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MEASUREMENT OF CARRYING CAPACITY OF TOURIST DESTINATIONS: A CASE ANALYSIS

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Abstract

The fact that tourism has the ability of attracting exchange earnings in leaps and bounds often leads to promoting it to unsustainable levels. Natural Calamities which have their genesis in excessive tourism have reinforced that the framework of tourism carrying capacity is reviewed and strengthened and made a mandatory part of Tourism Planning. This requires that the concept, critique and the existing frameworks of carrying capacity are studied.

This paper attempts to analyse the above requirements, list out the various components and methods of measurements of carrying capacity and suggest a combination of the appropriate approaches to measure tourism carrying capacity for different destinations.

Keywords: *Tourism, Measurement, Carrying Capacity, Requirement, Approach, Planning, Driver*

INTRODUCTION

Tourism has emerged as a major contributor of many economies. It is a key driver of socio-economic progress through creation of jobs and infrastructure. Tourism has also been the focus of developing countries as it is one of the main sources of foreign exchange income. However, tourism is a phenomenon which is extremely sensitive to the environment and ecosystem. Excessive tourism results in tremendous pressure on tourist destination due to demands made on environmental resources and accelerated urbanization. The rapid but unplanned exploitation and utilization of the resources creates a risk of losing their recovery capacities, and destroying the basic functionalities within tourism areas (Nghi et. al., 2007).

Places of natural beauty and those with diverse flora and fauna attract tourists in masses; however, excessive tourism creates exploitation of these resources which leads to environmental degradation which in turn affects tourism by reducing the attractiveness of the destination. This phenomenon can be summarized as '(Excessive) tourism kills tourism'. Briassoulis(1992) in his paper on 'Environmental impacts of tourism' has explained this phenomenon precisely. He states 'Tourism is a multifaceted economic activity which interacts with the environment in the framework of a two – way process. On one hand, environmental resources provide one of the basic 'ingredients', a critical production factor, for the production of the tourist products: the natural and / or man – made setting for the tourist to enjoy, live in and relax, on the other hand, tourism produces a variety of unwanted by – products, which are disposed, intentionally and unintentionally, to and modify the environment; the case of negative environmental externalities.' Recently, a fear in the local community that it might be swamped by excessive tourism, have led the local administration of Cinque Terre, a small town of Italy which comprises of 5 picturesque villages, to fix the maximum number of tourists to the town and reduce tourism to more sustainable levels.

Thus, tourism needs to within the 'tolerance limits' in order to be sustainable. The 2 - way interaction of tourism with ecology / environment makes management of visitor flows to a destination important from planning perspectives. The 'limits' within which tourism (flow)needs to be restricted so that the system can sustain the stress and not lose its inherent state is the genesis behind the concept of 'carrying capacities'. In literature there exist many definitions of carrying capacity given by institutions as well as individual authors. According to the United Nations World Tourism Organization (UNWTO) the carrying capacity is fundamental for environmental protection and sustainability. Namely, it stands for the maximum number of people that may visit a tourist destination at the same time, without causing destruction of the physical, economic, socio-cultural environment and an unacceptable decrease in the quality of visitors' satisfaction. Federation of National Parks of Europe (FNNPE, 1993) defines carrying capacity as an ability of the ecosystem to self sustain and trigger development of human activities in an unlimited scope, with no negative feedback effects. Chamberlain (1997) and Middleton & Hawkins (1998) have also defined carrying

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capacity on similar lines. These definitions elaborate carrying capacity as the point at which a destination or attraction starts experiencing adverse effects as a result of the number of visitors. These definitions also characterise carrying capacity as a combination of its various types / components / determinants / dimensions like, physical, ecological, political, economic, social, psychological, etc. Each capacity type is characterised by a tolerance limit which marks a threshold of change which, if overrun, leads to mainly negative effects in tourism. If tolerance limits are not overrun, then the effects of tourism can in principle be said to be positive.[1] The individual dimensions / capacities are generally measured with the help of associated parameters and overall carrying capacity is determined as a suitable combination of individual capacities.

Due to its inter-related dimensions and lucid theory of estimation / quantification, the concept of carrying capacity has generated many a critics. Jerome Massiani and Giovanni Santoro (2012) have stated that the variety of definitions / dimensions of carrying capacity along with other limitations. They have also summarised the various critique of carrying capacity as follows: 'A first critique is that the elements on which the carrying capacity of a tourism destination is based are taken as stable, while they are often mutable. Another critique relates to the fact that the level of tourist experience quality is subjective, which makes any quantification of the touristic experience vain. A third critique relates to the feasibility of management measures: the level of control necessary to manage an area with the rules based on carrying capacity is likely to be impossible in the 'real world.' It has also been felt by them that as the level of carrying capacity inter – alia has effect on management of visitor flows and translates into determining traffic regulation, limits to free access, limits to specific activities, concentration or dispersion of tourist flows, land use, economic tools such as pricing / taxes, capacity building measures etc., it needs to be 'tailor made' to suit a particular destinations.

Despite the valid criticism, measurement of carrying capacity of tourist destinations still has a lot of takers due to its importance in tourism management and the fact that it is a multidimensional concept which has the flexibility of being adapted to suit the inherent conditions of the tourist destination. Over the period of time, the concept of carrying capacity has also evolved and shifted from the idea of determining a maximum number of users towards the achievement of desirable conditions and the identification of limits of acceptable change (Coccossis H., Mexa A., 2004). There are no set formulae which would be specific for a destination type, however, the framework for estimation of limits of carrying capacity are present. The parameters to be associated with different dimensions have also been well discussed by many researchers in their case studies.

Some recent natural calamities like the flash floods which occurred in Uttarakhand in 2013 and 2014 somehow hint at the fact that the local administration had turned a blind eye towards the ecological impacts of excessive tourism. Such calamities reinforce the need for integrating the concept of carrying capacity with tourism planning which in turn necessitates a review of the existing framework in place and is the motivation behind this study.

In the next sectiondifferent dimensions and parameters of carrying capacity have been listed. Apart from some contribution from the author's side this list is majorly based on the study of existing literature. In section 3 the notable methods of measurement of carrying capacity are discussed and in the subsequent section, i.e. section 4, a combinational approach of the existing methods has been suggested to assess tourism carrying capacity of a destination. It may be noted that the dimensions and parameters to account for determining the carrying capacity of a tourist destination are inter-related and a few parameters can sometimes be clubbed into more than one dimension.

DIMENSIONS AND PARAMETERS OF CARRYING CAPACITY

A wide range of theoretical parameters have been listed in this section. However, the choice of parameters should keep into consideration the size, ecology, geography, demography & socio-economic conditions of the destination being studied. For instance the parameter 'tourist inhabitant ratio' should not be taken for trekking destinations where there is no local populace.

Table 1: Dimensions and Parameters of Carrying Capacity

S. No.	Dimension	Definition	Parameters
1	Physical	The physical carrying capacity relates to existing infra-structural components like accommodation units, sewer-age, water supply, electricity, fuel supply, transportation, telecommunications, law & order, health services etc.	(To cover aspects of availability, adequacy as well as qual-ity) A. Tourism Infrastructure: • Accommodation • Transport • Trained Guides

S. No.	Dimension	Definition	Parameters
			• Tour Operators • Parking B. General Infrastructure: • Power supply • Water Supply • Fuel (Gas supply) • Telecommunications • Connectivity • Drainage • Health Services
2	Ecological	Ecological carrying capacity relates to the maximum use of a tourist resource without causing harm to the environment or altering it.	A. Ecological sensitivity and Bio diversity (CONSTRAINT) B. Ecologically supportive best practices C. Pollution D. Impact on Climate change E. Accumulation of solid and non bio degradable waste
3	Demographic	The Demographic carrying capacity relates to tourism encouraging phenomenon like excessive migration for economic purposes which inter – alia changes the demography of the resident society which may also not be desirable.	A. Levels of Inbound Migration for employment in tourist establishments B. Level of tourists
4	Political	The Political carrying capacity relates to the attitude of the administration towards tourism, whether it wants to promote tourism by investing in infrastructure projects and facilitative measures or it wants to delimit tourism by measures like taxing tourists.	A. The attitude of the administration towards Tourism B. Tourist Facilitation measures C. Land use conflicts
5	Economic	Economic carrying capacity relates to the level of acceptable dependence between the local economy and the level of the tourist development of a place, which should never become too heavy. Developed and diverse economies are generally more adaptable to tourism demands.	A. Employment Pattern B. Employment generation C. Altered urban structure
6	Social	Social carrying capacity relates to the reaction of the local people to the tourist development of the place, which should never be negative. Smaller communities may especially experience dramatic social consequences due to excessive tourism development.	Effect of Tourism felt by the local residents on: A. Safety and Security B. Crowdedness C. Livelihood opportunities D. Inflation of rented accommodation, transport facilities, etc. E. Lack of community spaces F. Degradation of the socio – cultural values imbibed in the local community. G. Tourism monoculture
7	Cultural	Cultural carrying capacity relates to conserving the cultural heritage like monuments, arts and craft which are indigenous to the destination. Tourism on one hand may promote art and craft but over tourism may also endanger the protected monuments of the destination. Instances may also occur where communities and craftsmen involved in local arts and crafts may consider their occupation a low return generating one and may move to other general touristic establishments.	Effects of tourism felt by the local residents and stakeholders on A. Promotion of • Heritage • Art & Craft • Traditional Fairs & Festivals • Traditional cuisines B. Degradation of protected monuments C. Abandonment of traditional activities due to opportunity offered by tourism for higher income.
8	Psychological	Psychological carrying capacity relates to the quality of visitors' satisfaction with a certain tourist destination, which is not to be decreased.	A. Worth of visit both in terms of cost and experience B. Supportive attitude of locals C. Supportive attitude of Administration

Source: PAP/RAC: Guidelines for Carrying Capacity Assessment for Tourism in Mediterranean Coastal Areas. PAP-9/ 1997 /G.1. Split, Priority Actions Programme Regional Activity Centre, 1997. pp viii+51.

METHODS OF MEASUREMENT

Limits of Acceptable Changes

The most adopted method of measuring carrying ecological capacity is derived from the Battelle Environmental Evaluation System (BEES) which is used in environmental impact assessment (EIA) studies and limits of acceptable changes. This framework has been notably used by the likes of Sankar (2003) and Sharma (2016) and is based on the assumption that the carrying capacity of a destination was 100% before tourism activity was started and the adverse impact of tourism activities reduce it and management initiatives augment it. To predict the effect of tourism on each dimension (here ecology) indicators are identified and then subsequently their impacts are measured with Carrying Capacity Impact Unit (CCIU) which is obtained as a multiplication of Indicator Quality Unit (IQU) by Parametric Importance Unit (PIU). The IQU is the proportion of respondents agreeing to the impact of the indicator on tourism and PIU is the arithmetic mean of scores (on a 3 point scale of least, medium and high) given by respondents based on the ability of the indicator to predict the impact of each dimension. Ultimately, the sum of all the CCIUs will give the total carrying capacity remaining in the destination.

Normalizing Densities Method

This concept has been used mostly in Urban Planning and involves augmenting or curtailing the recommended (as per norms of Urban Planning) densities[1] of tourist destinations based on the qualitative assessment of indicators. In this method the tourist destinations are evaluated on selected indicators and based on the nature (positive / negative) and level of impact, scores corresponding to each indicator are given on a Normalizing Index of range - 10 to + 10.

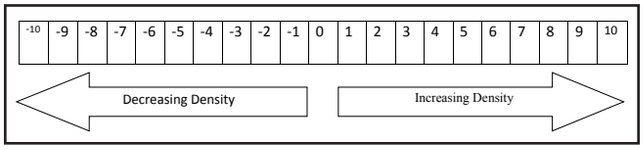

Fig. 1: Normalizing densities

[1] In India, the settlements have been classified as small Towns, Medium Towns, Large cities, Metropolitan cities and Megapolis cities, based on their census populations. Densities (Persons per hectare (pph)) for these cities have been recommended by Ministry of Urban Development for urban planning purposes.

S. No.	Settlement Type	Plain Town	Hill Town
1	Small Towns	75-125	45-75
2	Medium Town	100-150	60-90
3	Large Cities	100-150	60-90
4	Metropolitan Cities	125-175	100-150
5	Megapolis	More than 200	–

Source: Danube Competence Centre (DCC).

Normalizing Densities are obtained by multiplying a factor of 10 pph by the normalizing index. Thus, the recommended densities are augmented or curtailed to obtain the carrying capacity densities.

Framework given by the Members of the Environmental Planning Laboratory, University of Aegean, Greece

The members of the environmental planning laboratory, University of Aegean, Greece, in their work 'Defining, measuring and evaluating carrying capacity in European Tourism Destinations' have outlined the methodological considerations for measuring and implementing Tourism Carrying Capacity in two parts: (i) Descriptive and (ii) Evaluative.

The descriptive part describes how the system (tourism destination) under study works and highlights need of identification of constraints, bottlenecks and impacts. The constraints have been defined as limiting factors that are not flexible and cannot be easily managed. These generally relate to ecological sensitivity. The bottlenecks have been defined as limiting factors of the system which managers and planners can deal with. For example congestion can be managed by regulating visitor flows at peak hours. The impacts are defined as elements of the system which are affected by the intensity of tourism and type of use of the system.

The evaluative part describes how an area should be managed and comprises of identification of goals / objectives (i.e. defining the type of experience or other outcomes that a destination should provide) and the levels of acceptable impacts.

A COMBINATIONAL APPROACH

Based on the 3 most notable methods of determining carrying capacity as discussed in the previous section a combinational approach to arrive at the upper and lower limits of the carrying capacity of a destination is suggested as follows:

The assessment of tourism carrying capacity of a destination consists of identification of 3 kinds of limitations within which the system under study works and utilizing information on these to determine the upper and lower limits of the tourism carrying capacity. The 3 limitations are namely, constraints, bottlenecks and impacts. Constraints are inflexible components of the system like its ecological sensitivity or fragility which cannot be much altered / preserved with managerial interventions. Firstly, the constraints of any system are needed to be assessed to fix an upper limit of the tourism carrying capacity of the destination. Further development should be proposed only in those cases where

the upper limit of tourism carrying capacity has not been reached.

At the second stage, the bottlenecks of the system are needed to be outlined. The bottlenecks mainly pertain to limited supply of amenities like water, electricity, sewerage / drainage / telecommunications, transport, waste management capacity, health, law & order, banking etc. Their nature is such that they can be removed or relaxed through managerial interventions / measures like additional investment, regulation, and reorganization. The existing limits / restrictions of the bottlenecks are needed to be assessed. Due to their flexible nature and the fact that these can be altered, the bottlenecks should not be used for setting limits of carrying capacity. Possible solutions, in terms of policy measures, need to be worked out to remove / relax the bottlenecks which in turn can ensure that the negative impacts of tourism are lessened and the overall carrying capacity of the destination is augmented / optimized.

Next i.e. at the third stage, a list of impacts and the corresponding indicators is needed to be drawn. Impacts may relate to the effects which tourism levelsare likely to have on the composition / characteristics of the local community (demographic, social, economic cultural, etc.) as well as psychological satisfaction of the visitors. The impacts of tourism can be positive as well as negative. The indicators corresponding to the impacts have to be categorized into positive (augmenter) or negative (curtailer) depending upon the type of impact. An indicator would be said to be positive if its higher value supports augmentation in tourism levels and would be said to be negative if its higher value supports curtailment of tourism levels of the destination[2].

The relative importance of indicators corresponding to a given parameter and the different parameters corresponding to a given dimension should also be decided in consultation with the tourism experts.

For indicators against which reliable secondary data (record based) is available, it should be used by converting into a 4 point ordinal scale with High, Medium, Low and Negligible being the orders. For those indicators against which reliable secondary data is not available, primary data, in the form of a survey, may have to be collected. In such cases, feedback of the target respondent (which may be locals / stakeholders or tourists depending upon the indicators) corresponding to each indicator is taken on a 4 point ordinal scale with High, Medium, Low and Negligible being the categories of responses. The responses are given a score depending upon the proportion of respondents giving the particular response.

Table 2: Scores to be Assigned in Case of Positive Indicators

Category of response							
High		**Medium**		**Low**		**Negligible**	
Percentage of response	**Score**	**Percentage of response**	**Score**	**Percentage of response**	**Score**	**Percentage of response**	**Score**
100-90	10					100-90	-10
90-80	9					90-80	-9
80-70	8					80-70	-8
70-60	7					70-60	-7
60-50	6					60-50	-6
50-40	5	100-80	5	100-80	-5	50-40	-5
40-30	4	80-60	4	80-60	-4	40-30	-4
30-20	3	60-40	3	60-40	-3	30-20	-3
20-10	2	40-20	2	40-20	-2	20-10	-2
10-0	1	20-0	1	20-0	-1	10-0	-1

For instance promotion of traditional arts and crafts by tourism is a positive indicator. If 50% of the responses are 'High', 20% of the responses are 'Medium', 30% of the responses are 'Low' and 20% are 'Negligible' than the cumulative response would be: 5+1-2-2 = 2

[2] The suggestive list of impact indicators and their classification into augmenters or curtailers is given in Annexure 2.

Table 3: Scores to be Assigned in Case of Negative Indicators

Category of response							
High		**Medium**		**Low**		**Negligible**	
Percentage of response	**Score**	**Percentage of response**	**Score**	**Percentage of response**	**Score**	**Percentage of response**	**Score**
100-90	-10					100-90	10
90-80	-9					90-80	9
80-70	-8					80-70	8
70-60	-7					70-60	7
60-50	-6					60-50	6
50-40	-5	100-80	-5	100-80	5	50-40	5
40-30	-4	80-60	-4	80-60	4	40-30	4
30-20	-3	60-40	-3	60-40	3	30-20	3
20-10	-2	40-20	-2	40-20	2	20-10	2
10-0	-1	20-0	-1	20-0	1	10-0	1

Source: Jose U.V, Nahar Muhammed, S. Vijayakumar, Jose Sonia (2009), Balancing Tourism and Environment: The ETM Model, International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering Vol:3, No:6, World Academy of Science, Engineering and Technology.

For instance overcrowding due to tourism is a negative indicator. If 60% of the responses are 'High', 20% of the responses are 'Medium', 20% of the responses are 'Low' and 20% are 'Negligible' than the cumulative response would be: -6-1+1+2 = -4.

The scores thus obtained against all the impact indicators corresponding to a given parameter can be combined together in a weighted mean. The weights have to be assigned according to the relative importance of the indicators as opined by the experts. Similar level of aggregation at the level of a dimension is also to be done on the basis of relative importance of different parameters. In this manner an aggregated normalizing index corresponding to a dimension of carrying capacity can be obtained. By multiplying the aggregated normalizing index with 10, aggregated normalizing density corresponding to a particular dimension of carrying capacity can be obtained.

The final normalizing density corresponding to the total carrying capacity can be taken as minimum of the set of aggregated normalizing densities. For instance if 3 dimensions of carrying capacity are being considered for a destination and the normalized densities corresponding to the 3 are 30, 10 and -20, respectively, then the minimum of the 3 values i.e. -20 would be taken as the final normalizing density. The selection of minimum value is advocated for under the assumption that each dimensional carrying capacity represents a saturation point and if even one of them has received its saturation level than no further tourism should be proposed.

The final normalizing density can be combined (added or subtracted depending upon whether it is positive or negative) with the recommended density (based on the type of settlement) to arrive at the carrying capacity density. From the carrying capacity density the density of the resident population has to be subtracted to arrive at tourism carrying capacity density which when multiplied by the area of the destination would give the tourism carrying capacity of the destination. The tourism carrying capacity thus obtained can be taken to be its lower limit. The lower limit of the tourism carrying capacity needs to be reviewed at periodic intervals and it is likely to increase once efficient action to smoothen out the bottlenecks is taken. The lower limits of the tourism carrying capacity should, however, take into account that the local community involved in tourism is able to sustain itself.

In this approach as the upper limit of tourism carrying capacity as determined from constraints and the lower limit as determined from impacts are independent of each other, it may occur that in some cases the lower limit is more than the upper limit; hence in such cases the limit determined from constraints should be taken as the saturation limit.

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ANNEXURE - 1

Suggestive List of Bottlenecks

The bottlenecks in reaching the optimal tourism carrying capacity of a destination can be the limited availability/ low levels/ or decreased quality of the following services / facilities / amenities:

S. No.	Dimension	Services / Facilities / Amenities	Quantifiable parameters to judge levels
1	Physical	A. Tourism Infrastructure: i. Accommodation ii. Transport iii. Trained Guides iv. Tour Operators v. Parking B. General Infrastructure: i. Power supply ii. Water Supply iii. Fuel (Gas supply) iv. Telecommunications v. Connectivity vi. Drainage vii. Health Services	i. Budget accommodations and their bed capacity. ii. Starred Luxury accommodations and their bed capacity. iii. Tourist Transport vehicles. iv. Trained Guides v. Tour Operators vi. Capacity of Parking Lots vii. Hours of regular power supply viii. Per Capita availability of potable water ix. Quantity of gas / fuel available x. Availability of telecommunications and internet facilities xi. Capacity and frequency of inter-state and intra-state public transport xii. Last mile connectivity to tourist destination by mechanised / non mechanised transportation xiii. Drainage system of the destination xiv. Health care service providers and their distribution
2	Ecological	A. Ecologically supportive best practices B. Accumulation of solid and non bio degradable waste	i. Existence of practices like rain water harvesting/ community watersheds / solar power usage/ etc. ii. Impact of tourism felt on solid / non biodegradable waste generation

ANNEXURE 2

Suggestive List of Impact Indicators

Dimension	Parameter / Impact	Indicator	Category
Ecological	Pollution	i. Levels of air / noise / sound pollution	Curtailer
Demographic	A. Levels of Inbound Migration for employment in tourist establishments B. Level of tourists	i. Effect of migration on the age structure, gender structure of the resident demography.	Curtailer
		ii. Ratio of tourists to inhabitants	Curtailer
Economic	A. Employment Pattern B. Employment generation C. Altered urban structure	i. Seasonality of employment.	Curtailer
		ii. Excessive dependence on tourism	Curtailer
		iii. Availability of employment opportunities for local inhabitants in tourism related establishments	Augmenter
		iv. Rate of increase of urban settlements	
Political	Land use conflicts	i. Ratio of land use for tourism to other activities	Curtailer
Social	Effect of Tourism felt by the local residents on their quality / ease of life.	i. Decrease in Safety and Security	Curtailer
		ii. Crowdedness	Curtailer
		iii. Crowding out other activities or functions to outskirts of destination leading to tourism mono culture	Curtailer
		iv. Increased Livelihood opportunities	Augmenter
		v. Inflation of rented accommodation, transport facilities, etc.	Curtailer
		vi. Lack of community spaces	Curtailer
		vii. Degradation of the socio – cultural values imbibed in the local community.	Curtailer
Cultural	Effect of Tourism felt by the local residents and artisans / craftsmen / cultural community / etc. on the local art and craft	i. Promotion of Heritage	Augmenter
		ii. Promotion of Art & Craft	Augmenter
		iii. Promotion of Traditional Fairs & Festivals	Augmenter
		iv. Promotion of traditional cuisines	Augmenter
		v. Degradation of protected monuments Promotion of Traditional	Curtailer
		vi. Abandonment of traditional activities due to opportunity offered by tourism for higher income.	Curtailer
Psychological	Overall experience of the visitors	i. Worth of visit in terms of cost	Augmenter
		ii. Worth of visit in terms of experience	Augmenter
		iii. Supportive attitude of locals	Augmenter
		iv. Supportive attitude of Administration	Augmenter