreational quality of the visit of the region will reduce due to social and psychological effects of population density, collisions and the resulting stress (Shelbay and Heberlein 1986, Kuss *et al*., 1990, Manning 2002). Same was the case with this study that is why we have included the limiting factors, both the natural, social and the psychological in our methodology.

Conclusion

There are a number of methodologies developed by the many authors for the evaluation of the carrying capacity of the different area. In this paper, we have also developed a methodology for the evaluation of tourism carrying capacity. The tourism carrying capacity assessment method used in this article is mainly based on general equations which proposed by different authors like Cifuentes and Ceballos - Lascurain we have modified the mathematical equation so that it will be suited for our area. We have also used the three levels of tourism carrying capacity: Physical Carrying Capacity (PCC), Real Carrying Capacity (RCC) and Effective Carrying Capacity for better understanding about the carrying capacity of the Leh town. The effective real carrying capacity of the tourist destination has been estimated 566 visitors /day. It was found that tourist flow is well below carrying capacity at Leh during the months of November to April. The present threshold of carrying capacity has been is applied for seven months from November to April.

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