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The Assessment of Physical and Real Carrying Capacity for the Promotion of Sustainable Tourism in Rajshahi: A Study of Padma River Bank

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Abstract—*Assessment of tourism carrying capacity is essential to regulate and manage the visitors. The uncontrolled tourism activity is a major concern for the authorities to manage any destination. Again, sustainability of tourism development initiates concerns about the capability of tourist destinations. Rajshahi is one of the major old cities in Bangladesh in which waterfront development along the Padma River can have the potential for the development of waterfront tourism. Natural beauty and integrity of the Padma River is thus a wonderful site for recreation and tourism. Padma River bank is an unexplored tourist destination. The local authority has proposed the place for the development of tourism but, to avoid environmental degradation from the tourism pressure and to maintain its ecological balance it is important to assess the tourism carrying capacity of the place. The broad goal of this study is to assess the tourism carrying capacity of the Padma River bank and to provide some recommendations for the promotion of sustainable tourism at the selected site. This research is based on primary and secondary data. The most widely used method for collecting detailed information on visitors is visitors' survey based on questionnaires and it has been adopted for this study. Secondary data mainly the meteorological data has been collected from Bangladesh Meteorological Department (BMD). Tourism carrying capacity of the selected site has been assessed using the formula of physical and real carrying capacity which results that the actual numbers of visitors visiting the river bank are lower than the estimated value of its physical carrying capacity but higher than the real carrying capacity.*

Keywords*: Physical Carrying Capacity, Real Carrying Capacity, Sustainable Tourism.*

1. INTRODUCTION

Tourism is the act of traveling to another place for pleasure, business or for a particular service. Urban tourism is tourist activities that searching for a balance between the physical or environmental, economic and social interests in an urban setting. Waterfront tourism is a part of urban tourism planning and it requires an acknowledgment that the planning and development program should incorporate an understanding of ongoing physical, social and economic changes. Rajshahi is one of the major old cities in Bangladesh in which waterfront development along the Padma River can have the potential for the development of waterfront tourism. Many historical and archaeological sites are located inside and outside the structure plan area [8]. A plan has been proposed in the Rajshahi metropolitan development plan (2004-2024) to develop Padma riverside as tourist's spot through providing linkage among Padma river bank and other existing recreational facilities. Again, Successful tourism development is best achieved with the collaboration of all stakeholders, including governments and intergovernmental bodies, the private sector, related industries, destination communities and NGOs [6]. This study provides insight into the sustainability of waterfront tourism development in the bank of Padma through carrying capacity assessment.

2. REVIEW OF THE LITERATURE

Aminian and Khodayar explained (1986) that the phrase "carrying capacity" was first proposed by Verhulst (1838), a Belgian statistician interested in population growth. Aminian and Khodayar explained (1986) that Verhulst defined "Tourism carrying capacity is the maximum number of people who can use a recreational environment without an unacceptable decline in the quality of the recreational experience" [1]. Again, Aminian and Khodayar explained (1986) that WTO/UNEP defined carrying capacity as "the level of visitor use an area can accommodate with high level of satisfaction for visitors and few impacts on resources" [1].

The physical carrying capacity (PCC): Attallah (2015) explained that Cifuentes defined it as "the maximum number of visitors who can attend physically in a given place and time". To apply this method, it is important to consider tourist flows, the size of the area, the optimum space available for each tourist to move freely and the visiting time [2].

The real carrying capacity (RCC): Attallah (2015) explained that Nghi defined it as "the maximum permissible number of visits to a specific site", which is calculated according to the limiting factors resulting from specific conditions of that place and influence of these factors on the physical carrying

capacity. It is worth noting that these limiting or corrective factors are not necessarily the same for each site; and only the negative factors which hinder or affect tourism activities are considered, among which the environmental factors are usually the most important. These factors are then translated into quantitative values [2].

3. OBJECTIVES AND METHODOLOGY OF THE STUDY

A number of research works are available regarding carrying capacity assessment. But in case of Rajshahi City Corporation (RCC), no research has yet been conducted focusing carrying capacity assessment for the promotion of sustainable tourism in Rajshahi. The objective of this paper is to assess the tourism carrying capacity of the Padma River bank and to provide some recommendations for the promotion of sustainable tourism at the selected site. Padma Riverside (Shahid Minar to T- embankment) has been selected as the study area. The total population of the study area is 5, 21,579 [3, 4]. The total sample needed to conduct the study is about 384 with confidence level 95% and confidence interval 5 which is calculated by using sample calculator. In this study, random sampling technique has been used or else it may not fulfill the purpose. To fulfill the requirement of the objective at first questionnaire survey has been conducted. The main themes that are required to determine the physical carrying capacity from questionnaire survey and field survey include: the available area for public use, the area required per user, open period, duration of usability and the average time required per visit. Then data from questionnaire survey and secondary data from BMD (especially sunshine, humidity, rainfall, flood data) has been used to calculate the physical and real carrying capacity. At last, visitors count survey has been conducted to check whether the current number of visitors exceeds the maximum permissible number of visitors or not.

4. STUDY AREA PROFILE

The Padma riverside (Shahid Minar to T- embankment) has been selected as the study area, as the local authority has already been declared it one of the most potential location for local tourism development. The total population of the Rajshahi City Corporation (RCC) area has been considered as the population of the study area. The total population has been calculated for the year 2017 by projecting the population of the RCC according to the master plan 2001 and 2011 using empirical formula and according to this formula, the total population of the study area is 5, 21,579 [3, 4]. The total length of the study area is about 5.5 km and the area is about 568198 m^2 or 0.568 km^2. It lies between 24°22′00.50″ north latitudes and 88°36′09.32″ east longitudes (Google earth, 2017).

5. METHODS FOR CARRYING CAPACITY ASSESSMENT

5.1 Physical Carrying Capacity (PCC)

PCC is defined as the maximum number of visitors that can physically fit into a defined space, over a particular time [6]. It is expressed according to the following formula:

PCC=A x U/a x Rf

Where, A= available area for public use.

U/a= area required per user.

Rf= rotation factor (number of visits/day).

5.2 Real Carrying Capacity (RCC)

The maximum permissible number of visits to a site [6]. It is expressed according to the following formula:

RCC=PCC-Cf1-Cf2- …… Cfn

Where,

Cf= corrective factor expressed as a percentage.

RCC=PCC x (100-Cf1) % x (100-Cf2) % x ……. (100-Cfn)%

Cf= (M1/Mt) x 100

Where, Cf= corrective factor

M1= limiting magnitude of variable.

Mt= total magnitude of variable.

6. ANALYSIS AND DISCUSSION OF CARRYING CAPACITY

Tourism carrying capacity is the maximum number of people who can use a recreational environment without an unacceptable decline in the quality of the recreational experience.

6.1 Physical Carrying Capacity

From Table 1 it is noticed that the maximum number of visitors that the Padma River bank can physically conserves (without growing island of Padma) is about 4,87,963 persons per day and considering growing island of Padma it is about 10,49,475 persons per day.

Table 1: Carrying Capacity Estimation: Padma River Bank

Zones	Derived PCC (A x U/a x Rf)	Carrying Capacity (persons/day)
Shahid minar to kali mandir	39377 x ¼ x 12/1	1,18,131
Kali mandir to mukto manch	21370 x 1/8 x 12/(40/60)	48,083
Mukto manch to I-embankment	49816 x 1/3 x 12/2	99,632
I-embankment to T-embankment	83294 x 1/3 x 12/1.5	2,22,117
		Total= 4,87,963
Growing Island of Padma	374341 x 1/8 x 12/1	5,61,512
		Total= 10,49,475

Source: Calculated by the Authors.

6.2 Real Carrying Capacity

To calculate the real carrying capacity, six corrective factors related to the climate conditions of Rajshahi have been determined at first which includes excessive sunshine (29%), humidity (42%), rainfall (50%), flood (12.33%), overcrowding (83.59%) and infrastructure quality (70.57%).

Table 2: Determination of Corrective Factors

Variables	Unit of measure-ment	M1	M2	Cf (%)
Sunshine	hour	1260	4380	29
Humidity	month	5	12	42
Rainfall	month	6	12	50
Flood	day	45	365	12.33
Overcrowding	number	321	384	83.59
Infrastructure	number	271	384	70.57

Source: BMD & Field Survey, 2017.

Real Carrying Capacity (without considering the growing island of padma)

RCC=PCC-Cfs-Cfh-Cfr-Cff-Cfo

=PCC x (100-Cfs) % x (100-Cfh) % x (100-Cfr) % x (100-Cff) % x (100-Cfi) % x (100-Cfo) % x (100-Cfi)

= 4,87,963 x (100-29)% x (100-42)% x (100-50)% x (100-12.33)% x (100-83.59)% x (100- 70.57)%

= 4, 87,963 x 0.71 x 0.58 x 0.50 x 0.88 x 0.16 x 0.29

= 4, 102 visits/day

Real Carrying Capacity (considering the growing island of padma)

RCC=PCC-Cfs-Cfh-Cfr-Cff-Cfo

=PCC x (100-Cfs) % x (100-Cfh) % x (100-Cfr) % x (100-Cff) % x (100-Cfi) % x (100-Cfo) % x (100-Cfi)

= 10,49,475 x (100-29)% x (100-42)% x (100-50)% x (100-12.33)% x (100-83.59)% x (100-70.57)%

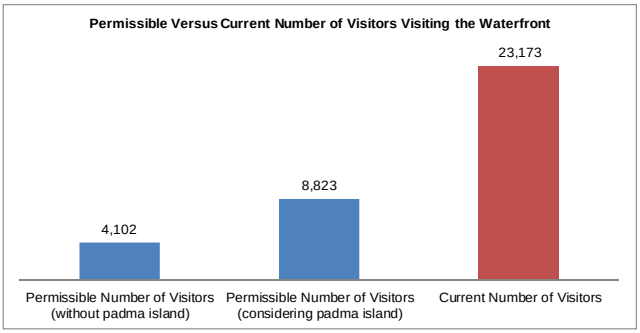
= 10, 49,475 x 0.71 x 0.58 x 0.50 x 0.88 x 0.16 x 0.29

= 8,823 visits/day

6.3 Permissible Versus Current Number of Visitors: A Comparative Analysis

Visitor count survey has been carried out to identify the number of visitors visiting the Padma waterfront every day. The survey results that the current number of visitors visiting this place is about 19,743 persons per day on the normal day of the week and 27,199 persons per day on the holiday. By using geometric mean, the average number of visitors visiting the waterfront is about 23,173 persons per day.

From the figure 1 it is noticed that the current number of visitors visiting the Padma waterfront exceed the maximum permissible number of visitors to the study area and it is about 3 times and 6 times higher than the permissible number of visitors which is about 23,173 when the theoretically calculated maximum permissible number of visitors (without Padma island) to the study area is about 4,102 and considering the growing island of Padma it is about 8,823 persons per day.



Source: BMD & Field Survey, 2017.

Figure 1: Comparison of permissible and current number of visitors.

The finding from the comparative analysis exhibits that the facilities and services available in the study area is not satisfactory and there is a potentiality of causing environmental degradation and other negative environmental impacts such as: loss of biodiversity, changes in climate pattern, increase in natural disaster mainly drought as a consequence of overuse of the natural resources in the near future.

In order to make the study area fit to carry or permit the current number of visitors visiting the study area sufficient facilities and services regarding waterfront tourism development must be provided and the repair, maintenance, control and management capacity of the development authority must be increased which will help to reduce the value of the limiting factors and increase the real carrying

capacity (the maximum permissible number of visitors) of the study area.

7. PLANNING INITIATIVES FOR SUSTAINABLE WATERFRONT TOURISM

The planning initiatives for the development of sustainable waterfront tourism in Rajshahi should focus on:

1) Development of tourism industry [7]
2) Industry relationship and communication
3) Careful and integrated visitors management
4) Accommodation of tourists [7]
5) Visitor flow management
6) Environmental impact management

8. AUTHOR'S RECOMMENDED SUSTAINABLE WATERFRONT TOURISM DEVELOPMENT STRATEGY

To achieve balance among the ecological, economic and social aspects and enhance visitors' satisfaction policy-level sustainable waterfront tourism strategy can play the most vital role.

1) Develop Padma waterfront as tourists spot with the evacuation of slums, properly designed modern facilities and services and improvement of security to attract outside visitors [8].
2) Maintain environmental quality through the Protection, enhancement and bring attention to the prime natural resources- the Padma river and its ecological system [8].
3) Create the legal, policy, administrative and social framework for successfully integrated conservation practices [7].
4) Develop partnerships and communication initiatives with the tourism industry to identify, design and implement alliances that leverage the strengths of the sector on behalf of the tourism promotion [8].
5) Assess, develop and disseminate good practice approaches and other mechanisms to promote, recognize and incentivize sustainable waterfront tourism practices [8].
6) Upgrade infrastructure in order to increase visitor capacity.
7) Divide the entire study area into several zones on the basis of usage of the area and provide different types of facilities in these zones to disseminate the visitors into these zones, which will help to reduce the tourists' pressure on one particular zone.
8) Impose entry fee on some zones on the basis of the usage and facilities of these zones which help to develop the local economy and further maintenance and management of the waterfront.
9) Control entry through some entry points by the provision of the fence to the whole area in order to ensure safety, security and beauty of the whole area.
10) Patronize those people who could make aware of energy and environmental conservation, water and air quality, recycling, safe management of waste and toxic materials, noise abatement, community involvement etc.

9. CONCLUDING REMARKS

The physical and real carrying capacity for the study has been calculated depending on the formulas proposed by Cifuentes (1992). Six corrective factors related to the climate conditions of Rajshahi were determined including excessive sunshine, humidity, rainfall, flood, overcrowding and infrastructure quality. The physical carrying capacity has been calculated at 4,87,963 tourists per day (without considering growing island of Padma) and 10,49,475 tourists per day (considering growing island of Padma) meaning that the maximum number of people who are allowed to enter the study area should never exceed this range. Regarding the physical carrying capacity, the real carrying capacity of the study area (without Padma island) has been calculated at 4,102 and considering the growing island of Padma it is about 8,823 visits per day respectively, that express the maximum permissible number of visits to this site but the current number of visitors visiting the study area is about 23,173 which is about 3 times and 6 times higher than the permissible number of visitors.

Again, assessment of carrying capacity is not a fixed term. It develops with time and the growth of tourism and can be affected by management techniques and controls. It can be changed or extended through the extended management capacities and management controls. This research could be acted as a basic reference for the carrying capacity promoting waterfront tourism in the bank of Padma River.

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