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Sustainable Tourism Management by Using Recreational Carrying Capacity Concept (Case: Mesr Desert in Iran)

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Abstract

Deserts have a variety of potentials in ecotourism where comprehensive planning can lead to the sustainable development of the desert. Carrying capacity can have different partial definitions, especially depending on the economic, social and environmental dimensions. The set of these types of capacities can constitute the tourism carrying capacity. One of the distinguished deserts in Iran is Mesr, located in Isfahan province. The objective of this paper is to identify the optimum number of eco-tourists visiting Mesr desert, for the achievement of sustainable development in this area, based on the desert ecological potentials. Therefore organising and planning these potentials could raise the economical growth of the region. The carrying capacity of the area is assessed by using the methodology suggested by the IUCN. The capacities are assessed in three levels. With respect to these capacities in the planning process, the environmental damages prevent in the region and provide easy options for eco-tourism. It is necessary to survey the damaging factors that make the color of the sand to fade. After sampling of septic and non-septic sand, the outcome shows remarkable effect of insecticides on sand pigment. This implies more control on accommodation conditions.

Keywords: sustainable development, desert tourism, sand pigment, carrying capacity

1. Introduction

The concept of carrying capacity is one of the key principles of sustainable tourism (Barrow, 2007). Finding convincing or widely agreed approaches to estimates and models for carrying capacity, especially for human population, is difficult (Cohen, 1995).

Ecologists define carrying capacity as the population of a given species that can be supported indefinitely in a given habitat without permanently damaging the ecosystem upon which it depends (E. Rees, 1992).

The concept of carrying capacity is very old in wildlife management, and was used for the first time by Dasmann in 1945 for assessing the capacity of the forests for grazing by animals (Wall, 1983). It was from early 1960s that this concept was applied in recreational research for the purpose of determining the ecological disturbance from man use (Lucas, 1964).

That carrying capacity would gain prominence in outdoor recreation management is logical enough. Many managers are trained in the biological sciences, therefore, are familiar with the concept as it had been applied to management of wildlife and livestock (Dasmann, 1964). Tourism carrying capacity evaluation has recently become an important issue for sustainable tourism development (Trumbic, 2005). Thus the concept of carrying capacity of tourism area is based on a theory that a tourism area will be waned. In other words, big number of tourists can destroy bases of a tourism attraction (Getz, 1983; Cooke, 1982).

Carrying capacities in nature are not fixed, static, or simple relations. They are contingent on technology, preferences, and the structure of production and consumption (Arrow, 1996). Therefore, analyzing carrying capacity is a tool planning which can determine the development level and the quantity of tourists.

Carrying capacity is a major concept which includes physical, social and environmental impacts. It is often observed that tourism generates a negative impact on the environment of destination places, among which the depletion of the natural capital is the most evident (Kurhade, 2013; Nghi, 2007). The indicator of Tourism Carrying Capacity can be particularly relevant to this purpose. In fact, it gives an idea of the threshold of tourists that can be accepted at a destination while considering the capacities of some components of the environmental (Kurhade, 2013).

World Tourism Organization (1993) defines CC as, the level of visitors use in an area accommodating with high levels of satisfaction to visitors and few impacts on resource. Mathieson and Wall (1982) defined it as the maximum number of people who can use a site without an unacceptable decline in the quality of experience gained by visitors (Kurhade, 2013).

2. The Objective

The objective of this study is to identify the optimum number of tourists for the achievement of sustainable development based on the desert potentials. Therefore, organizing and planning such potentials could raise the economical growth of the region.

Today the size of the global park tourism industry is great and on the growth. Most parks and protected areas need visitor management to enhance values, specifically when tourism becomes an integral component of the park (Eagles & McCool, 2002). Therefore, a comprehensive park planning and management approach should define the optimum capacity for visitors in order to provide the desired biophysical and social conditions. The capacity of a park varies depending upon the place, season, time, visitor behavior, facility design, patterns and management level, and the dynamic characteristics of the environmental elements (Ceballos-Lascuráin, 1996).

Many studies are conducted concerning different aspects of the carrying capacity for National Parks and protected areas or some areas with ecological value (Papageorgiou & Brotherton, 1999; Leujak & Ormond, 2007; Sayan & Atik, 2011; Nghi, 2007).

Desert tourism is a kind of echo-tourism with special capabilities in Iran. Desert areas in Iran with high level of temperature (in Lout desert 65ºC (Kardavani, 2009), hotter than Nevada and Africa desert) are unique places for Sun tourism and sand-therapy. With respect to the fact that the Ozone layer over Iran is not faded, the sun rays here have therapeutic advantages (Armaghan, 2008). In addition this region is sustainable for night tourism astronomy. The Mesr desert is a tourist attraction among the many in Iran. The sand type here is of Quartz with a variety of colors constituting the habitat of deferent insects unique to this region.

In this context, the concept of carrying capacity is often presented as a particularly useful approach for determining the intensity of tourism development in the region. An increase in the number of tour packages has made the area under study to be one of priorities in tourism on Iran. Therefore, a survey deems necessary to determine the tourism effect on the environmental aspect of this region.

According to the reviews made in this respect, no study is conducted on sand pigment change. Therefore, a reference is made to the corresponding author's MS dissertation (2009) and her article (2010). Heavy population of insects, the habitants of the area, make tourist use insecticides. The chemical interaction of the insecticide with the sand effect the sand pigment (see Table 1). It is obvious that in due time, if this trend continues, that is in the short future the colorful sand beds will became discolored, hence, loss of an ecotourism attraction point. This claim on discoloration of sand is supported through X Ray Diffraction (XRD) analysis (see Sec.4).

3. Introduction of the Study Area

Mesr desert is located in Khour-o-Biyabanak area near Naein, in north-east of Esfahan Province with a 34º4” latitude and 54º47” altitude coordinate (see Figure 1).

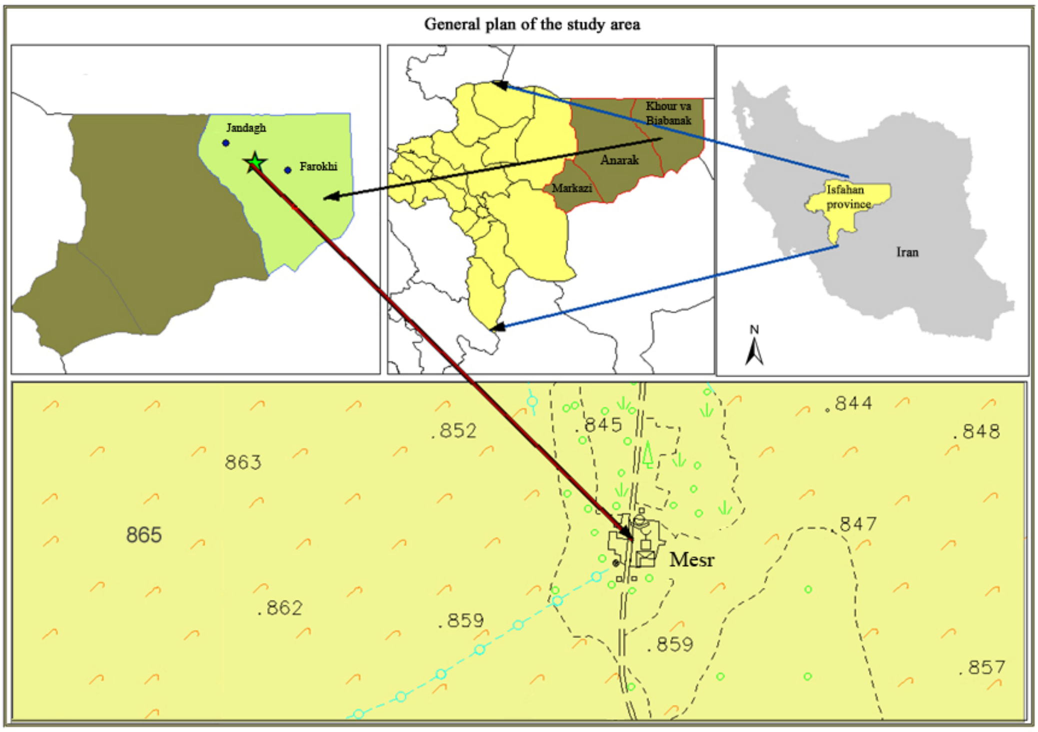

Figure1. General plan of the study area

This desert is endowed with colorful sand dunes indicating the unique feature of the geomorphology of the area. Due to its dry and arid climate the plantation species are limited, to name a few: Grass (Poaceae), Calligonum comosum, Tamarix sp, Haloxylon persicum (Esfahan Natural Resources Organization, 1998).

Regarding the animal life in the area the following list is provided by the Agriculture—Jahad Organization of Khour (2006); Birds: Ammoperdix griseogularis, Perdicinae sp, Aquila sp, Podoces sp, Passeridae.n; Reptiles: Ophidian.n, Venomous snake, Echiruroida, Schis carinatus.

Others: Felis silvestris, Varanidae sp, Canidae, Gazelle, Capra aegagrus, Leporidae.n.

Note: The Acinonyx jubatus venaticus and Equus hemionus are extinct. The direction of the dominant slope is southern (Esfahan Natural Resources Organization, 1998). There are special potentials in desert tourism. About 25.000 tourists visit the area a year which varies in different seasons because of unbearable heat in summer time and sandy days for 45 days (Tourism Organization of Iran, 2014).

4. Research Method

The concept of ecotourism carrying capacity in this case desert tourism activities can be explained on the basis of the following interrelated elements: (1) The amount of use of a given kind, (2) a particular environment can endure, (3) over time, (4) without degradation of its sustainability for that use (Fennel, 1999). The annual visits, geographical, bio-physical, ecological, and managerial characteristics of the site were investigated. Physical, real, and effective carrying capacities was suggested by the IUCN (Ceballos-Lascuráin, 1996).

5. Results

Geo-chemistry analyses assessed tourism damages to the area along with using carrying capacity method to identify tourist acceptability. Therefore carrying capacity of Mesr desert measured. Tourism damages to the area sampled which follows in the second section of the results. Then threatening damages surveyed in quantities and different aspects.

5.1 Physical Carrying Capacity

The Physical Carrying capacity is the maximum number of tourists who can visit a place at a specific time. In other words, it is a maximum capacity that can place visitors without any limits.

Carrying formula is as follow:

$$PCC = A \times V/A \times RF$$

A (Area)=using area for visitors

V/A (Visitors/Area)=the number of visitors in km^2

RF (Rotation Factor)=time average of visiting in a days

V/A=a space that a visitor needs to be comfortable and move easily a dependent variable of the area. In this research the space is 10 km^2/person.

RF=is the number of visits made during the visiting period divided by average time for a visit.

A=750 km^2 (The total area is a 50×15 km rectangular)

V/A=1/10

RF=24/24

$$PCC = A \times V/A \times RF$$

Which gives

$$PCC = 750 \times 1/10 \times 24/24$$

PCC=75 persons/a day

Real Carrying capacity: In order to compute the RCC, the corrective factors (CF is existing limit in percent) computed through:

RCC=PCC–Cf1–Cf2– … –Cfn

$$Cf = M\_1/M\_2 \times 100$$

M_1=The amount limitation of a factor

M_2=Total amount of a factor

RCC=PCC×$(100 - Cf\_1)/100 \times (100 - Cf\_2)/100 \times \ldots \times (100 - Cf\_n)/100$

At this stage to identify the amount of area limitation which is its properties, are reduced from physical capacity:

Limits of the stormy days

Based on Khour climatology station, there are 45 stormy days from March to April.

Cf_1=$45/365 \times 100$

Cf_1=%12

Limits of the hottest days

Based on Khour climatology station, there are 130 very hot days from June to September.

Cf_2=$130/365 \times 100$

Cf2=%35

Therefore, the calculation of the RCC is as follows:

RCC=75×$(100 \quad 12)/100 \times (100 \quad 35)/100$

RCC=75×0.85×0.65=44 persons/a days

Effective capacity: The ability to manage a place with maximum number of visitors with respect to sustainability is the effective carrying capacity. Management abilities include a set of conditions necessary to achieve desirable objectives. There are different variables such as policies, strategies, rules and regulations, and human resources in assessing the abilities quantitatively. Lack of management abilities is the most common problem in tourism in developing countries. It is worth mentioning that the effective carrying capacity is not bigger than real carrying capacity, but there is a chance to improve real carrying capacity with effective management abilities (Farhoudi & Shourjeh, 2005).

5.2 The Importance of Carrying Capacity for Given Environmental Protection

The magical attraction of the Mesr desert is disturbed by insects. This desert has many visitors and they have to use insecticides to be protected from the native insects (Figure 2). The study run on this region revealed the amount of the empty can or plastic insecticides containers. Through amore in depth study the sand color change became obvious. Six sand samples are collected from the study area and analyzed.

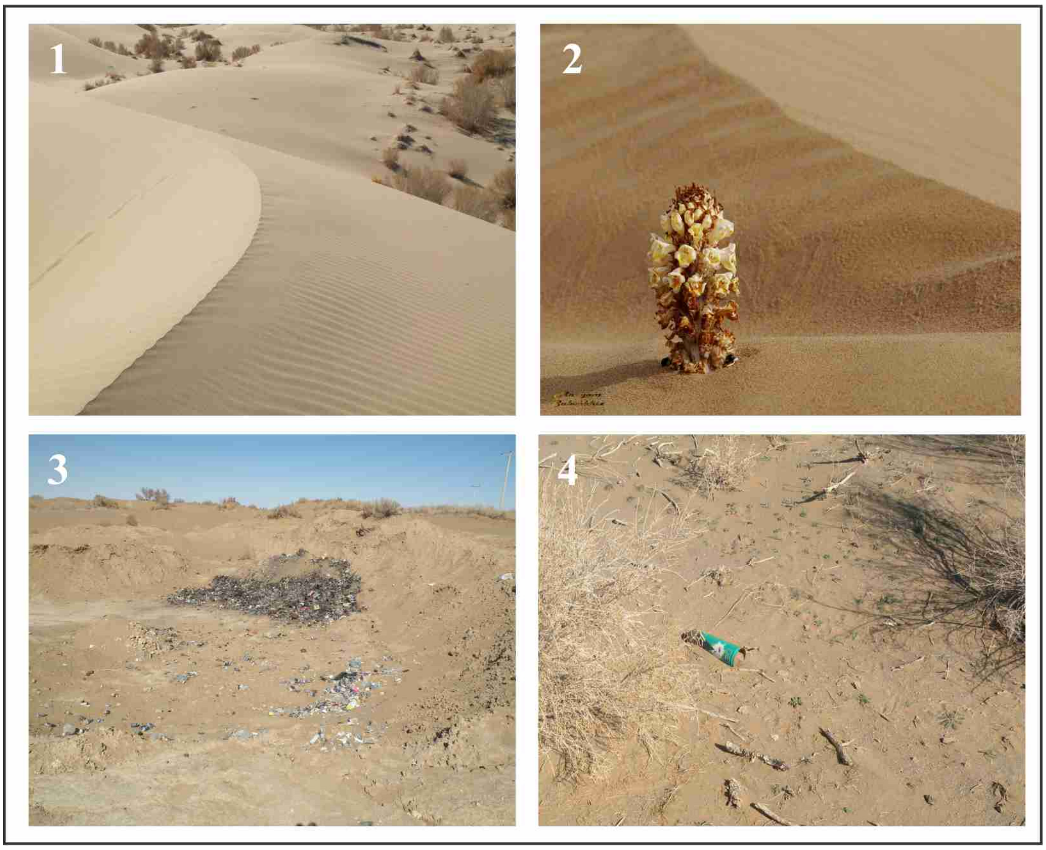

Figure 2. Insecticide in desert by tourists

Note. 1 and 2. Non septic sample. 3 and 4. Septic sample.

The six sand samples are analyzed by XRD (X-Ray Diffractometer, Brucker, D8ADVANCE, Germany, X-Ray) in Esfahan University central lab. Non-septic sand (samples; 22B, K, L, B3) are compared to septic sand (samples; B2, 23C) and the results are tabulated in Table 1.

There are remarkable mineralogical changes in septic sample (23C) compared with non-septic sample (22B). 21.7% Decrease of Quartz level in septic sample (23C) in comparison with 10.1% increase in Calcite mineral and also 10.6% increase in Albite mineral is due to exposure to insecticide. It is also observed that the septic sample (B2) with 21.3% decrease of Quartz and 25.8% increase of Calcite mineral of non-septic sample (B3) prevail, see Table 1.

Table1. Results of XRD analysis of septic and non-septic sand in Mesr desert

Mineral Name	Formula	Sample 23 C (Septic)	Sample 22 B (Non-septic)	Sample K (Non-septic)	Sample L (Non-septic)	Sample B2 (septic)	Sample B3 (Non-septic)
Quartz, syn	SiO_2	45.4%	66.1%	54%	59.3%	36.6%	57.9%
Calcite, syn	$CaCO_3$	26%	15.9%	27.7%	28.7%	52.8%	27%
Albite, calcian, ordered	NaAlSi3O8	28.6%	18%	18.3%	12%	10.7%	11.2%

The sample of 22B to 23C and also sample of B3 to B2 changed after contaminated by insecticides. The samples K & L are non-contaminated.

Insecticides or (Pyrethroid insecticides) contain insoluble Alkaline (Darab et al., 2010). In this study it is found that the chemical component active in discoloration consist of the following two essential ingredients which dissolve Quartz:

(1) Enduring toxic ingredient.

(2) Alkaline substance that reduces and changes the chemical properties of sand of Quartz.

6. Discussion

There is a significant effect to the area from number of visitors per a period of time, in the other word, more visitors bring more damages. From another aspect there are also more threats when visitors leave insecticide in the area. Geo-Chemise analyses in the section two show major damages to the environment. Chemical substances destroy quartz sand which is the hardest one. This amount of chemical activity in long term demolish sands combination and the view of the area as well.

7. Conclusion

Calculation of the carrying capacity of the area is made in order to achieve sustainable development objectives in tourism. Carrying capacity is a big contribution in preventing the biological damages to the environment. To determine number of visitors, the average usage of sites are surveyed in physical, real, effective levels.

According to the findings indicating the real carrying capacity of 44 no harm would threaten this desert if the insecticides consumption is controlled.

The results obtained from XRD analyzed and the tests run on chemical properties of both the septic and non-septic samples proved that insecticides are the main threat for windy sands.

Non-observance of carrying capacity in this area of ecotourism causes the problems mentioned above. Proper management in ecotourism will promote the enjoyment and secure the sustainability of the environment.

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