Estimation of Carrying Capacity in Historic City of Yazd for Walking Tourists during Nowruz Holidays

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Abstract

The purpose of this study is to estimate the physical, real, and effective tourism carrying capacity of one of the three pathways defined for walking tourists based on the Historic City of Yazd document in the UNESCO World Heritage List. In recent years, this pathway has been renovated. Mass arrival of tourists select it because of its older and larger number of historical buildings, boutique hotels and handicraft stores. In this research, a library-documentary approach, together with an analytical method, has been implemented. The data was collected from official sources and field studies as well as the data was consolidated by convening a panel of professionals. The total area of the main tourism pathway was first calculated using AutoCAD software based on urban map and, along with other information required in carrying capacity formulas, was embedded.

Resumen

El objetivo de este estudio es estimar la capacidad de carga turística física, real y efectiva de uno de los tres caminos definidos como caminables para turistas sobre la base del documento de la Ciudad Histórica de Yazd de la Lista del Patrimonio Mundial de la UNESCO. En los últimos años, este camino ha sido renovado. La llegada masiva de turistas por este camino se debe a la cantidad de edificios históricos, hoteles de boutique, y tiendas de artesanía. En esta investigación toma un enfoque bibliotecario-documental y aplica método analítico. Los datos se recopilaron de fuentes oficiales y estudios de campo, así como los datos se consolidaron mediante la convocatoria de un panel de profesionales. El área total de la vía turística principal se calculó primero utilizando el software de AutoCAD, basado en el mapa urbano y otra información necesaria en las fórmulas de capacidad de carga física.

Then, the number of allowed visitors was estimated based on existing limitations. The research findings show that the number of visitors in this area, based on official statistics, is far from its carrying capacity. Thereby, it is suggested that for high seasons, Nowruz Holidays in particular, measures should be taken to control the crowd of this area such as advertising alternative tourist attractions, leading the crowding population towards other pathways, planning distribution of tours, specifying time limit for tours, increasing the time spent visiting the site in the first half of the year, enhancing qualities of urban spaces, as well as organizing tour guides and local trained people to manage tourists.

Keywords: Tourism Carrying Capacity, Historic City, Walking Tours, Nowruz Holidays

Posteriormente, el número de visitantes permitidos se estimó en función de las limitaciones existentes. Los resultados de la investigación muestran que el número de visitantes en esta área, basado en estadísticas oficiales, está lejos de su capacidad de carga. Por lo tanto, se sugiere que para las temporadas altas, Vacaciones de Nowruz en particular. Se deben tomar medidas para controlar la multitud en esta área, tales como la publicidad de atracciones turísticas alternativas, llevando a la población de hacinamiento hacia otros caminos, la planificación y distribución de tours, especificando el límite de tiempo para los mismos, aumentando el tiempo dedicado a visitar el sitio en la primera mitad del año, potenciando las cualidades de los espacios urbanos, así como organizando guías turísticos y personas capacitadas localmente para gestionar a los turistas.

Palabras clave: Capacidad de carga turística, Ciudad Histórica, Visitas Guiadas a pie, Vacaciones Nowruz

Introduction

UNWTO's predictions on the growth of tourism demand up to 2030 show that global growth in international tourist arrivals will continue. This represents an increase of some 43 million international tourist arrivals every year. Based on these calculations, international tourist arrivals are anticipated to reach 1.8 billion by 2030 (World Tourism Organization, 2011). Cultural and heritage tourism forms important parts of the global tourism demand (Richards, 2000), and cultural and historical heritage factors inspire and motivate a substantial flow of tourists (García-Hernández, de la Calle-Vaquero, & Yubero, 2017).

When tourism grows extensively, it can influence carrying capacity and brings about certain consequences such as increased prostitution, gambling, drunkenness, noise pollution and congestion (Butler, 2006). The concept of tourism carrying capacity expresses how many visitors can be acceptable in a given destination. The importance of evaluating carrying capacity is due to its direct link with the management of tourism flows as a central policy issue (Coccossis & Mexa, 2004). Tourism carrying capacity is a multidimensional concept and it can be helpful to assist for the design of touristic flow management policy in an urban context (Massiani & Santoro, 2012).

In the field of urban tourism, the term 'urban' directly refers to the range of specific activities people get engaged in for pleasure while on holiday (Ashworth, 1992). After inscription of Historic City of Yazd in the UNESCO World Heritage List, the number of visitors to this area has frequently risen. For instance, the number of foreign tourists in 2017 was 113500, which reached 126066 in 2018 (Cultural Heritage and Handicrafts and Tourism Organization of Yazd Province,

2019). Specially, during the Nowruz Holidays, the number of domestic tourists increases considerably. This period is somewhat overlapping with the high season of foreign tourists. This number of visitors needs proper management to reduce the negative effects of tourism development. Management of flows could prove to be a more appropriate way to go, especially in historical centers (Coccossis, Mexa, Collovini, Parpairis, & Konstandoglou, 2001). Historical-heritage values in the field of urban tourism are among the main factors attracting tourists to these areas. Tourists visit urban historic environments, known as open-air and living museums, with adventurous motivations and spend a lot of time walking on pathways in the historic fabrics. In this regard, walkability should be an attraction for tourists in exploring places. Tourists can easily be attracted to cities which are outstanding destinations as large multifunctional entities and walk mainly within their urban spaces (Ujang & Muslim, 2014). Appropriate management of the footpaths can remarkably decrease the pressure of recreational activities on the adjacent environment (Cavan, 2011). Otherwise, too great an influx of tourists is a risk for the conservation of monuments and historic areas (ICOMOS, 2011).

In Historic City of Yazd inscription document of UNESCO World Heritage List, three pathways have been specified for walking tourists. In this study, the only renovated pathway with the highest number of visitors in recent years has been selected according to the professionals' opinions and authors' surveys. This pathway has the highest number of tourist attractions in comparison with other pathways due to the largest number of monuments, boutique hotels and handicraft stores. The aim of the present paper is to investigate the maximum number of visitors that can be allowed at this pathway of Historic City of Yazd based on existing management. The results are presented and discussed in the last section which provides an introduction for management of mass tourism especially during Nowruz Holidays.

Literature Review

CARRYING CAPACITY AND MEASUREMENT

Carrying capacity is based on the assumptions that population growth is eventually limited by a variety of environmental factors (Seidl & Tisdell, 1999). McCool and Lime (2001) express the concept of carrying capacity as originally developed in the fields of range and wildlife management and it was based on the sense which an organism can survive only within a limited range of physical conditions (Carey, 1993). Tourism Carrying Capacity (TCC) is a very broad concept and there exists a diversity of definitions of TCC dependent on the context of the study. The literature review demonstrates researchers from different disciplines have studied TCC leading to analyses from their own approaches, but at the same time complicating comprehension between scholars of the different fields. Regarding to the ecological approach, Clark (1996, p. 252) defines TCC as "… certain threshold level of tourism activity beyond which there will occur damage to the environment, including natural habitats". Mathieson and Wall (1982, p. 21) define TCC based on social approach "unacceptable declines in the quality of experiences gained by visitors". In line with Economic Approach, Lim (1998, p. 3) suggests a definition for TCC as "the level at which tourism interference with non-tourism activities becomes economically unacceptable". And finally, in context of physical approach, Middleton and Hawkins (1998, p. 239) present a definition for TCC as "... a measure of the tolerance of a site or building to tourist activity and the limit beyond which an area may suffer from the

adverse impacts of tourism". In sum, World Tourism Organization in a comprehensive definition of the carrying capacity stated "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" (McNeely, Thorsell, & Ceballos-Lascuráin, 1992, p. 5).

According to the literature, two approaches, namely quantitative and qualitative, have been used for the purpose of investigating TCC. Initially, some authors (Gartner, 1996; Inskeep, 1991; Pigram & Wahab, 1997; Saveriades, 2000) suggested that destinations should not be developed beyond their saturation points or innate capacities for tourism. Accordingly, planners and scholars should determine numerical capacities to ensure that unwanted consequences do not impact on the environment, tourism experiences and the community social fabric. In recent years, the carrying capacity approach has been shifted from determining a maximum number of visitors to the attainment of desirable conditions to recognize limits of acceptable change (Coccossis & Mexa, 2004) and from measuring this phenomena toward its understanding (Massiani & Santoro, 2012). In this regard, and in contrast with the quantitative approach, there is a critical view to the TCC concept. Some researchers (Hammitt & Cole, 1987; Leung & Marion, 2000; McCool & Lime, 2001) believe relationships between tourist use and impacts in term of ecological, social and economical conditions is non-linear because of the dynamic nature of human environmental systems. This dynamicity is due to the fact that ecological, social and economical carrying capacities change over time and severity of involvement, and exposure to tourism and tourists, also since each area has its specific carrying capacity thresholds and its own limits for acceptable change (Mansfeld & Jonas, 2006). In agreement with the critical view but an aspect that has been neglected, is the estimation of a physical carrying capacity associated with built environments. In this method, intervening with ecological, social and economic variables must be avoided since the built environment is largely a static or stable system. Salerno et al. (2013) state that TCC can be used as a starting point by organizations and institutions responsible for urban tourism to better inform tourism monitoring and planning.

The concept of TCC, in addition to calculating a specific number, refers to a methodology that can be implemented for minimizing environmental impacts and consequently generating useful data for decision-making in tourism planning (González-Guerrero, Olivares Robles, Valdez Pérez, Morales Ibarra, & Castañeda Martínez, 2016). Carrying capacity has a positive relationship with other decision-support systems for providing a quantitative estimation according to qualitative evaluations of the recognition phase (Rahmani, Fakhraee, Karami, & Kamari, 2015). Carrying capacity is usually considered as an interval and approximate value and due to its nature, it should be periodically measured and interpreted. For this purpose, constant monitoring needs to be done by using scientific methods and based on experts' opinions from different fields (Zelenka & Kacetl, 2014).

According to the knowledge of the researchers, no similar study has been conducted in the World Heritage sites with the same methodology and case study. In context of investigating tourism carrying capacity, two significant studies have been conducted in historical environments. Cimnaghi and Mussini (2015) employed a comprehensive methodology to assess the carrying capacity of two Italian cultural heritage sites (the National Museum of the arts of the XXI Century in Rome and the National Gallery of Marche in Urbino) as a way of providing

technical support for cultural development and tourism management policies. They suggested guidelines to improve the tourism product without generating negative impacts on the built heritage. In another study, Massiani and Santoro (2012) investigated the relationship between tourism management and sustainable development considering Venice (in Italy) as a case study. They considered the role of capacity in evaluating the consequences of tourism and fitted concepts of tourist capacity and tourism management into the Venice context.

In regard of implementation of quantitative method in assessing carrying capacity, previous studies can be categorized into three groups; ecotourism (Fadee, Ramezani, & Fadaee, 2013; González-Guerrero et al., 2016; Hoseinzadeh & Erfanian, 2015; Jalilian, Danehkar, & Mirsanjari, 2015; Kourandeh & Fataei, 2013; Movahedi, Amani, & Banikamali, 2013; Sadeghi, Rezaeyian, & Dehdar Dargahi, 2014; Tabibian, Setoodeh, Shayesteh, & Chalabianlu, 2007; Zacarias, Williams, & Newton, 2011), urban and rural setting (Noori, Rast Ghalam, & Amini, 2011; Pirmohammadzadeh, Zarepour, & Jalili, 2015; Rahmani et al., 2015; P. Rezaei & Ghahramanee, 2015; Shabani Fard, Pourahmad, Hosseini, & Rashidi, 2009), and historical building (Farhoodi & Shurcheh, 2005; Foroughi & Jafari, 2015). González-Guerrero et al. (2016) applied a technique in the Apatlaco Ecotourism Park, located in the area of influence of the Iztaccíhualtl Popocatépetl National Park (in Mexico). The methodology entails the calculation of physical, real and effective carrying capacity that together make up the TCC. Rahmani et al. (2015) computed physical, effective and real carrying capacity for extensive tourism in Eram Boulevard of Hamadan (in Iran) through comparison of the values obtained from calculations based on ecological vulnerability of ecosystems and ecological limitations using ArcGIS software. Foroughi and Jafari (2015) calculated the number of tourists which can physically and really attend the Sheikh Lotfollah Mosque of Isfahan (in Iran), based on determining the effective indices for estimating the capacity of the building through quantitative methods of TCC.

As mentioned above, TCC is implemented via quantitative and qualitative methods but generally most studies have used quantitative methods to determine the optimal number of visitors in a particular destination to be sustainable. This is because tourism impacts on cultural sites and TCC is a vital part of sustainable management, marketing and cultural attractions of historic cities (Pedersen, 2002; Timothy & Boyd, 2014; Van der Borg & Costa, 1993). Mediocre and small historic centers with high tourism attractiveness may be particularly sensitive to tourist densities because their local character and sense of place may endure rigorous changes during transformations made for tourism purposes (Bucurescu, 2015). Assessment of tourism carrying capacity of a walking pathway on a historic city scale as part of the World Heritage Sites can provide useful guidance for the implementation of future management plans and it could be an appropriate basis for assessing social and economic capacities.

CULTURAL HERITAGE TOURISM

Tourism is an opportunity for growing personality and constitutes a severe, mostly informal, learning experience, both for the traveler and for the host community. Despite the reasons driving it, in fact, tourism is intrinsically a cultural experience and a self-development opportunity for the travelers, who are exposed to various cultural traditions, lifestyles, and worldviews. Also, the host community can share their own identity and learn from the stranger. Tourism cultivates mutual understanding and fortifies the sense of belonging to a certain

cultural tradition, helps to decrease distances among people and social classes (Cravidão et al., 2018). Cultural tourism, based on the definition of European Association for Tourism and Leisure Education, is "the movement of persons to cultural attractions away from their normal place of residence, with the intention to gather new information and experiences to satisfy their cultural needs" (Richards, 1996, p. 24). Heritage tourism is mostly considered as being equivalent with various types of tourism, such as cultural, historical and arts tourism (Jordan, 2013). Zeppel and Hall (1992) and Richards (2001) consider heritage tourism as a subset of cultural tourism. Jamieson (1998, p. 65) offers a definition of cultural heritage tourism as "travel concerned with experiencing the visual and performing arts, heritage buildings, areas, landscapes, and special lifestyles, values, traditions and events".

Generally, distinctive signs of cultural heritage are historical buildings (Daifuku, 1968) and the existence of historical buildings, sites or monuments is the fundamental potential for the development of cultural heritage tourism (Hayati, 2014). Orbaşli (2000, p. 45) argues that "historic buildings, their associated relics, the morphological pattern of streets and spaces, and historical associations have all become tourist resources". Henderson (2002) argued that the historical buildings will be more meaningful if the buildings are related to the cultural landscapes and this is also the main aspect of cultural tourism for selling. Cultural heritage tourism, as a major segment of global tourism industry, has been rapidly growing and encountering high demands at World Heritage Sites, especially in recent decades (Jolliffe & Baum, 2001; Jordan & Jolliffe, 2013; Richards, 2003).

WORLD HERITAGE TOURISM IN HISTORIC CITIES

World Heritage refers to the designation for places on Earth that are of outstanding universal value to humanity and as such, have been inscribed on the World Heritage List to be protected for future generations to appreciate and enjoy (UNESCO, n.d.). To ensure, as far as possible, the proper identification, protection, conservation and presentation of the world's heritage, the Member States of UNESCO adopted the World Heritage Convention in 1972 (UNESCO, 2008). According to the 1972 Convention concerning the Protection of World Cultural and Natural Heritage, cultural heritage should be considered as "monuments", "sites", and "groups of buildings" (UNESCO, 1972, p. 2). The groups of buildings refer specifically to urban buildings corresponding to historic cities as indicated in the Operational Guidelines for the Implementation of the World Heritage Convention (UNESCO, 1987). The term historic city is brought up on the basis of the historic urban landscape approach (Bandarin & Van Oers, 2012). Over a long time, the historic urban environments, as the center of local urban life, have generally been formed based on social and cultural activities (Brambilla, De Gregorio, Maffei, Yuksel Can, & Ozcevik, 2007). The historical city center host the cultural heritage built upon time (Jordan & Jolliffe, 2013; Laws & Le Pelley, 2000). Visitor arrival tends to be focused in urban centers that sometimes overlap with historic centers and this phenomenon affects the city, especially in historic centers (García-Hernández et al., 2017). Therefore, the densest tourism areas are the historic city centers (García-Palomares, Gutiérrez, & Mínguez, 2015).

The inscription of a site on the World Heritage List brings an unavoidable and welcomed awareness and curiosity about the site and its outstanding values. It also grows certain activities that are proposed at the site and the number of tourists who visit it. If these are well planned

and organized respecting sustainable tourism principles, they can attract important funds and in kind contributions to the site and to the local economy. However, many World Heritage sites lack resources, experienced and trained personnel able to manage tourism as an advantage to the long-term preservation of their World Heritage values. It can prove a consuming process that requires the constitution of policies, environmental impact assessments and continuous monitoring (UNESCO, 2008).

If the destination does not equip itself with an appropriate or updated tourism management plan which notices the changes brought about by the UNESCO recognition, it might generate tension because tourism can lead to an abuse of spaces, commodification, rise of waste and resource utilization (Cravidão et al., 2018), and ignore risk of priceless monuments and the historic centres of cities (UNESCO, 1992).

URBAN WALKING TOURS

Walking is known as a public recreational, physical, and psychological activity that needs no specific equipment, facilities, or training (Hyun, Park, & Kim, 2016). Walking is one of the most popular activities undertaken by tourists during their travel (Hall, Ram, & Shoval, 2017). Most of the activities for tourists in urban destinations are taking place without the use of motorized vehicles because there is an inverse relationship between the speed and exploration of the destination, mainly by walking (Le-Klähn & Hall, 2015). Meanwhile, tourists tend to avoid wasting time in traffic (Shoval & Isaacson, 2006). In this sense, Walking is an Inclusive mode of movement (Wang & Kao, 2017) and is not a means of getting somewhere but it is the goal for informing us about a society's imaginaries (Hall et al., 2017; Karupiah & Bada, 2018). Walking tourists who travel for recreational purposes are motivated by the availability of footpaths, the attractiveness of the route such as interesting facades, a diversity of architecture, the absence of long, blank spaces, and the number of destinations within a walkable distance like workplaces and shops (Chhetri & Arrowsmith, 2008). Furthermore, walking gives the visitors the possibility of experiencing and interpreting their surrounding environment and provides opportunities to enjoy the nature, culture, and the landscape (Nyaupane, Lew, & Tatsugawa, 2014).

The roots of the Walking Tour date back to the nineteenth century when tourism promoters developed suggested guidebook to help tourists better enjoy their leisure trip. The tourists preferred walking to see the sights and to perceive local culture and history in that period of time. Nowadays, tourists also come to visit the sights (e.g. the streets, the squares, and the buildings) and try to understand and embrace the culture and life of a place. When visitors walk on streets as a set route of historic sites and look at highlighted points of interest along the way, they can involve themselves into the history (Gordon, 2014). There are significant differences between residents' and tourists' walking behaviors in urban environments, because tourists have limited time, budget and lack of knowledge about the urban space rather than permanent residents. Therefore, the visitors need mediators' knowledge, such as that provided by guide maps, platforms and social media, recommendations and word-of-mouth (Garay Tamajón & Cànoves Valiente, 2017) in selecting their pathways (Ram & Hall, 2018). Generally, a walking tour refers to an escorted tour by their length and their tour guides. Walking tours primarily last under 12 hours. They are often led, on foot, by guides that have more than a cursory knowledge of the sights covered on tour, and seek to explain and illuminate these sights in unique details,

such as historical, cultural and artistic significance (Thakur, 2013). Walking tours are able to form valuable memories embedded in place (Benton & Cecil, 2010; Harrison, 2012). In addition, walking tours can play a significant role in competitive marketing and promote tourist destinations (Nepal, 2005). Walkability can direct debates over destination carrying capacity and it is substantial that given growing concerns over tourism pressures in destination and urban environments (Ram & Hall, 2018).

NOWRUZ HOLIDAYS

Nowruz celebration has its roots in Zoroastrian religious tradition of Sasanian period (224 to 651 AD) in ancient Persia (presently known as Iran) (Sharma & Yosufi, 2018). Nowruz (pronounced no-rooz) is a compound of two Persian words. The first word "now" means new and the second word "ruz" means day and refers to "time"; together they mean "New Year". The beginning of the New Year happens when the season changes from winter to spring (Bashiri, 2001; Michael, 2014). Nowruz is celebrated on March 21 every year, a date originally determined by astronomical calculations (UNESCO, 2009). International Day of Nowruz was inscribed in 2009 on the Representative List of the Intangible Cultural Heritage of Humanity as a cultural tradition observed by numerous peoples (UNESCO, 2014). Many groups of people in the Black Sea basin, the Balkans, the Caucasus, Western Asia, central and southern Asia, and Iranians worldwide celebrate Nowruz annually and consider it to be one of their main national festivals (Ansari, Voorhies, Matthews, & Setork, 2013; Rostami, 2007). Nowruz Holidays last two weeks and marks at the beginning of "Farvardin", the first month of the Iran's official Solar Hejri calendar (Balafkan, 2009; Iranica, 2011). Nowruz Holiday in Iran is usually accompanied with a large number of domestic trips which have been increasing over the past several years (Hatami, 2011).

MATERIALS AND METHODS

STUDY AREA

Yazd province is one of 31 provinces of Iran, located in the central region of the country, between latitudes 29° 48′ to 33° 30′ N and longitudes 52° 45′ to 56° 30′ E. The province is bounded on the east by the Lut Desert and on the north by the Great Salt Desert. The weather in the area is hot and dry in summer, and cold and dry in winter. Yazd Township, the capital of Yazd province, is about 99.5 km2 and its altitude is about 1200 meters above sea level (Naghshan Consulant Engineers, 2008). According to the latest report of the Statistical Center of Iran (2016), the population of this city is 656474.

According to archaeological studies, Yazd province (Figure 1) has been one of the most important centers of prehistoric civilization with some of its villages and towns dating back to ca. 3500 years ago (Ja'fari, 1964). Since Yazd occupies a central region of Persia, it has always been a key route to other parts of the country since the Medes era (549-678 B.C.). During the Achaemenian period (330-550 B.C.), several centuries before the invasion of Alexander the Great to Iran, Yazd was a civilized region and played a strategic and communitive role. During the Sassanid period (224-651 A.D.), the historic fabric of Yazd did not develop until it was dominated by Muslims (Kateb Yazdi, 1979).

Figure 1 Location of Yazd province. Source: UNESCO (2017)

The Historic City of Yazd (Figure 2), with an area of 195 hectares, was inscribed as the first city of Iran in World Heritage Site at the 41st session of the UNESCO World Heritage Committee in July 2017 in Kraków, Poland. Earlier, Dolatabad Garden and Zarch Qanat, also located in this area, were inscribed in the UNESCO World Heritage List in 2011 and 2016, respectively (UNESCO, 2017). According to the experts and historical sources, the only area remaining away from the Islamic period is what today is called Fahadan Neighborhood (Kateb Yazdi, 1979). The pathway selected for this study is located in this area (Figure 3).

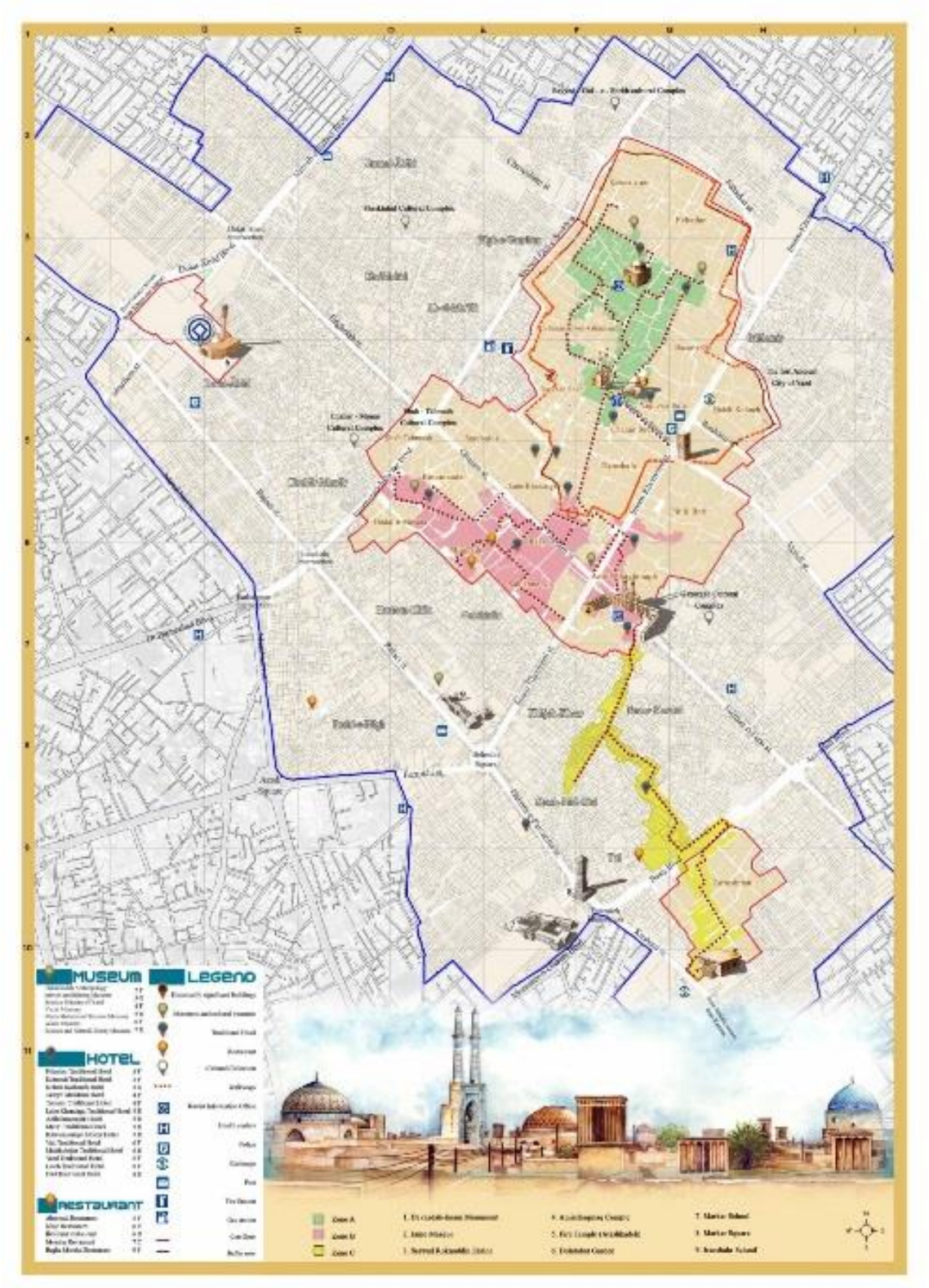

Figure 2 All Pathways within the Historic City of Yazd . Source: UNESCO (2017)

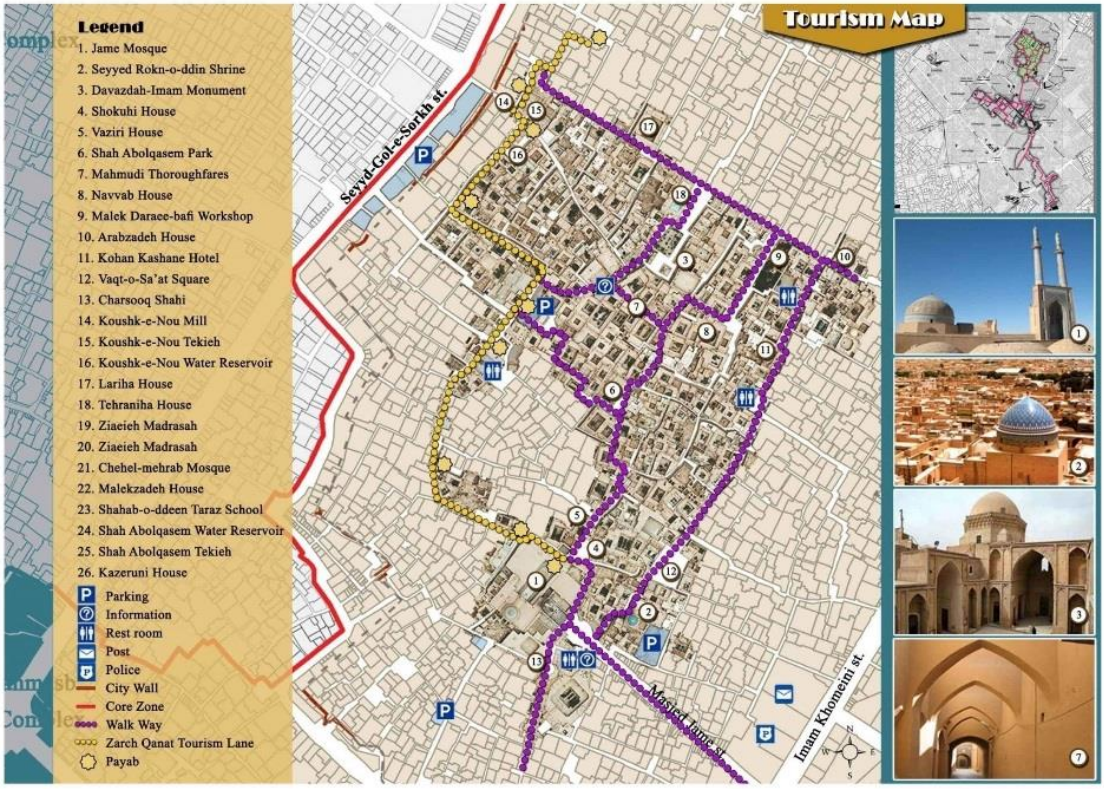

Figure 3 Studied Pathway within the Historic City of Yazd. Source: UNESCO (2017)

METHODOLOGY

The study adopted a library-documentary approach with an analytical method. The researchers performed assessment of urban maps (using AutoCAD software) and field studies (specification of period of location availability and the part of the pathway that lacks physical and visual qualities). The data was collected from sources such as Cultural Heritage and Handicrafts and Tourism Organization of Yazd Province (2019) (number of tourists during Nowruz Holidays), World Heritage Base of Historic City of Yazd (2015) (urban map), Yazd Meteorological Organization (2018) (number of extremely hot, very cold, freezing and dust storm days) as well as referring to professionals (selection the most crowded pathway among three pathways, specification of the average space required by visitors, determination average visit time and estimation number of ideal employees for managing hordes of visitors during Nowruz Holidays). The researchers convened panel of professionals from the whole range of academic and practical members of their specialism. The profile of professionals is described in Table 1.

Occupation	Education	Age	Gender
Director of Tourism Education Institute (Former head of Yazd Tour Guide Association)	Bachelor	39	Male
Expert of Tours Department of Cultural Heritage, Handicrafts and Tourism Organization of Yazd	Master	47	Male
Tour Guide	Bachelor	41	Male
Tour Guide and lecturer in Tourism and Tour Guiding	Ph.D. Student	32	Female

Table 1 Sources of Information from the Professionals . Source: Prepared by the author. Based on the researchers' field surveys, the following photos represent the population in the studied area in Nowruz Holidays compared with normal days (Figure 4 and 5).

Figure 4 Different views of the studied area in Nowruz Holidays (upper part) compared with normal days (lower part). Source: Prepared by the author

Figure 5 Different views of the studied area in Nowruz Holidays (right) compared with normal days (left). Source: Prepared by the author

According to the official statistics, number of tourists during Nowruz Holidays is presented in Table 2.

	Year				
	2015	2016	2017	2018	2019
Population	624624	900967	776409	852350	1908000

Table 2 Number of tourists who visited Yazd province during Nowruz Holidays . Source: Cultural Heritage and Handicrafts and Tourism Organization of Yazd Province (2019)

PHYSICAL CARRYING CAPACITY (PCC)

Pcc can be defined as the maximum number of tourists who may visit the specific area over a particular time. This number can be calculated from the following relationship:

$$Pcc = A \times \frac{v}{a} R_f \qquad (1)$$

where A is the total size of the area, $\frac{v}{a}$ is the amount of area that each visitor needs to move easily without any interference from physical objects or people (under normal conditions, this amount is about 1 square meters per individual and it will be determined according to the experts such as tour guides, based on characteristics of any regions and tourism activities), and R_f or rotation factor is the number of daily visits and is calculated as follows:

$$Rf = \frac{period\ of\ location\ availability}{average\ visit\ time} \qquad (2)$$

REAL CARRYING CAPACITY (RCC)

Rcc refers to the maximum number of visitors who are allowed to attend the area, given the limiting factors (caused by specific conditions of the place and their impact on physical carrying capacity). These factors are determined with consideration of the ecological, social and physical variables. This value is calculated via the following equation:

$$Rcc = Pcc - Cf_1 - Cf_2 - \cdots - Cf_x \qquad (3)$$

where Cf or constraint factors are the limiting factors that are expressed in percentages. So the formula can be expressed as follows:

$$Rcc = Pcc \times \left(\frac{100 - Cf_1}{100}\right) \times \left(\frac{100 - Cf_2}{100}\right) \times \ldots \times \left(\frac{100 - Cf_x}{100}\right) \qquad (4)$$

Each limiting factor is calculated by the following relationship:

$$Cf = \frac{M_1}{M_+} \times 100 \qquad (5)$$

where M_1 is limiting value of a variable and M_+ is the total value of a variable.

EFFECTIVE CARRYING CAPACITY (ECC)

Ecc is the maximum number of visitors attending a specific area which the existing management can handle in a sustainable manner.

$$Cf = Rcc \times Mc \qquad (6)$$

where Mc is management capacity and can be determined using the following equation:

$$Mc = \frac{100-Fm}{100} \qquad (7)$$

where Fm is management Adjustment factor and is computed by the following relationship:

$$Fm = \frac{Imc-Amc}{Imc} \times 100 \qquad (8)$$

where Imc or ideal management capacity is the number of ideal facilities for the sustainable tourism management and Amc or actual management capacity denotes the number of existing facilities. In this research, the management capacity is considered as the number of employees who are involved in the field of tourism deputy at Cultural Heritage, Handicrafts and Tourism Organization of Yazd Province.

Data Analysis

CALCULATING PCC

The constituents of equation (1) for the visitors' pathway of the Historic City of Yazd are as follows:

The total area in square meters which was calculated using AutoCAD software based on urban map:

$$A = 17272$$

According to professionals' opinion, the average space requirement for an individual was considered to be 3 square meters for extensive tourism consistent with natural conditions and without causing disturbance to others is according to the following equation:

$$\frac{v}{a} = \frac{1}{3}$$

According to authors' survey, the appropriate duration is 12 hours for visiting the area daily and also based on professionals' opinion, 4 hours is the average duration needed for the visit as follows:

$$Rf = \left(\frac{12}{4}\right)$$

Thus, Pcc is calculated as follows:

$$Pcc = 17272 \times \frac{1}{3} \times 3 = 17272$$

CALCULATING RCC

According to equation (4), Cf is expressed in percentage and calculated as follows:

After the authors' survey, the area of the part of the pathway that lacks physical and visual qualities using AutoCAD software was calculated:

$$Cf_1 = \frac{1079}{17272} \times 100 = 6.24\ \%$$

According to Yazd Meteorological Organization (2018), the average number of extremely hot days in a year based on 10-year statistics is calculated as follows:

$$Cf_2 = \frac{64}{365} \times 100 = 17.53\ \%$$

According to Yazd Meteorological Organization (2018), the average number of very cold and freezing days in a year based on 10-year statistics is as follows:

$$Cf_3 = \frac{59}{365} \times 100 = 16.16\ \%$$

According to Yazd Meteorological Organization (2018), the average number of dust storm days in a year based on 10-year statistics is as follows:

$$Cf_4 = \frac{1}{365} \times 100 = 0.27\ \%$$

Thus, Rcc is computed as follows:

$$Rcc = 17272 \times \left(\frac{100 - 6.24}{100}\right) \times \left(\frac{100 - 17.53}{100}\right) \times \left(\frac{100 - 16.16}{100}\right) \times \left(\frac{100 - 0.27}{100}\right) = 10823$$

CALCULATING ECC

The constituents of equation (6) for the visitors' pathway of the Historic City of Yazd are as follows:

At present, there are 19 personnel, including 11 employees and 8 operational staffs. After the discussion, the professionals concluded that the number of employees of Yazd Cultural Heritage, Handicrafts and Tourism Organization is adequate, but due to multiplicity of the historical buildings in the area, the number of operational staffs does not meet the needs and 16 more staffs are required, including 8 in charge of tourist information, 7 in charge of the historical buildings and 1 supervisor and coordinator between the administrative and operational departments.

$$Fm = \frac{35 - 19}{35} \times 100 = 45.71$$
$$Mc = \frac{100 - 45.71}{100} = 0.54$$

Thus, Ecc is computed as follows:

$$Ecc = 10823 \times 0.54 = 5844$$

Discussion and Conclusion

Tourism Carrying Capacity (TCC) is a very broad concept which is difficult to define uniformly. Attempts have been made by different researchers stating various definitions of carrying capacity according to their field of study. The concept of carrying capacity has arisen from ecological topics (Carey, 1993; McCool & Lime, 2001). Initially, some authors recommended determining it based on numerical methods. Later, some other researchers criticized this method because the social, ecological, and economic subjects have dynamic variables and could not be obtained by linear calculations. Nevertheless, beyond being a numerical calculation, the TCC helps to identify weaknesses and minimise impacts through measures based on analysis, including strategies for visitor management of built environments such as urban fabric and historical building (López-Bonilla and López-Bonilla, 2008, cited in González-Guerrero et al., 2016). In line with the physical approach implemented in this study, the stable variables include climate, management capabilities, visit time, etc. From this view, The World Tourism Organization defines carrying capacity as "the level of visitors' use an area can accommodate" (cited in Buckley, 1999, p. 706). In practice, determining the carrying capacity is neither easy nor highly precise. It depends considerably on the assumptions to be made, and as such, carrying capacity can change over time. However, estimating carrying capacity is a useful technic in planning to achieve a sustainable level of development of tourism activities (Foroughi & Zahedi, 2015).

Sites that are inscribed in the UNESCO's World Heritage List are an important source of cultural heritage tourists for their outstanding universal values. After the inscription, the number of visitors is usually increased. One of the challenges facing historic cities as one of the subcategories of cultural heritage sites is the lack of readiness to deal with a large number of visitors. Hence, these destinations need to be equipped with tourism management plan in order to minimize the negative impacts of excessive tourism development (Chai, 2011; Cravidão et al., 2018).

In Historic City of Yazd inscription document of UNESCO World Heritage List, three pathways have been specified for walking tourists. According to the professionals' opinions and authors' surveys, one of these pathways has been selected which renovated recently. This pathway hosts the highest number of visitors in comparison with other pathways due to the largest number of monuments, boutique hotels and handicraft stores. Based on the official statistics, during the Nowruz Holidays of 2019, about 106000 individuals stayed in Yazd province daily and their main destination was the Historic City of Yazd.

Following the methodology of González-Guerrero et al. (2016), Rahmani et al. (2015) and Zacarias et al. (2011) for the estimation of the TCC, the number of tourists is approximately 6.1 times the physical capacity, 9.8 times the real capacity, and 18.1 times the effective capacity of the studied area which was calculated. Zacarias et al. (2011) express that Pcc value is only theoretical and in order to obtain Rcc, correction factors derived from the particular characteristics of the site must be used to correct Pcc. Then, given the value of physical carrying capacity (17272 people per day) and effective carrying capacity (5844 people per day), it can be

concluded that the Ecc in the studied area is approximately 34% of Pcc and this number of visitors even exceeds the Pcc of the studied pathway during Nowruz Holidays 2019. Therefore, due to the crowd, the required area for each tourist reduces, and, subsequently, the time of the visit increases.

Unlike Rahmani et al. (2015) and Tabibian et al. (2007) who estimated the amount of Mc basis of the unclear calculations, in this research, the panel of professionals was convened and according to their estimations, actual management capacity (Amc) of Cultural Heritage, Handicrafts and Tourism Organization of Yazd Province is about 54% of ideal management capacity (Imc) while these 19 employees usually do not attend the Organization at the same time. Anyway, it should be noted that Ecc does not go beyond real carrying capacity and actual management capacity can lead to use of a zone to the maximum level of Rcc and not above it (Nasrollahi, 2010). Thus, Cultural Heritage, Handicrafts and Tourism Organization of Yazd Province needs 35 personnel, under normal conditions, to manage 10823 visitors, but in the high season such as Nowruz Holidays 2019, 343 staffs are required to manage 106000 visitors daily. On other days of the year, even during international tourist high seasons (April, May, September, October and November), the number of visitors is smaller than Ecc, and it exceeds just during two weeks of Nowruz Holidays.

According to the literature review, TCC strategies can be divided into two extensive categories. The first category is when the number of visitors is smaller than the TCC and the second category is when the number of visitors exceeds the TCC. Researchers such as Massiani and Santoro (2012), Rahmani et al. (2015) and Tabibian et al. (2007), in their case studies, have concluded that the pressures of visitors are more than TCC, suggesting strategies like using compensatory approaches to shift some of the demands to non-peak periods, controlling and distributing the tourist flows in different times and places, considering reasonable alternatives, increasing entrance charges during peak periods, and using new techniques to simulate sites for reducing time per visit.

On the other hand, researchers such as Cimnaghi and Mussini (2015) and González-Guerrero et al. (2016) argue that the number of visitors in their study areas is smaller than TCC and, therefore, suggest strategies including enhancing accessibility, developing marketing, providing tourism information and reinforcing personnel and equipment.

In order to optimize Pcc that includes A (the total size of the area), $\frac{v}{a}$ (the amount of area that each visitor needs to move easily without any interference from physical objects or people), and R_f (rotation factor is the number of daily visits), the following strategies can be suggested during the peak periods, especially Nowruz Holidays: providing convenient facilities and advertising alternative tourist attractions in other pathways also leading the crowding population to the two other specified pathways to extend A; planning distribution of tours throughout the day to avoid overlapping to regulate $\frac{v}{a}$; specifying time limit according to the number of tours members as well as increasing the time spent visiting the site in the first six months of the year due to long days to enhance R_f.

In regard of optimizing Rcc, it should be considered that among Cf or limiting factors (caused by specific conditions of the place and their impact on physical carrying capacity), climatic factors are fixed and only the factor related to physical environment is modifiable. Therefore, making suitable pavement, restoring facades for urban spaces and lighting in part of the pathway that does not have physical and visual qualities can be suggested.

Since Mc (management capacity) affects Ecc and it is not possible to provide trained staffs for the short periods of time apparently, organizing tour guides and local trained people to manage the flow of tourists who attend in site can be an appropriate strategy.

Eventually, during normal days when the number of visitors is low, hospitality marketing such as contracting hotels, restaurants, and travel agencies to offer discounts; holding events such as conferences, celebrations; and holding student tours can be implemented to reach TCC.

The limitations encountered by the researchers during the study include the lack of accurate and daily statistics on the number of tourists visiting the Historic City of Yazd during Nowruz Holidays. Other researchers can calculate the carrying capacity of the existing historical buildings in the area as well as the two other pathways specified in the UNESCO document. They also can consider the social and economical approaches in their qualitative evaluations. However, it should be noted, as N. Rezaei (2017) states, that tourism in historic center of Yazd is in its early stages of development and thus, the evaluation of socio-economic impacts requires more time to pass. The results of this study can be used by organizations and institutions responsible for tourism and urban management for future planning. The main contribution of this research is the assessment of TCC of a walking pathway on a historic city scale. Since the attendance of tourists at World Heritage Sites should be monitored and presented to UNESCO in form of periodic reports, the authors choose the Historic City of Yazd, as part of the World Heritage Sites to estimate TCC. The previous studies were limited to historical buildings, ancient sites or ecotourism.

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