

Carrying capacity studies for a nature-based tourism destination in the Indian Sundarbans

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Abstract – Tourism, as an anthropogenic and anthropocentric activity, has high impact on all dimensions of sustainable development particularly in nature-based destinations with low population density. The concept of carrying capacity applies most appropriately in this context of sensitive zones. Carrying capacity has multiple facets—physical, ecological, social, and economic, among others. Assessment of tourism carrying capacity helps to regulate tourist traffic flow and adopt management practices specific to a certain location in the interest of sustainability. This paper attempts to assess the physical carrying capacity of a nature-based tourism destination in the Jharkhali Island of the Indian Sundarbans, a world heritage site of natural category. Tourism in Jharkhali is still in the growing phase and is being promoted by local authorities with robust infrastructure and investments. Jharkhali not only has its own attraction in the form of a wildlife park but also acts as a gateway to the nearby mangrove forests, boat rides in the river, and other spots of scenic interest. This paper attempts to compute the real carrying capacity of the tourist area located in this island by following the widely applied methodological framework of carrying capacity assessment. It was found that the tourist area may be able to handle about 1080 tourists per day within the limits of the current amenities and management practices. Regulating the tourist traffic flow accordingly will ensure sustainable resource allocation and favourable visitor experience-cum-satisfaction, without depleting the picturesque qualities of the land, creeks, and the adjoining river.

Keywords – Natural Areas, Physical Carrying Capacity, Sustainability, Tourist Density, Tourist Traffic Flow

I. INTRODUCTION

The Indian Sundarban forests, spread over 24 Parganas (North and South) districts, have a total area of 4260 sq. km. It is a part of the world-famous Sundarbans Biosphere Reserve and also a World Heritage Site inscribed in 1987 [1]. An intricate tapestry of islands and creeks, this mangrove forest is a unique habitat and biodiversity hotspot. Its wide range of bio-aesthetics consists of sea beaches, forest lands, wildlife parks, and riverfronts. Well known for its

tourism potential, certain locations in this zone have emerged as popular destinations. Sadly, it is also affected by unplanned tourism development, especially along the coastlines and riversides, often resulting in unsustainable use of natural resources. Jharkhali Island, 22.01921662, 88.68313102, of Basanti Block, Canning sub-division, south 24 Parganas district has emerged as one such tourist destination. Jharkhali has a wild animal park located in the village named Lot no. 126 which forms the main attraction of the Island. This river-

facing village also acts as a gateway to the nearby mangrove forests, boat rides in the river, and other spots of scenic interest. Thus the village takes the form of nature-based rural tourism, drawing tourists for its pristine natural qualities (fig. 1). Tourism was initiated here in 1983 in the form of a modest guest house built by the government near the river. Over the years, tourist flow has increased steadily and the current tourism infrastructure consists of nearly twenty accommodation facilities with a corporate resort, known as Jharkhali tourism hub, as the main anchor.



Fig. 1 Riverview from the Jharkhali Island

The other facilities are small-scale lodges and homestays of different budget ranges. The last decade has seen a high level of interest, investment, and infrastructure development by the State authorities to promote tourism in this remote village, with the tourism hub being one such initiative.

However, tourism in Jharkhali is still in its early stages and may be considered at the juncture of the exploration and involvement stages of the tourism area life cycle [2]. Since tourist carrying capacity is an important tool for understanding the sustenance limits of a tourism destination and, therefore, capable of guiding a young destination on the right track of sustainable tourism, it was felt appropriate to undertake such a study for this place. The aim is to comprehend the current tourism scenario and chart a roadmap for tourism planning and further infrastructure development in this fragile environment.

A. Local population

The village covers an area of 45.58 sq. km. and is home to 3820 households (Census 2011), with a

density of 344 people per sq. km. A study by the authors had earlier shown that the local population is by and large favourable towards tourism [3]. They are involved directly or indirectly in the supply of eatables, raw materials, organizing inter-island boat trips, acting as tourist guides, selling non-wood forest products, and other miscellaneous activities.

B. Tourist population

Tourism in Jharkhali is mostly seasonal and remains active for about 220 days in a year- late September to March, peaking up in December to January. The current bed capacity stands at about 400, with 34% under village/ residential ownership while the rest belong to non-village owners, as revealed by our field survey of 2019-2020. A small percentage remains government-owned. The main tourist attraction is a wild animal park consisting of a tiger rescue centre with two rehabilitated tigers, a butterfly park and children's play area. The tourist traffic volume and flow as obtained from the Department of Tourism, Government of West Bengal for the years 2016, 2017 and 2018 indicate a steep rise in visitations and consequently, in the number of lodging facilities in the last decade (fig. 2).



Fig. 2 Growth of hotels vis-à-vis tourist volume till 2017

C. Visitor carrying capacity

The concept of capacity is based on the ability of certain ecosystems to withstand the ever-increasing anthropogenic load. This is more applicable to coastal environments as their carrying capacity is

finite and hence, is important for coastal management initiatives [4]. United Nations World Tourism Organization (UNWTO) defines carrying capacity as ‘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’ (cited in [5]). Carrying capacity has multiple facets—physical, ecological, social, and economic [6]. Physical carrying capacity depends on the spatial configurations and limits of a particular location, while ecological carrying capacity is more complex and involves an ecosystem-based approach. Social carrying capacity focusses on acceptable crowding and economic capacity engages over economic aspects [6]. The carrying capacity of an area is usually defined as the maximum population that can be sustained at a minimum standard of living necessary for survival [7] and is expressed as the ‘no. of persons that can be sustained per sq. km. of land’. The carrying capacity of a particular tourist spot is dependent on the number of tourists visiting the place, the length of visit /stay, the characteristics of the tourists/hosts, the geographical concentration of the visitors, and the degree of seasonality. The concept is also related to eco-tourism and long-term sustainability [8], resource consumption, visitor satisfaction, destination management, and tourism area life cycle.

Carrying capacity assessment is a useful method to determine the 'appropriate' tourist volume for the region as a whole and the tourist site in particular by calculating the physical carrying capacity of the area within its ecological and environmental settings. The thrust of this index is to understand the sustainable limit of the area in primarily physical, and partly environmental terms.

II. MATERIALS AND METHOD

Physical Carrying Capacity (PCC) is the maximum number of tourists that may be comfortably accommodated within the physical extent of the site over a given time [9, 10], expressing the crowding in a site, and expressed as:

$$PCC = A * D * Rf$$

Where,

A= Effective area (in m²) available for use by the tourists. This means the building footprint and water-bodies will be deducted from the total site area and only the accessible usable area is to be considered. In natural areas like Jharkhali, the gated zone of the Wild Animal Park is applicable and the usable land area of this park has been considered after deducting the water body, structures, and the tiger enclosure areas.

This is found to be 12000 m².

D = Tourist density is the per capita comfortable area required to appreciate the attributes of the destination. In this study, one visitor per 20 m² has been considered appropriate in the interest of quietude and calmness, and avoid too much noise. It is understood that people will move in groups and person-to-person distance in the group will be less. However the general distribution of the crowd and the physical distance between the groups may be evened out by this figure, expressed in (1 tourist / 20 m²) = 0.05 tourists/ m², as a measure of crowdedness.

Rf = Rotation factor, i.e. the number of times these visits are possible to be undertaken within a specific duration, i.e. the daily permissible visiting hours, and is given by:

$$Rf = \text{visiting hours} / \text{average trip time.}$$

The park is open from 8.30 am to 4 pm i.e. 7.5 hours. It was observed that the average time taken by tourists to move around the tiger enclosure, butterfly Park, and the children's park is about 2.5 hours. Hence, Rf = (7.5/ 2.5) = 3.

III. RESULTS

Based on the above, the physical carrying capacity of the tourist area in Jharkhali is assessed, as given in table 1.

Table 1. Calculation of PCC for Jharkhali Park

Accessible area (m ²)	Tourist density (person/m ²)	Rotation factor	PCC (no. of visitors per day)
A	D	Rf	PCC
12000	0.05	3	1800

The PCC for Jharkhali Park works out to 1800 tourists per day. However, this figure has to be 'corrected' after due consideration of the context-specific 'limiting factors' that restrict movement in practice, mainly for climatic reasons. This is the Real Carrying Capacity [9, 10].

D. Real Carrying Capacity

Real Carrying Capacity (RCC) is the maximum number of visitors, derived from PCC but moderated according to the destination's limitations, which may be the local physical or environmental conditions and management's capability to handle the tourist volume, without impairing the tourism experience [9, 10].

It is given by:

$$RCC = PCC \times (Cf_1 \times Cf_2 \times Cf_3 \times \dots \times Cfn)$$

where: " Cf_i (corrective factors or limiting factors) are factors having a negative impact on tourism activities and assessed by limiting threshold which is used for identifying the impact level of a factor (%), where limiting factors can be determined by:

$$Cf_1 = (1 - M1 / Mt)$$

M1: limiting magnitude of variable no. 1;

Mt: total magnitude of the variable. These factors are selected based on tourism activities and local conditions of the study area [9, 10].

E. Limiting factors in Jharkhali tourism

Considering the seasonality of the Jharkhali tourism, weather conditions have been taken as the limiting factor. Active for 220 days a year, it remains dormant for 145 days.

Hence, $Cf_1 = \{1 - (145 \div 365)\} = 1 - 0.4 = 0.6$.

Therefore, the corrected maximum PCC i.e., the RCC would be $1800 \times 0.6 = 1080$ visitors per day.

IV. DISCUSSION

The real carrying capacity assessed here indicates a rationalized number of visitors, which include both day-trippers as well as those staying overnight for the gated area of the Jharkhali wild animal park. The defined nature of space and time has simplified the assessment. The well-bounded park and clear operating hours for tourists have been considered for ascertaining the visitor carrying capacity. The desirable tourist density was decided based on the functional requirement of a calm environment to avoid agitation in the animals, and the spaciousness to be compatible with the passive

recreation. PCC delineation for non-monitored natural areas such as the riverfront or village areas would make this calculation far more complex due to the number of variables and the subjectivity. Jharkhali is also used as a transit to visit the neighbouring attractions by hired boat. This includes the Kalash Island and the Bonnie camp. Some also visit the Bhagabatpur Crocodile Project as well as the Lothian Wildlife Sanctuary. These chartered trips/ circuits take a minimum of two to three days depending upon the commencement point. There is also a 'fixed day tour package' offered by the local tour operators involving a boat ride [11]. The PCC of these trips has not been assessed due to its open-endedness and non-regular nature.

The credibility of the result has also been reviewed. With full occupancy during peak seasons, 400 tourists are expected to undertake overnight stays. The RCC obtained shows a reasonable share of day-trippers versus overnight tourists taken together and hence, appears rational under the current conditions. However, it is important to remember that the estimated maximum of 1080 visitors per day is a dynamic value depending on the ongoing extent of resource consumption, infrastructure available, and visitor management. Based on the upgradation or degradation of spatio-physical conditions, this figure is likely to go up or down, respectively.

V. CONCLUSION

This paper assessed the physical carrying capacity of a nature-based tourist destination in Jharkhali - one of the inhabited Islands of the Indian Sundarbans. The village in question is a riverside habitation of low population density and with pristine scenic qualities. The result obtained may be duly considered by the Park authorities; tourism planners, managers and marketeers; local civic bodies, and the local community for long-term sustainability [12]. Any increase in the number of visitors will intensify the land, water, and energy consumption while affecting the natural qualities. Future scope of research in this track may include the transit visitors who travel to the nearby locales through this village.

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