Determining Tourism Carrying Capacity of Inani Beach, Cox's Bazar, Bangladesh

Md Saiful Islam[1]*, Marzia Khandaker Momo[2], Md Kamrul Hassan[3]

Abstract

Tourism carrying capacity (TCC) is often discussed, calculated and implemented in popular tourist destinations as every destination has a capacity to accommodate tourists, beyond which it cannot serve. Therefore, for a given destination, the number of tourists must be kept at an optimum level in order to preserve the natural and/or man-made attractions. Inani Beach is a popular sea beach in Cox's Bazar receiving thousands of tourists every year. This beach is famous not only for its natural boulders and sandy beach, but also for being home for endangered red crabs. However, the TCC of Inani Beach is not yet calculated and therefore the natural beauty and the colony of red crabs are under threat due to overtourism. This study assesses the TCC of Inani Beach employing the Cifuentes method with some modifications. Findings show that the TCC of Inani Beach is a total of 2,883 tourists per day divided into two sessions (3 hours per session of the 6 hours during the high tide in daylight), so the maximum number of tourists in each session is 1441. The study contributes to TCC literature in the context of Bangladesh and also will assist the government and private sector to improve strategy and policymaking.

Keywords: Tourism, carrying capacity, Sustainable tourism development, Cifuentes method, Inani Beach, Cox's Bazar.

1. Introduction

A place becomes a tourist destination because of its natural, cultural, archaeological and/or other man-made attractions. Tourists visit the place to explore and experience the natural or man-made attractions, but these attractions must not be irritated because of over tourism (Butler, 2020). In reality, over tourism often generates negative impacts on the environment of destination places among which depletion of the natural environment and destruction or near-destruction of historical landmarks are more

[1]   *Department of Maritime Tourism and Hospitality Management, Bangabandhu Sheikh Mujibur Rahman Maritime University, Bangladesh*

[2] *Strong Climate Champion (Bangladesh Chapter), SUN^x Malta & The Institute of Tourism Studies (ITS), Malta.*

[3] *Department of Tourism and Hospitality Management, University of Dhaka, Bangladesh.*
   *Corresponding Author's E-mail
   saiful.mthm@bsmrmu.edu.bd

evident (Hasan, Hassan, & Islam, 2014). Thus, to avoid negative impact, the deliberation of tourism carrying capacity (TCC) must be included in the tourism planning as initiated by governments and other stakeholders though it is often difficult to calculate and implement the TCC at destination level (O'Reilly, 1986).

The United Nations World Tourism Organization (UNWTO) defines tourism 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" (UNEP/MAP/PAP, 1997, p. 1). The number of tourists is a factor that may not only hamper the nature but also the satisfaction level of tourists (Corbau, Benedetto, Congiatu, Simeoni, & Carboni, 2019). TCC confines the tourists in a confined number so the overall natural, social, economic and ecological may remain intact without minimizing tourist satisfaction (Rodella, Corbau, Simeoni, & Utizi, 2017).

In many countries, particularly in developed countries, TCC is widely used and measured for every destination offered to tourists (Butler, 2020). However, in Bangladesh, assessing and applying TCC at tourist spots is still not in practice. To date, only the TCC of the Saint Martin's Island has been assessed by Hasan, Hassan, & Islam (2014). No attempt has been made since then to assess TCC of any other destination or tourist spot in Bangladesh. However, because of uncontrolled tourism development without controlling the number of tourists, many tourist destinations in Bangladesh are in threat of losing their natural recovery system and are becoming unattractive day by day (Wolf, Brown, & Wohlfart, 2018). This study is another attempt to initiate the process of assessing the TCC of popular tourist spots in Bangladesh.

Inani Beach, like other popular sea beaches in Bangladesh, is suffering from overtourism. For example, Saint Martin's Island and Kolatolo Sea Beach at Cox's Bazar are facing severe challenges of overtourism leading to degradation of natural and ecological environment, increased tension among host communities, and dissatisfaction among tourists. Determining and applying TCC of Inani Beach can be an effective tool for creating a balance between development of tourism facilities and conservation of ecological, sociocultural and ecological environment of the area. Also, application of TCC in a tourist destination can help mitigating the conflict between local community and tourists by promoting a mutual benefit-sharing environment.

For Inani Beach, the notion of TCC is particularly important as it is already overburdened with ever-increasing number of tourists. Particularly, no restriction is in place for the maximum number of tourists to visit the beach at a time that the beach can tolerate as the actual carrying capacity of the beach is still unknown. The study seeks to calculate the TCC of Inani Beach in terms of its physical, social, economic and ecological contexts using the Cifuentes method. The government may use the study as a reference to improve strategy and policy making and also to initiate further research.

2. Methodology

2.1 The Cifuentes method

The study has employed the formula proposed by Cifuentes (1992, 1999). The Cifuentes method is widely used in calculating TCC around the world and has been recommended by the United Nations World Tourism Organisation (UNWTO, 1998) and the International Union for Conservation of Nature (IUCN) (Ceballos-Lascuráin, 1996). The method has been applied in Costa Rica (Cifuentes, 1992; Cifuentes et al., 1999), Mexico (Segrado Pavón et al., 2015), Turkey (Sayan and Atik, 2011), Bangladesh (Hasan et al., 2014), Brazil (De Sousa, Pereira, da Costa, & Jiménez, 2014), Iran (Salemi, Jozi, Malmasi, & Rezaian, 2019), Portugal (Zacarias, Williams, & Newton, 2011) and in many other coastal and island destinations (Rodella et al., 2017).

The logic of the method is based on site-specific factors that make a tourist destination ideal for a certain number of tourists to accommodate without hampering the local economy, natural setting and ecosystem, socio-cultural environment. Also, the method considers all possible contextual factors that may reduce the level and quality of tourism experience and which are considered as the limitations of the area. In the Cifuentes method (1992, 1999), the carrying capacity of a given tourist destination is assessed in three successive phases: first, Physical Carrying Capacity (PCC); second, Real Carrying Capacity (RCC); and third, Effective Carrying Capacity (ECC).

2.1.1 Physical carrying capacity (PCC)

PCC refers to the maximum number of tourists that a specific area or tourist spot (e.g., Sea beach) can physically accommodate over particular period of time. PCC can be calculated by using the following formula:

$$PCC = A \times V/a \times Rf \dots \dots \dots \dots \dots \dots \dots \text{(1)}$$

Here, *A* is the available area for tourism activity or use. For example, in a particular beach, *A* can be measured by multiplying the length by the width of the beach that are allotted for tourism activities.

V/a is the required space per tourist for a tourist to undertake activities comfortably. Here, *V* is one individual tourist (numerically 1) and *a* is the area required by per tourist. V is to be divided by *a.*

Rf refers to rotation factor which is the number of permissible visits over a specified time (normally daily open hours). *Rf* is calculated by dividing 'daily open period' by 'average time visit' using the following formula:

$$Rf = \text{Open period / average time of visit} \dots \dots \dots \dots \dots \text{(2)}$$

2.1.2 Real carrying capacity (RCC)

RCC is the maximum number of permissible visits to a spot, once the *corrective factors (CFs)* derived from particular characteristics of the tourist spot have been applied to the PCC. RCC is expressed by the following general formula:

$$\mathbf{RCC} = \boldsymbol{PCC} \times \frac{\mathbf{100 - cf1}}{\mathbf{100}} \times \frac{\mathbf{100 - cf2}}{\mathbf{100}} \times ... \times \frac{\mathbf{100 - cfn}}{\mathbf{100}} ... ... (3)$$

Here, CF is assessed to identify the impact level of a factor that has a negative impact on tourism activities, calculated by limiting threshold, to ultimately apply to the PCC. The impact levels of these factors are translated into quantitative or semi-quantitative values to measure the capacity of environmental and socio-economic subsystem of a tourist destination and also the satisfaction level of tourists. CF can be determined by:

$$\mathbf{Cf} = \frac{\boldsymbol{M1}}{\boldsymbol{Mt}} \qquad\qquad .... (4)$$

Here, $M1$ is the limiting magnitude of the variable and Mt is the total magnitude of the variable.

2.1.3 Effective carrying capacity (ECC)

ECC is the final calculation of maximum number of visits that a tourist destination can allow based on the *management capacity (MC)*. MC is the current capacity of tourism management authorities or bodies in the respective tourist destination in terms of adequate staff, infrastructures, financial resources, and equipment required for the optimum service, surveillance and security of the tourists and conservation of nature. MC is applied to RCC and determined as:

$$\mathbf{ECC = RCC \times MC}...(5)$$

2.2 The concept of 'tourist-group consideration' in determining TCC

The Cifuentes method is based on and recognizes the necessary distance of one tourist from another for tourist satisfaction and comfort. However, Tran Nghi et al. (2007) criticize that, the method proposed by Cifuentes does not recognize the necessity of distance between groups of tourists. That means in calculating PCC, considering only the distance between tourists from one another is not sufficient, but the distance between tourist groups is also important determinant factor for tourist satisfaction

(Hasan et al., 2014). Therefore, when tourists are in groups they need some distance from other groups around for their comfort and satisfaction (Tran Nghi et al., 2007).

Tran Nghi et al. (2007) provide a new technique to consider and integrate the distance between groups in calculating TCC of trekking trails assuming tourists are in a line or in a queue one behind another. However, when the TCC of a sea beach is to be calculated, this technique is no more useful as unlike in a trail where tourists are in a line or queue one behind another, in beach or park tourists are scattered instead of being in a line or queue. Hasan et al. (2014) offer a new technique to incorporate the concept of 'distance between groups' in calculating TCC of beach- and park-like destinations based on basic formula given by Cifuentes (1992).

In this technique proposed by Hasan et al. (2014), each tourist group is considered as a unit of calculation. For example, if each individual tourist requires $4m^2$ space in the beach the total area required by a group of 4 tourists will be $16m^2$ ($4m^2 \times 4$). This $16m^2$ is required for having the necessary distance between tourists within the group. If the group requires a distance of 2 meters from other groups around them, a space of 1 meter should be kept as buffer zone in all four sides of each group (Figure 1).

Finally, the area required by each group, considering the necessary distance between groups, will be: $6m \times 6m = 36m^2$. In this technique, the total available area A is divided by the area required by each group to identify the maximum number of groups to be allowed to enter the destination. Once the number of groups is determined, PCC is calculated by multiplying the number of groups by the number of members in each group multiplied by rotation factor (if any).

3. Study area: Inani Beach

Inani Beach is one of the most popular sandy sea beaches located in Cox's Bazar district, Bangladesh. It is the most popular and renowned beach in the Inani area in Ukhia. It was previously famous for stony corals on the beach. Ever increasing popularity of Inani mainly among domestic tourists has led it to overtourism and now it is suffering from a number of physical, social, economic and ecological problems (Ahmed, Das, Haydar, Bhuiyan, Ali, & Paul, 2014). Located in Ukhia Upazila of Cox's Bazar District, Inani Beach is a 1 km long sandy beach (between Borokhal and Chotokhal), 26 km south of Kolatoli, Cox Bazar (see Map 1).

For Inani Beach, assessing TCC is particularly important as it is one of the most attractive sea beaches of Bangladesh and the number of tourists during the peak tourism season in winter may cause damage to natural habitats for red crabs and birds. The beach is only 1 kilometer long. Yet a large number of local people, mainly fishermen, have been using the beach for fishing and fish landing for many years. In addition to the

local population, the ever-increasing number of tourists is putting more and more pressure on the ecological environment of the beach. Overtourism leads not only to degradation of natural environment, but also to conflict between local people and tourists over resource sharing (i.e., the beach area), and ultimately hampers the level of tourist satisfaction. Thus, assessing the TCC of Inani Beach is particularly important in order to keep tourism development and saturation at the optimum level.
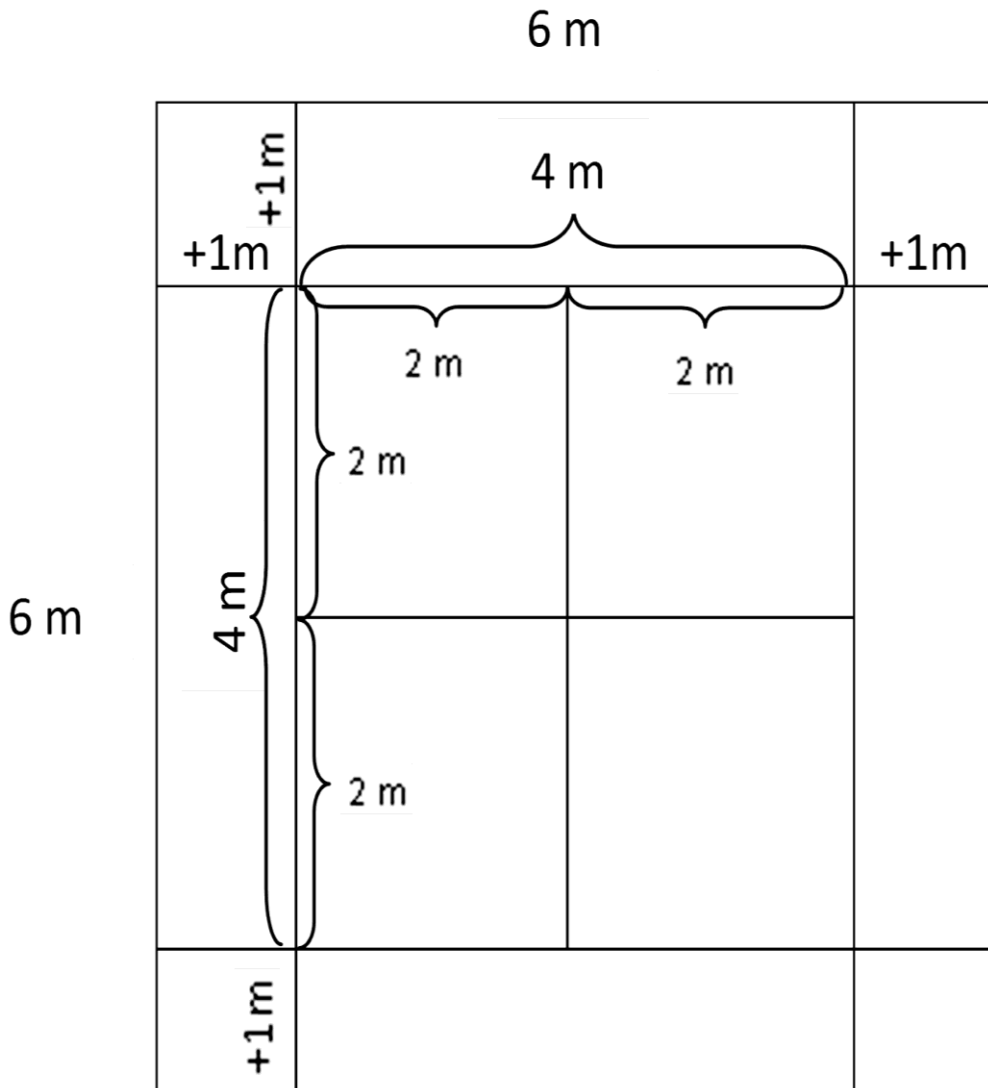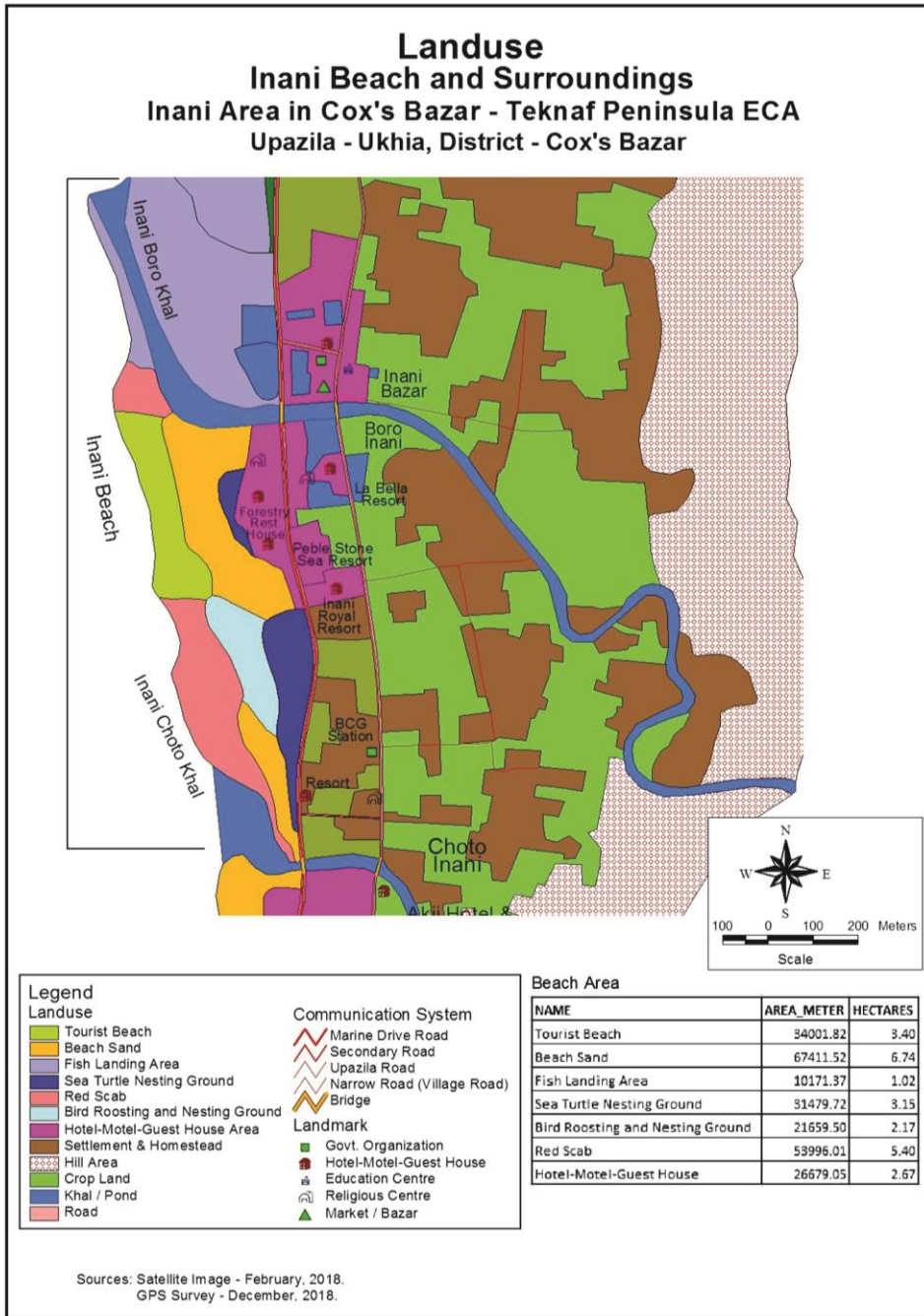

Figure 1: Distance required by a group of four tourists (Source: Hasan et al., 2014).

Landuse
Inani Beach and Surroundings
Inani Area in Cox's Bazar - Teknaf Peninsula ECA
Upazila - Ukhia, District - Cox's Bazar

Legend

Landuse
- Tourist Beach
- Beach Sand
- Fish Landing Area
- Sea Turtle Nesting Ground
- Red Scab
- Bird Roosting and Nesting Ground
- Hotel-Motel-Guest House Area
- Settlement & Homestead
- Hill Area
- Crop Land
- Khal / Pond
- Road

Communication System
- Marine Drive Road
- Secondary Road
- Upazila Road
- Narrow Road (Village Road)
- Bridge

Landmark
- Govt. Organization
- Hotel-Motel-Guest House
- Education Centre
- Religious Centre
- Market / Bazar

Beach Area

NAME	AREA_METER	HECTARES
Tourist Beach	34001.82	3.40
Beach Sand	67411.52	6.74
Fish Landing Area	10171.37	1.02
Sea Turtle Nesting Ground	31479.72	3.15
Bird Roosting and Nesting Ground	21659.50	2.17
Red Scab	53996.01	5.40
Hotel-Motel-Guest House	26679.05	2.67

Sources: Satellite Image - February, 2018.
GPS Survey - December, 2018.

Map 1: Land use of the 1 km long Inani Beach (Source: GIS survey)

4. Findings

4.1 Physical carrying capacity of Inani Beach

To determine the physical carrying capacity (PCC) of a tourist spot, it is required to know the measurement of the area for tourism use. To determine real TCC of Inani Beach, parameters in the following table (Table 1) have been considered.

Table 1: Key parameters for calculating TCC of Inani Beach

Total area of Inani Beach* (Calculation: 1 km or 1000m long from north to south between Borokhal and Chotokhal; and 100m wide on an average)	$100,000m^2$
Average area required per tourist on the beach**	$4m^2$ (2m×2m)
Average number of tourists in one group**	12 tourists
Distance required between groups from each other**	6m
Daily beach using period (during the high tide in daylight)*	6 hours/day
Average time taken by tourists for tourism activities on beach**	3 hours/day
Rotation factor (Calculation: As the average time for tourism activities on beach is 3 hours/day, two (2) visits/day are possible in 6 hours during the high tide in day light.)	2 (6 hours ÷ 3 hours)

* based on GIS Survey
** based on Field Survey

Area required by per group: Each group of 12 tourists (see Figure 2), requires 14 meters in length and 12 meters in width considering the distance between individual tourists and between tourist groups (see Table 1) to ensure comfortable distance.

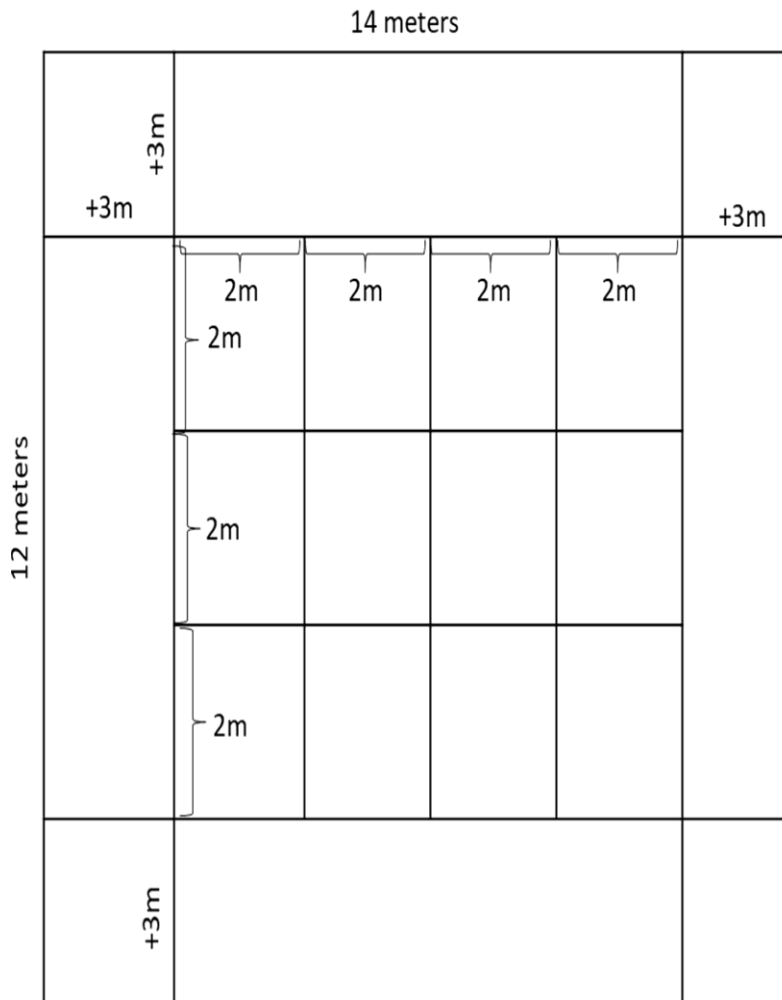So, area required per group = 14m × 12m = $168m^2$

Figure 2: Area required by each group

So, the maximum number of tourist groups: $100{,}000 \div 168 = 595$ groups

So, the PCC of Inani Beach = Maximum number of tourist groups × Number of tourists in each group × Rotation factor

$$= 595 \times 12 \times 2$$

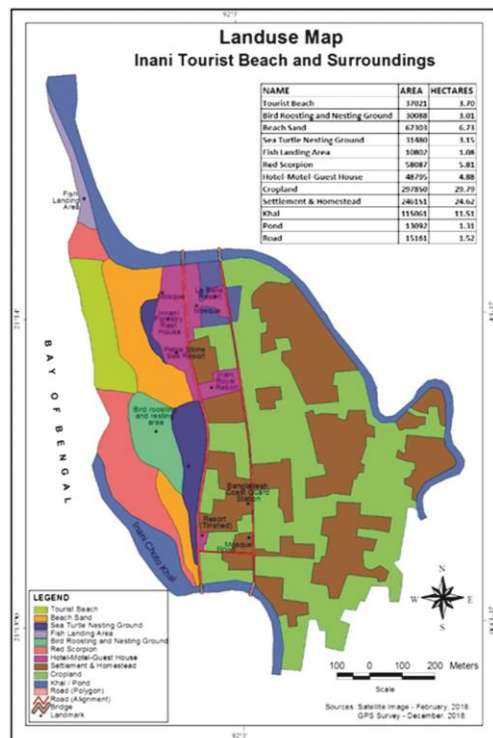= 14,280 visits per day in two sessions

4.2 Real carrying capacity of Inani Beach

However, the whole 100,000m^2 cannot be allocated for tourism. While assessing TCC, environmental, socio-cultural and economic sustainability of the local area are considered. As a result, the real carrying capacity of a destination is not determined by considering merely the physical capacity of the area but by thoughtfully considering the other aspects in order to achieve long term sustainability of the destination. Based on field survey, sea turtle and birds breeding zones, red crab territories, forest cover and vegetation, fish landing areas, fisheries and hatcheries, human settlement, farmland, grazing land for cattle, fallow land, muddy and physically harmful areas have been discarded from the total beach area to determine a tourist zone (see Map 2).
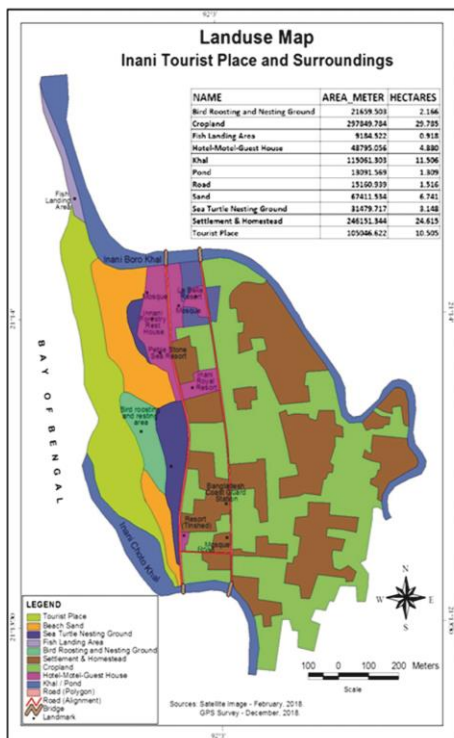
(a) Total Area for Tourism   (b) Real Area for Tourism

Map 2: (a) Total Area; and (b) Real Area for Tourism in the Inani Beach
(Source: GIS survey)

From the field visit with geographic information system (GIS) experts, three corrective factors were determined with land area covered by each. Biodiversity hotspots were particularly important as sea turtles, red crabs and sea birds use around 350 meters of the beach length for breeding. Around 100 meters were discarded as identified by the local fishermen as their fish landing area. Also, the GIS team in consultation with tourists, identified about 100 meters beach area as muddy and unfitting for tourism activities. Finally, real carrying capacity (RCC) of the tourist zone of Inani Beach has been assessed.

So, the real area of Inani Beach for tourism:

Total Area – **Biodiversity hotspots** *(Sea turtle breeding zone + Red Crab territory + Bird roosting area)* – **Fish landing area** – **Muddy area/Barren land**

= 1000m – 350m – 100m – 100m

= 450m (length from north to south)

So, the real area for tourism in the Inani Beach:

450m long $\times$ 100m wide = 45,000m^2

Area required per group: 168m^2

So, maximum number of tourist groups: $45,000 \div 168 = 267$ groups

Beach using period is 6 hours/day (high tide in the daylight); and each tourist group takes about 3 hours. Thus, the number of visits per day is 2 (Rotation factor).

So, the Real Carrying Capacity (RCC) of Inani Beach = Maximum number of tourist groups $\times$ Number of tourists in each group $\times$ Rotation factor

= $267 \times 12 \times 2$

= 6,408 visits per day in two sessions

4.3 Effective carrying capacity of Inani Beach

Considering the management capacity in terms of staff, infrastructure and equipment, the ECC of Inani Beach was determined as indicated by Corbau et al. (2019). Total 10 correction factors under these three major elements (staff, infrastructure and equipment) were applied to assess the MC (see Table 2).

Table 2: Calculation of the correction factors for MC.

		Optimum	Max. score	Actual situation	Score
Staff	Lifeguard	Present permanently	1	Yes, but not sufficient for the number of tourists. So, the score has been halved.	0.5
	Tourist Police	Present permanently	1	Yes	1
Infrastructure	Shaded structure for lifeguard, first aid kit.	At least one	1	Absent	0
	Signage with swimming rules, cautions, and emergency numbers	At least one	1	Absent	0
	Washrooms	At least one	1	Yes	1
	Beach chair for hire	As per tourists' demand	1	Yes	1
	Public tourist lounge with prayer room	At least one	1	Absent	0
Equipment	Surveillance equipment (CC-camera & emergency support)	At least one	1	Absent	0
	Communication system (telephone and walkie-talkie)	At least one	1	Yes	1
	Emergency first aid kit	At least one	1	Absent	0
Sum			**10**		**4.5**
MC index			**1**		**0.45**

As the MC score is 0.45, the ECC of Inani Beach is (6,408×0.45) or 2,883 visits per day in two sessions. That means a total of 2,883 tourists can visit Inani Beach per day but in two sessions (3 hours each) and the maximum number of tourists in each session will be (2,883 ÷2) or 1441.

Table 3: PCC, RCC and ECC of Inani Beach.

Sessions	PCC	RCC	ECC
One session *(3 hours)*	7,140	3,204	1,441
Two sessions *(6 hours)*	14,280	6,408	2,883

Though Table 3 compiles all results for PCC, RCC and ECC for both one session and two sessions, in practice only the results of ECC are implemented. ECC is the ultimate maximum number of tourists to be allowed to enter the destination under study. For Inani Beach, the ECC is 1441 tourists in one session (3 hours), that is, a total of 1441 tourists can be allowed to Inani Beach in one session. As mentioned above, the average time taken by tourists for tourism activities on beach is 3 hours, therefore, two visits per day (3 hours each) are possible during the high tide in daylight (of 6 hours). So, the daily ECC of Inani Beach is 2883 tourists in two sessions, that is, a total of 2883 tourists can be allowed to Inani Beach per day in two sessions. However, as the assessment of the carrying capacity is only carried out within a specified time period, the number of maximum tourists determined in this study can be changed based on the change in the capacity of the beach and situation over time.

5. Conclusion

Carrying capacity assessment of tourism activities is a practical tool for maintaining the sustainable balance between development and conservation. Determining and applying TCC to a tourist destination can effectively contribute to the preservation of the natural, cultural and local economic environment of the destination while ensuring satisfaction of tourists and wellbeing local communities. For Inani Beach, assessing and applying TCC can help protect not only the natural settings of the beach area and its biodiversity but also the tourism industry, as in nature-based tourist destinations tourism business relies mainly on natural beauty. The original value of the study lies in its endeavour to determine the TCC of Inani Beach.

The study assesses the TCC of Inani Beach that may help the government and other stakeholders involved in tourism sector in Inani to better address challenges stemming from overtourism and improve strategy and policymaking. The most important strategic response to improve the current carrying capacity of Inani Beach is to improve the management capacity. For example, a number of basic tourism facilities shown in Table 2 are absent. If some facilities can be introduced and/or improved, the carrying capacity of Inani Beach will increase significantly.

References

Ahmed, M. M., Das, S. K., Haydar, M. A., Bhuiyan, M. M. H., Ali, M. I., & Paul, D. (2014). Study of natural radioactivity and radiological hazard of sand, sediment, and soil samples from Inani Beach, Cox's Bazar, Bangladesh. *Journal of Nuclear and Particle Physics*, *4*(2), 69-78.

Butler, R. W. (2020). Tourism carrying capacity research: a perspective article. *Tourism Review*. Vol. 75 No. 1, pp. 207-211. https://doi.org/10.1108/TR-05-2019-0194

Ceballos-Lascuráin, H. (1996). Tourism, ecotourism, and protected areas: the state of nature-based tourism around the world and guidelines for its development. International Union for Conservation of Nature (IUCN), Gland, Switzerland, pp. 301. https://doi.org/10.2305/IUCN.CH.1996.7.en

Cifuentes, M. (1992). Determination de capacidad de carga turistica en areas protegidas (Determination of the touristic carrying capacity in Protected Areas). Centro agronomico de investigacion y enseñanza catie, Turrialba, Costa Rica, pp. 23.

Cifuentes, M., Mesquita, C.A.B., Méndez, J., Morales, M.E., & Aguilar, N. (1999). Capacidad de Carga Turistica de las Areas de Uso Publico del Monumento Nacional Guayabo, Costa Rica (Touristic carrying capacity of the public areas of the Guayabo National Monument). Costa Rica (No. 338.4791 C236c). Turrialba, CR: WWF.

Corbau, C., Benedetto, G., Congiatu, P. P., Simeoni, U., & Carboni, D. (2019). Tourism analysis at Asinara Island (Italy): Carrying capacity and web evaluations in two pocket beaches. *Ocean & Coastal Management*, *169*, 27-36.

De Sousa, R. C., Pereira, L. C., da Costa, R. M., & Jiménez, J. A. (2014). Tourism carrying capacity on estuarine beaches in the Brazilian Amazon region. *Journal of coastal research*, (70 (10070)), 545-550.

Hasan, S. R., Hassan, M. K., & Islam, M. S. (2014). Tourist-Group consideration in tourism carrying capacity assessment: A new approach for the Saint Martin's Island, Bangladesh. Journal of Economics and Sustainable Development, 5(19), 150–158.

O'Reilly, A. M. (1986). Tourism carrying capacity: concept and issues. *Tourism management*, *7*(4), 254-258.

Rodella, I., Corbau, C., Simeoni, U., & Utizi, K. (2017). Assessment of the relationship between geomorphological evolution, carrying capacity and users' perception: Case studies in Emilia-Romagna (Italy). Tourism Management, 59, 7-22.

Salemi, M., Jozi, S. A., Malmasi, S., & Rezaian, S. (2019). A new model of ecological carrying capacity for developing ecotourism in the protected area of the north karkheh, Iran. Journal of the Indian Society of Remote Sensing, 47(11), 1937-1947.

Sayan, M.S., Atik, M. (2011). Recreation carrying capacity estimates for protected areas: a study of Termessos national park. Ekoloji 20 (78), 66–74. https://doi.org/10.5053/ekoloji.2011.7811.

Segrado Pavón, R. G., Arroyo Arcos, L., Amador Soriano, K., Palma Polanco, M., & Serrano Barquín, R. D. C. (2015). Hacia un Modelo de Aprovechamiento Turistico Sustentable en Areas Naturales Protegidas: Estudio de Caso del Parque Natural Chankanaab de Cozumel, Mexico (Towards a model of sustainable tourism developement in natural Protected Areas: study case of the Chankanaab natural park of Cozumel, Mexico). PASOS Rev. Tur. Patrim. Cult. 13 (1), 25–42.

Tran, N., Nguyen, T. L., Nguyen, D. T., Dang, M., & Dinh, X. T. (2007). Tourism carrying capacity assessment for Phong Nha-Ke Bang and Dong Hoi, Quang Binh Province. VNU Journal of Science, Earth Sciences 23 (2007) 80-87

UNEP/MAP/PAP (1997). Guidelines for Carrying Capacity Assessment for Tourism in Mediterranean Coastal Areas. Priority Actions Programme Regional Activity Centre (Split), Turkey.

United Nations World Tourism Organisation, 1998. Guide for Local Authorities on Developing Sustainable Tourism. World Tourism Organization, Madrid (Spain) 194pp.

Wolf, I. D., Brown, G., & Wohlfart, T. (2018). Applying public participation GIS (PPGIS) to inform and manage visitor conflict along multi-use trails, Journal of Sustainable Tourism, 26:3, 470-495, DOI: 10.1080/09669582.2017.1360315

Zacarias, D. A., Williams, A. T., & Newton, A. (2011). Recreation carrying capacity estimations to support beach management at Praia de Faro, Portugal. *Applied Geography*, *31*(3), 1075-1081. DOI: https://doi.org/10.1016/j.apgeog.2011.01.020.