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Determining the ecological capability of forest park Heydareh in Hamadan city, approach to carrying capacity model

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Abstract

Carrying Capacity is based on understanding the limits of acceptable change in indicators of environmental quality, is widely used in urban, regional and tourism planning. Therefore, a scientific, applied understanding of the estimation of carrying capacity and creating consensus amongst planners, researchers and executives of development programmers are prerequisites of the application of this method. The study adopted a descriptive-analytical method and was conducted as a documentary study. The methodological concepts, components and framework of quantitative estimation of carrying capacity of land zones were identified through a systematic study. The analysis was conducted based on a sample of quantitative usage of carrying capacity in tourism development planning to determine the ecological capability of Forest Park Heydareh (Velayat) in Hamadan city using ArcGIS software in synthesis and overlapping the layers. The analysis was carried out using paired comparison method and an hourly model, which aimed to develop approaches to protect and increase the environmental capability of tourism industry in the studied area. The results showed that considerable decrease in the estimated allowable number of visitors - resulted from imposing ecological limitations and encouraging the private sector, NGOs and mass media about environmental knowledge and ecotourism – may significantly influence the planning process the Forest Park Heydareh (Velayat) in Hamadan city.

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Introduction

In the process of land planning and management, recognizing land capabilities and suitability for different usages as well as utilizing quantitative methods of estimating the usage proportion of available resources across certain limits of the territory within specific planning time units play a crucial role in designing and management of the territory. Experience dictates that many top policy- and decision-makers, who preside over the planning process and seek to make decisions based on specific, measureable goals for land exploitation and sustainable management, hunt for clear, simple and preferably quantitative responses for the following substantial questions:

- What location or location alternatives are suitable for the respective activities?

- What are the consequences of the activities and how would it be possible to make the best utilization of land and resources with the least damages and harms?

- What is the land capacity for providing sustainable, suitable services and bearing the load of respective activities and uses within the planning period?

On the other hand, the experts who undertake to answer the above questions face a complicated, capricious issue that requires appropriate methods to understand analysis and predict. Various approaches have been proposed over the last decades to provide reasonable, justifiable responses to the questions, which may methodologically be categorized into three groups including approaches to evaluation of land capability, proportion and resources, evaluation methods of environmental impact and approaches to estimating land carrying capacity. The first category deals with understanding, classification and determining land capabilities, characteristics and suitability for one or more uses consistent with the compatibility between the respective uses across a certain management territory. The second category comprises different approaches to evaluating environmental impacts at various strategic, designing, planning and project levels, which are considered as suitable tools for various scenarios of environmental degradation caused by implementation of development programmers, which would help the planners understand, though qualitatively, the limits of acceptable change in the environment (Tabibian *et al.*, 2007, p.18). Although these two approaches were used as the basis of land planning and usage in many countries including Iran until a few decades ago, they failed to provide quantitative values as to land resources usability. In this regard, the third category developed to estimate land carrying capacity is considered as an effective tool in combination with other categories for planning, particularly for land uses policies. In order to use this approach, physical planning experts need a scientific, applied understanding of the principles, framework and methodological requirements of land uses values. They also need to build consensus amongst assessors, decision-makers and executives in conceptual terms and in terms of the estimation results. These are the prerequisites of the third approach particularly in the countries embarking on development (Fouladvand, 2008, p.21). Land use and regional planning was a central issue in the third five-year development plan of Iran, which has been extended into the fourth five-year development plan as a critical approach. It seems that the realization of government policies on the fair allocation of resources to physical spaces and a sustainable, balanced development require special attention paid to actual local capacities consistent with local demands and the type of development. The implementation of carrying capacity approach and its applicable techniques in different development segments, particularly in planning social and cultural activities such as urban development planning and tourism development, may be an effective measure to achieve this goal. In this regard, the research and academic community may play a significant role.

Study methods

The study adopted an analytical-comparative method with a library-documentary approach. The researchers performed direct and indirect observation, examination of aerial photographs and field studies. The data was collected from such sources as Statistical Yearbook of Hamadan Province (2011), Detailed Plan of Hamadan City (2005) as well as referring to state organizations such as municipality, Administration of Cultural Heritage, Handicrafts and Tourism of Hamadan Province and Statistics and Information Office of Hamadan Governorate. The data was analyzed using ArcGIS software to synthesize and overlay the layers through paired comparison method and an hourly model. The ecological capability of Forest Park Heydareh (Velayat) in Hamadan city was determined by using the quantitative approach to estimating carrying capacity.

Literature review

The concept of carrying capacity and its application in tourism planning and management in Iran dates back to about one decade ago so that there is scarcity of scholarly research on the topic. Jouzi *et al.* (2009) conducted a study entitled 'evaluation of ecological capability of Bulhasan region of Dezful to implement tourism usage using multi-criteria decision-making'. Weighting the criteria using Analytical Hierarchy Process, they found that about 74.18% of the region had 'great' capability, 18.21% had 'good' capability and 7.7% had 'unsuitable' capability for extensive tourism while 32.87% had 'great' capability, 15.6% had 'good' capability and 51.61% had 'unsuitable' capability for intensive tourism. Nahreli and Rezaie (2002) investigated the carrying capacity based on various recreational activities, the type of resorts and their relative capacities. They reported that the disregard for this issue may seriously endanger the sustainability of recreational resources. In a study entitled 'investigation of the concepts and quantitative approaches to carrying capacity and proposing an applicable model based on the strategic planning experience of tourism development in Abbasabad Valley, Ganjnameh, Hamadan', Tabibian *et al.* (2007) systematically introduced and analysed the concepts, components and methodological framework of quantitative estimation of land carrying capacity. In two studies entitled 'investigation and introduction of recreational carrying capacity' and 'investigating urban tourist carrying capacity and modeling sustainable tourist cities from physical perspective (Case study: Tehran 12 municipality district)', Shabanifard *et al.* (2009) analyzed their data by using the model proposed by International Union for Conservation of Nature (IUCN) to examine the carrying capacity and the quality of tourism experience in terms of physical, real and effective dimensions. They reported that the number of tourists entering the studied district of the city was greater than the de facto carrying capacity so that the tourism development had an unsustainable form in the district.

Theoretical foundations

Carrying capacity theory and concept

In the development process of environmental management and planning, the concept of carrying capacity was first tailored to address biological and biophysical concepts (Stankey *et al.*, 1990, p.274) so that until early 1970s, estimation of carrying capacity was mainly used in pasture management to estimate ecological capability of pastures. With the advent of the concept of human sustainable development in early 1970s and the introduction of economic and environmental sustainable development in 1990s that addressed three essential indexes including welfare, economic productivity and healthy environment as the principles of sustainable development, carrying capacity was considered as a suitable tool to estimate each of the three indexes above besides other measures of development indexes. At the same time, the increasing trend of excessive exploitation of natural resources, pollution, environmental degradation and crises required approaches to convert degraded (human-built) ecosystems to adapted ecosystems. Under such circumstances, estimation of land carrying capacity and optimization

or adjustment of the threshold of changes was used as one of the control and monitoring methods of changes in natural resources and departure-destination balance. The application of carrying capacity in tourism development planning in the mid-1990s contributed to considerable progress so that new concepts such as social and psychological carrying capacity were introduced into environmental evaluation literature, which was a turning point in the application of this concept (Graefe *et al.*, 1984, pp.273-284). Carrying capacity is variously defined; however, all definitions share a common point that is changes in the impact indication. In other words, what gains more importance in estimating carrying capacity is a type of compromise between maximizing and optimizing in order to achieve an acceptable limit of change in thresholds and indicators of the impact. The need for such compromise results from the dramatic difference between natural and human carrying capacity: based on IUCN's definition, natural carrying capacity is an ecosystem's capacity to sustain a certain number of living organisms while maintaining their productivity, adaptability and renewability(Hardy & Beeton, 2001; Medeiros de Araujo & Bramwell. 2002; Jamal & Stronza, 2009).

Besides, based on the definition provided by the University of Michigan in 1998, human carrying capacity is the maximum resource consumption and effluent discharge that may be continued infinitely without any disturbance of ecosystem performance integrity and processing capability (City Fabric Consultant Engineers, 2002). In this regard, in ecosystem terms, carrying capacity is defined as the maximum population of a certain species that may be sustained by a certain area of land or habitat at the present time without any reduction or risk of threat to the survival of the future generation of that species. In general, the carrying capacity at the ecosystem level has been defined as the degree to which a process or environmental variable within an ecosystem may change without the structure or performance of the ecosystem exceeding certain limits (Duarte *et al.*, 2003, pp.109-143).

Considering the principles delineated in the above definitions, the theoretical framework of the present study was based on the applied definition of the carrying capacity presented by the World Tourism Organization: the maximum number of visitors to a tourist region in a specific time without making any change or disturbance in the physical, economic, social and cultural environment and without suffering any unacceptable reduction in tourists' satisfaction (WTO, PAP/RAC, 1992, p.5).

Types of carrying capacity

Since categorization is considered as the methodological basis of carrying capacity, different types of carrying capacity based on Hunter classification are as follows:

- Physical carrying capacity indicates the actual and physical numbers, capacity and volume without considering the ecosystem performance and includes part of a region beyond which environmental changes, disorders or issues occur.

- Perceptual carrying capacity is the least degree of desirability and pleasure the users of a developed region are prepared to accept before embarking on finding another alternative for the same usage.

- Social carrying capacity refers to the tolerance level of the host population in a developing region to bear the presence and behavior of new users and/or the degree to which they are prepared to accept the congestion of new users.

- Economic carrying capacity is the ability to accept and attract new development activities without displacement or disturbance of desirable local uses and activities. In the methodology devised by IUCN to estimate natural habitat carrying capacity for tourism purposes, three carrying capacities are addressed including physical carrying capacity (Pcc), real carrying capacity (Rcc) and effective carrying capacity (Ecc), which will be delineated below (Fouladvand, 2008, p.33).

The status of carrying capacity in planning and management system of environment and tourism development

In land planning and management system, estimating environmental carrying capacity is used as a holistic approach and supporting tool for decisions. Evaluation of carrying capacity is used to quantify the extent that land resources are used and as a benchmark for identification and monitoring the threshold of changes and tensions in natural ecosystems as well as final evaluation, control and monitoring of disorders and degradation of ecosystems. Fig. 1 illustrates the status of carrying capacity in environmental planning and management system for tourism development. In this figure illustrated based on Garrigos and colleagues' approach and analyses (Garrigos *et al.*, 2004, pp.275-283), the status of carrying capacity was determined based on the following premises:

- Carrying capacity is used as the decision-support system in direct relationship with other decision-support systems in order to provide a quantitative estimate based on qualitative evaluations of the recognition phase.

- Ecosystems are considered as open systems, and carrying capacity is consistent with the equilibrium in ecosystem-management relationship.

- Despite other decision-support systems, carrying capacity is a dynamic process that aims to adjust degraded and stressed ecosystems into adapted ecosystems using continuous and consistent feedback.

- Since the four ecosystems share a common ground, carrying capacity is defined for various uses (Makhdoum *et al.*, 2006).

Approaches to estimating the carrying capacity

As discussed above, the interface of all approaches to estimating carrying capacity is recognition and determination of limits of acceptable change, which is the basis of estimations. When approaches to estimating land carrying capacity are used to sustain development activities in a certain territory and planning period, the consistency among policies, proactive planning, admitting growth limits and commitment to a long-term perspective will be the prerequisite of objectives, which should be considered in the early stages of planning (Butler, 2000, pp.7-14). One of the criticisms to carrying capacity is the abstract nature and inconsistency of the computed values with realities in a specific region (Papageorgiou & Brotherton, 1999; Buckley, 1999, pp.275-284). Lack of a comprehensive definition of the carrying capacity, the changing nature of this concept and numerous approaches to estimation account for such criticisms. Consequently, a framework was developed in 1985 to determine limits of acceptable change (LAC) in order to operationalize this concept and realize the necessary prerequisites (Stankey *et al.*, 1990, p.280). As a management process, LAC is used to find a logical relationship between the status quo and desired, acceptable conditions in a region or land territory and provides suitable strategies for optimal use of the region through recognizing the problems and relying on management judgments. LAC provides the planners and decision makers with the planning and decision-making framework and facilitates the estimation of carrying capacity through conventional approaches (Stankey *et al.*, 1990, p.281). The concept of LAC contributes to this study as the final value computed for carrying capacity will be void of operational and managerial content without taking into account the considerations in LAC framework. Various approaches are used to estimate physical, ecological, social and perceptual carrying capacities. Some of these methods include weighted valuation, multi-criteria ranking of capacity, managerial model of adapted ecosystem, ecological footprint models and other simple and compound models (Prato, 2001; Lee *et al.*, 2000). One of the applied approaches to estimating carrying capacity is the guideline proposed by IUCN in 1996 to be used for computing the carrying capacity of regions suitable for tourism development inside the protected zones (Stankey *et al.*, 1990, p.281).

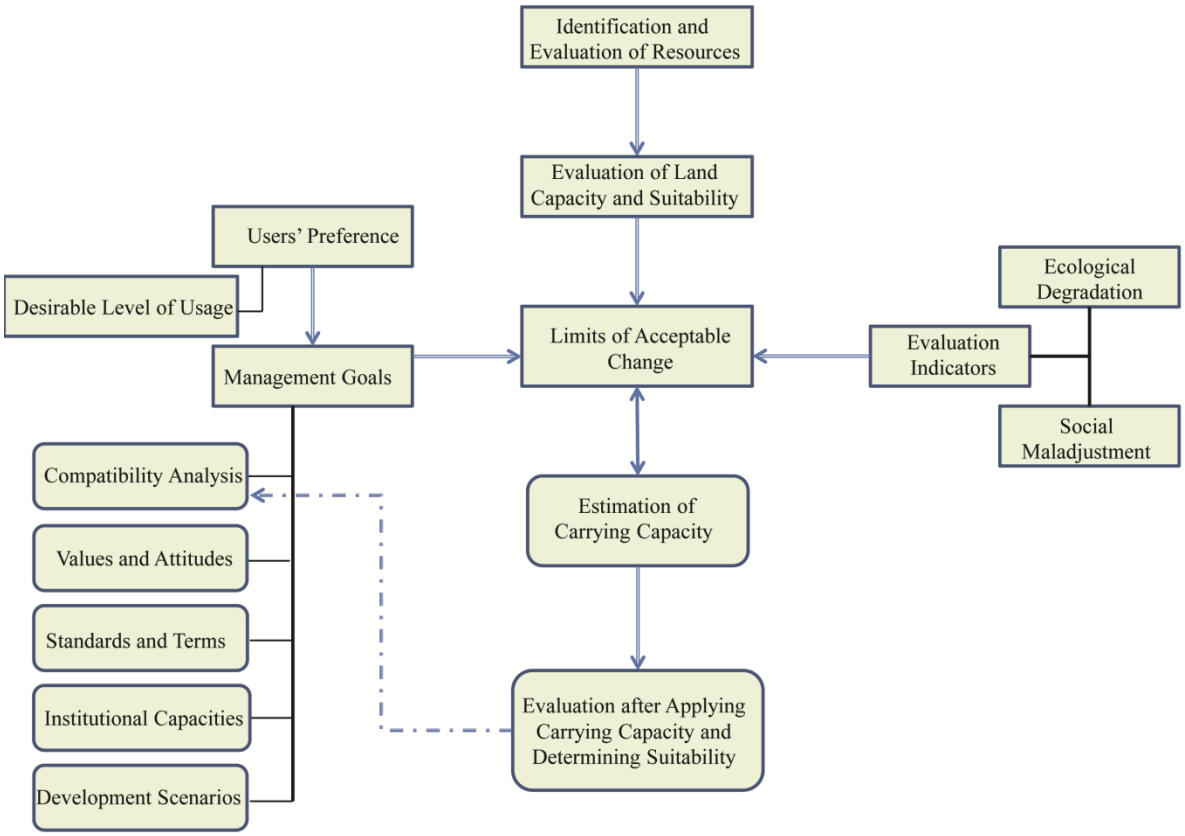

Fig. 1. Flowchart of the status of carrying capacity in environmental planning and management system in tourism development

Physical carrying capacity (Pcc)

Pcc refers to the maximum number of visitors who may attend the same place at the same time. This number can be calculated via the following formula for tourist regions:

$$Pcc = A \times {}^{v}/_{a} \times Rf \qquad (1)$$

Where A is the area of the tourism zone; ${}^{v}/_{a}$ is the amount of space every visitor needs to be able to move freely without any interference from physical objects or people (under normal conditions, this amount is about 4 square meters per individual and is variable in a mass tourist activity based on natural barriers, region sensitivity and/or safety considerations); and Rf is the daily number of visits paid to a certain place, which is calculated as follows:

R*f*= Period of location availability/Average visit time (2)

Real carrying capacity (Rcc)

Rcc is the maximum number of visitors to a resort who are allowed to attend the place consistent with the limiting factors caused by specific conditions of the location and the impact of these conditions on Pcc. These limiting factors are considered in terms of biophysical, ecological, social and managerial variables. Rcc is computed via the following equation where CF is a limiting factor expressed in percent, M_1 is the limiting value of a variable and M_+ is the total value of a variable.

$$Rcc = Pcc - Cf1 - Cf2 - \ldots - Cfx \qquad (3)$$

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

$$CF = M/M_+ \times 100 \qquad (5)$$

Effective carrying capacity (Ecc)

Ecc is the maximum number of visitors to a place that the existing management can handle in sustainable manner. Management capacities constitute a set of

conditions that the local management needs in order to achieve its goals and fulfill its functions. Various variables are involved in quantitative estimation of these capacities, including policies, rules and regulations, infrastructural facilities, equipment, manpower and financial resources. A lack of such management capacities is one of the most serious problems in the management of tourist areas in developing countries. Notably, one should remember that Ecc may never exceed Rcc so that management capacities can facilitate the usage of a territory to its Rcc limit but not beyond (Makhdoum, 2004).

The concept of tourism and tourist based on the definition provided by World Tourism Organization, tourist (for census purposes), is a visitor who visits a place for at least one night and whose main purpose is to derive pleasure, relax, do business and professional activities and other tourism activities (Chok *et al*., 2007, p.145).

Tourist hotspot refers to the focal location and center of gravity of attractions in a tourist region. The hotspot may constitute a village, a set of attractions altogether or a combination of both (Hall, 2008, p.34; Hjalager, 2010, p.2).

Tourist area is part of a tourism region containing recreational resources and capacities and involving spatial and physical integrity. Besides geographical coherence, a tourist area has an independent network of roads (Hall, 2007, p.113).

Tourism planning and its characteristics

Tourism planning aims to understand and provide for the requirements of the fulfillment of tourism development goals, minimize negative impacts and utilize its positive outcomes. Tourism planning should bear the following characteristics: it should be creative, dynamic, innovative, coordinative of internal constituents (supply and demand) and flexible; it should also emphasize the sustainability of development and be practical (Vaspour Tourism Consultant engineers, 2012).

Forest Park Heydareh(Velayat) in Hamadan city

Hamadan is located in the west of Iran in a mountainous region and is the provincial center of Hamadan Province. It lies on the northern slope of Mount Alvand, standing 1800 meters above the sea level. It has a cold climate. The overall gradient of the city is along south-north direction with 48.32º east altitude and 34.48º north latitude (Detailed Plan of Hamadan City, 2005). Hamadan is one of the oldest cities in Iran and in the world. In 2006, The Islamic Consultative Assembly of Iran announced Hamadan as the Capital of Iranian History and Civilization. Hamadan is the fourteenth most populous city in Iran and was introduced as a megacity in 2009 (Statistical Yearbook of Hamadan Province, 2011).

The study area in south-western of Hamadan city and northern slopes of Mount Alvand mountain range is located (Consulting engineers and dynamic strategies, 2010). This region with an area of about 101 hectares is located at longitude 48° 27′ 19″ & 48° 28′ 23″, latitude 34° 47′ 23″ & 34° 48′ 5″. Maximum area height 2181/2 meters and minimum its height equal to 1831/3 and also average elevation is 1995 meters from sea level. Forest Park Heydareh (Velayat) exceptional position, with prospect its interactive than Maryanaj and Hamadan cities, and exposure to beside a collection of attractions, recreation and tourism, with various historical and religious functions, cultural, scientific and recreational People desire along with the, Hamadan, for leisure in the lap of nature along with family, as well as the Alvand Hamadani citizens attachment and scope of its special status and potential exception to this forest park provides Until an the tourism park, with an approach to increasing the information and raise the ability to think of visitor becomes (Neyzar Hekmatan Consulting Engineers, 2011).

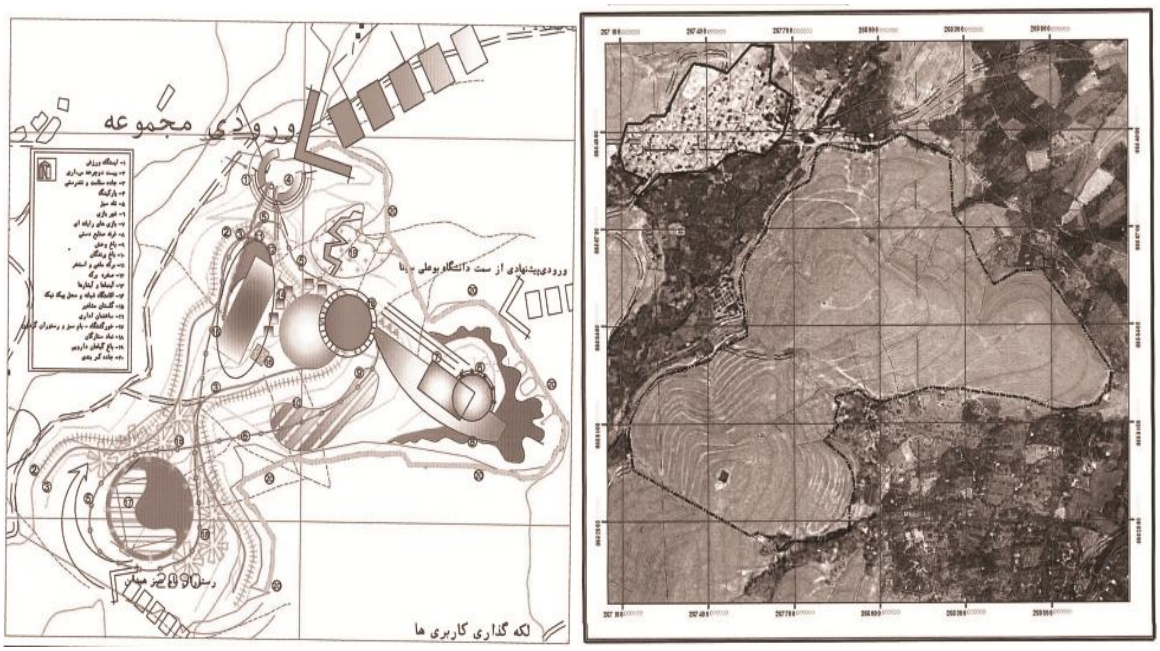

Fig. 2. Forest Park Heydareh (Velayat) in Hamadan city

Data analysis

In order to estimate the carrying capacity for tourism development in the studied area, the ecological capability and land suitability were mapped by using the existing models at extensive and intensive tourism levels. The results of this stage provided the data required to determine the vulnerability and ecological limitations of the areas. Subsequently, the carrying capacity of the areas suitable for tourism development was calculated by using the

IUCN guideline that aims to determine the maximum number of people who are allowed to use a potential area as a recreational resort within a specific period. This number is practically determined based on natural potential, ecological and social concerns and the management of the area.

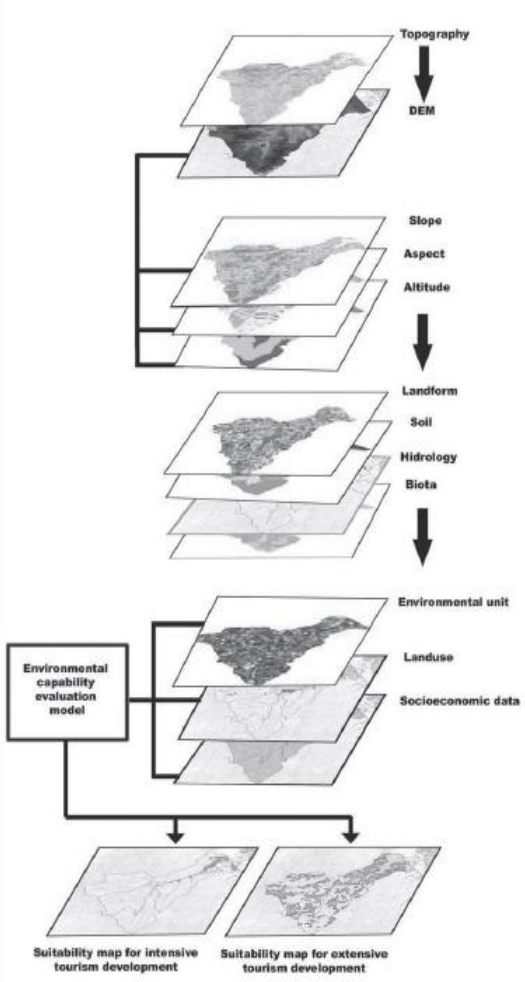

Fig. 3. Flowchart of evaluation stages of ecological capability and optimization of the study location

Pcc for the territories suitable for extensive tourism

As mentioned, Pcc is computed via the following equation:

$$Pcc = A \times V/a \times Rf \quad (6)$$

The constituents of Equation for the Forest Park Heydareh (Velayat) in Hamadan City as extensive tourism are as follows:

(Area in square meters) A = 1013800

The number of individuals in square meter for extensive tourism consistent with natural conditions and without causing disturbance to others is calculated via the following equation:

$$V/a = \frac{1}{4^2} = \frac{1}{16}$$

$$Rf = \frac{12}{12} = 1$$ (The number of visitors per day)

Thus, Pcc is calculated for extensive tourism as follows:

$$Pcc = 1013800 \times 1 \times \frac{1}{16} = 63362.5$$

Rcc for the territories suitable for extensive tourism

In order to identify ecological limitations across for the Forest Park Heydareh (Velayat) in Hamadan City and include them in estimating the carrying capacity, ecological vulnerability of ecosystems should be determined so that Rcc may be calculated consistent with the vulnerability of each ecosystem. To this end, the ecological factors were sorted out first. Threshold limit value principle is used to determine ecological vulnerability in ecology. Based on this principle, the more the value of an ecological factor approaches its limit or critical values, the more the ecosystem becomes vulnerable. In this regard, the vulnerability of every category of ecological factors was determined on a scale of 1-4 where 1 indicated least vulnerable and 4 denoted maximum vulnerability.

Table 1. Coding ecological vulnerability

Vulnerability	Code
Low	1
Moderate	2
Severe	3
Extreme	4

The ecological factors considered in the present study consisted of elevation, soil depth, vegetation density, and parent rock strength and soil erodibility. Table 2 illustrates the categories of ecological factors and the vulnerability of every category.

Subsequently, the weight of every parameter is computed against another ones using pairwise comparison. In this method, paired comparison matrices are developed first, and every two parameters are compared together to calculate their relative weight. The overall weights are computed by integrating and synthesis of relative weights. In this regard, Table 3 illustrates the weights of ecological factors. The ecological vulnerability of every category was computed via the following equation where H represents the ecological vulnerability of every category, W is the weight of every parameter and S is the vulnerability code of every category (Malczewski, 1999, pp.177-192).

$$Hi = Wi \times Si \quad (7)$$

Table 2. Coding the vulnerability of ecological parameters.

Category No.	Soil erodibility	S	Parent rock strength	S	Vegetation density	S	Soil depth	S	Elevation layers	S
1	Moderate	1	Very Strong	1	Low density	1	Deep	1	1900-1950	1
2	Serious	2	Strong	2	Moderate density	2	Relatively deep	1.75	1950-1970	2
3	Severe	3	Moderately strong	3	Relatively dense	3	Low depth to moderately deep	2.5	1970-1990	3
4	Extreme	4	Low strength	4	Dense	4	Low depth	3.25	1990-2000	4
5	-	-	-	-	-	-	Very low depth	4	-	-

Table 3. Weighting ecological parameters.

Weight	Ecological factor
0.311	Elevation
0.124	Soil depth
0.126	Vegetation density
0.186	Parent rock strength
0.253	Soil erodibility

The following equation is used to compute the limitation percentage caused by the conditions of every category of ecological parameters:

$$Cf_1 = \frac{Hi \times Ai}{\sum Ai} \times 100 \qquad (8)$$

Where Hi is the vulnerability, Ai is the area suffering the vulnerability and ΣAi is the total area of the territory suitable for extensive tourist purposes. Using this equation, the percentage of ecological limitations for extensive tourism was calculated for ecological factors in the Forest Park Heydareh (Velayat) in Hamadan city. One of the limitations affecting visit times that should be subtracted from Pcc is the limitation posed by rain, snow, frost and hot sunshine hours. Based on the average weather conditions during 2001-2011 obtained from Hamadan Synoptic Station, the mean rainy and snowy days were 77.1 and 16.5, respectively. Thus, total rain or snow hours are:

(16.5 + 77.1) × 12 = 1123.2

The frost has occurred in this station for 136.1 days in total. In every frosty day, there are five hours of inclement weather for visitors to visit the Forest Park Heydareh (Velayat) in Hamadan city. Thus, there are 680.5 hours of inclement weather in total. In hot months, burning daily sunshine creates undesirable conditions for visitors to the Forest Park Heydareh (Velayat) in Hamadan city, which should be taken into account. Given that the burning sunshine occurs from 10:00 A.M to 2:00 P.M every day from May/June to August/September, total burning sunshine hours are computed as follows:

Days 124= 4 ×31

Hours 496= 4 ×124

The mean percentage of cloudiness is 20% over this period, which is subtracted from sunshine hours:

99.2 = 0.3 ×496

396.8= 99.2-496 Total hours of burning sunshine

The following equation is used to compute the limitation percentage caused by each climatic factor:

$$M_1 / M_+ \times 100 \qquad (9)$$

1123.2 + 680.5 + 396.8 = 2200.5 Total hours with climatic limitations

(2200.5 / 4380)×100=50.2

Therefore, Rcc for the territories suitable for extensive tourism was computed as follows:

$$Rcc = Pcc \times \frac{100 - Cf_1}{100} \times \frac{100 - Cf_2}{100} \times \frac{100 - Cf_x}{100} \qquad (10)$$

It should be noted that this capacity involves all territories of extensive tourism including private gardens so that the available capacity is obtained by excluding the private gardens from the territory area. Thus, Rcc is computed as follows:

Pcc= 63362.5

Rcc=63362.5×0.6973×0.7351×0.43983×0.3462×0.498=2463

Therefore, Rcc for the total area of Forest Park Heydareh (Velayat) in Hamadan city suitable for extensive tourism equals 2463 individuals per day.

Calculating Ecc

Since no exact estimation of management capacities was available for the Forest Park Heydareh (Velayat) in Hamadan city area, such capacities were computed based on existing facilities such as infrastructural, service, health and sanitation and safety facilities in order to be used in estimating Ecc. Still, given that management capacities of the Forest Park Heydareh (Velayat) in Hamadan city area are maximally devised as much as 60 percent as desirable capacities to achieve goals, Ecc is computed as follows:

CF=2463×60%=1478 individuals per Day

Conclusion and Implication

Carrying capacity is an evolving, dynamic concept. The values obtained from applying the same approach may vary between two different societies or within the same society in two different epochs based on socioeconomic conditions, dominant rules and values, management goals and public understanding of the importance of ecosystem and natural resources preservation. Considering the definitions of carrying capacity in various applied aspects, one may deduce that estimated value of carrying capacity as a specification of a developing area allows the evaluators and decision makers to develop their plans based on appropriate per capita or overall usage of land resources so that they may ensure the preservation of natural resources potential, fertility, renewability, structural and functional integrity and well-being of ecosystem processes in the long run. Accordingly, in order to estimate the carrying capacity of the Forest Park Heydareh (Velayat) in Hamadan city area, the ecological capability and land suitability was determined for tourism development at an extensive level. Subsequently, the carrying capacity of territories suitable for tourism development across the Forest Park Heydareh (Velayat) in Hamadan city was computed using IUCN guideline. Ecological limitations and vulnerability were determined using ArcGIS software through paired comparison method and an hourly model that is a weighting and classification method. Three types of carrying capacity (Pcc, Rcc and Ecc) were computed for extensive tourism in the area through comparison of the values obtained from calculations based on ecological vulnerability of ecosystems and ecological limitations including elevation, soil depth, vegetation, parent rock strength and soil erodibility as well as management capacity limitations. The results revealed that Pcc would decrease in the Forest Park Heydareh (Velayat) in Hamadan city area by about 98 percent. This considerable reduction in the allowable number of tourist population, involving ecological limitations in computations, may significantly influence development planning of the area.

Some recommendations are made below to restore the equilibrium between ecotourism and environmental protection so as to prevent damages to the area as a result of ecotourism development:

- Considering the compromise between tourism development and environmental protection by selecting a reasonable alternative without damaging either of these two factors.

- Conducting Meta studies of nature tourism as a joint effort by Environmental Protection Organization and Office of Tourism.

- Developing ecotourism management and guide programs taught by qualified experts

- Considering the devolution of some tourism segments to the private sector with an emphasis on the preservation of natural resources.

- Conducting environmental evaluations, issuing certificates for tourism areas and generating domestic and international publicity.

- Considering environmental and tourism zoning in tourism development planning and establishing standards to control the propagation of dwellings along the Forest Park Heydareh (Velayat) in Hamadan city.

- Prioritizing lands in tourism development plans, introducing rules and regulations of environmental and tourism protection, increasing penalties on violators, developing surveillance programs (continuous monitoring) and supporting NGOs, allocating a percentage of hotel and other usage taxes along the route to develop infrastructural facilities, annual organizing of training workshops on environmental protection and tourism development for employees, furthering mass media public training, etc.

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