Abstract—Increasing demand and acceptance of tourists in the critical and sensitive mountain areas of Iran in the recent years and lack of a comprehensive and planned program for the areas' tourism has intensified the necessary for special attention to these areas. Therefore, in this study, the capacity threshold for accepting tourists in the mountain tourism areas of Iran, such as Abinam, Sardabi, Larikhani and Gavdilan located at Deylaman district in Gilan province has been investigated in Spring 2013 in line with Approach to Sustainable Tourism Development based on the tourism carrying capacity method. To this regard, firstly the indexes influencing the region tourism carrying capacity estimation (TCC) have been evaluated by using the existent literature and the experts' comments, and then the number of tourists that can effectively, physically and really attend in the region has been calculated by applying the quantitative method. Results indicated that Gavdilan district has a more capacity for attracting tourists and generally the amount of entered tourists, especially on holydays, is more than the regions' actual capacity. In addition, the regions' effective carrying capacity can be increased by enhancing the service and infrastructure capacity.

Keywords—Tourism Carrying Capacity, Sustainable Tourism Development, Tourism, Deylaman District.

I. INTRODUCTION

The carrying capacity of a tourist region refers to the number of tourists who can be accepted by the region for a specific period (day, month and year). This capacity depends on the regional extent and topography, the soil type, the method of animal behavior and the level and quality of regional tourism facilities (Zahedi, 2006).

The carrying capacity is useful as a way to think about the planning. It focuses on the ability of natural environment for supporting the growth and it indicates that the development must respect to the operation of environmental natural processes. The carrying capacity has often been regarded as a method to control the development outcomes and process (Hall, 1999).

II. TOURISM CARRYING CAPACITY

Each region or country has a limited ability to attract the tourist and the related activity field, which these limitations will often be explained by the carrying capacity technique in the framework of Sustainable Tourism Development theory. But it is noteworthy that providing a specific and understandable definition of carrying capacity needs to investigate it as a process in the tourism development planning process. This issue has two parallel and complementary processes that can be a general framework to guide the native societies, planners and decision-makers (Coccossis & Maxa, 2002).
Generally, the concept of tourism carrying capacity is perceptible as a tool for the tourism regions planning. This is a dynamic technique that its result may be changed (Santos Lobo et al., 2013).

As shown in Fig. (1), the framework mentioned above includes the principles, purposes and policies that would be applied to formulate a region tourism planning that has the sustainable native tourism capacities in terms of its specific characteristics. All of the assessments of tourism carrying capacity don't just include determining the thresholds rate, such as to determine the number of visitors. Even if the thresholds are determined, these limitations can't necessarily follow the purposes and changeable criteria formulations. Formulating all of the assessments of tourism carrying capacity doesn't just include the threshold rate, such as determining the number of visitors. Even if the thresholds are determined, these limitations can't necessarily follow the purposes and changeable criteria formulations. TCC formulation not only must provide a maximum level, but also it should provide a minimum level of development, that is the lowest level that native societies need. In addition, TCC may include some different areas of the carrying capacity in three combinations, such as Physical-Ecological, Social-Demographic and Political-Economic. Each of tourism carrying capacities not only is as a numerical value, but also it needs a managerial tool (Saveriades, 2000).

III. INDEXES OF TOURISM CARRYING CAPACITY

The indexes provide important opportunities to define and use TCC. The indexes are often as a prerequisite to formulate the tourism strategy. Using the indexes is a reflection of the pressures and the key factors status (e.g. the native specific characteristics and specific behaviors) that are used as a tool to analysis the system and to introduce the limitations of tourism carrying capacity (Coccossos & Maxa, 2002). Although, the carrying capacity can often be classified as the physical, psychological and ecological ones and so on, but it is worth mentioning that in order to achieve an applied and logical carrying capacity in each region, assessment and combination of all capacities mentioned above is so necessary and essential, and regarding all of the factors, the dynamic recreation resource management can be as a measure to evaluate the carrying capacity (Baud-Bovy & Lawson, 1998).

Estimation of indexes application needs to utilize them with the determined goals and the sensitivity of places under studying.

In this filed, three indexes have been suggested in TCC combinations that priority and importance of each them will be different with respect to the type of place and the tourism purposes:

a. Ecological-Physical Indexes
b. Social-Demographic Indexes
c. Political-Economic Indexes (Coccossis & Maxa, 2002)

In fact, the tourism indexes (indicators) provide a total relationship between the tourism and environment, impacts of environmental factors on the tourism activities, impact of the tourism industry on the environment and the reaction required for improving and supporting the system status in order to sustain it in the different tourist places. The carrying capacity indicators are looking to explain the pressures, thresholds, system status and its impacts on the tourism. If we want to provide a general scheme of the relationship between the sustainable development, the sustainable tourism carrying capacity and TCC indicators, it will be showed as Diagram (1). As you can see in Diagram (1), there is a close and mutual correlation between each of three kinds of indicators. While we should pay attention to the relationship between them, we must assess and review them continuously in order to achieve the sustainable tourism development (Farhoudi & Shourcheh, 2007).

Diagram 1 Sustainable Tourism, Sustainability-Carrying Capacity Development Indicators

IV. APPLICATION OF TOURISM CARRYING CAPACITY

The carrying capacity is an essential concept in order to policy-making. Although, many scientific topics proposed in relation to the capacity estimation (threshold & limit) indicate that these problems are resulted from the multi-dimension nature of the concept and inherent limitations for estimating the human and natural ecosystems.

Today, this tendency to use the carrying capacity for determining the thresholds has been switched to make a desirable status of optimal policy for decision-making and planning and it is recommended to replace more concepts in the management goals. Also, the useful tools that can help to the planners and decision-makers to control the tourism development are growing and developing. However, there are some limitations not only in the application of carrying capacity, but also in the estimation of it (Coccossis & Schwartz, 2012- Maxa 2002).

Thus, the concept of a tourism destination carrying capacity is based on the assumption that sooner or later a tourism destination will reach a point that is waiting for a fall. In other words, the number of tourists leads to destroy the resources and the destination attractions (Cooke, 1982- Getz, 1983).
Therefore, the carrying capacity analysis is a basic method in the planning process that finally determines the development and usage rate for the tourists. Determining the tourism carrying capacity is a necessary policy for planning that will usually be made based on the district characteristics analysis and development of it and the places used by the tourist as well as it is a feedback to analysis the tourism markets (Ghaderi, 2004).

V. CARRYING CAPACITY ESTIMATION METHODS

As previously mentioned, the interface between the carrying capacity estimation methods is identifying and determining the limits of acceptable changes in the definiteness used that are the main basis for the estimations.

In a general classification, the carrying capacity includes physical-ecological, social-conceptual and political-economic ones that each of them consists of the real, physical and permissible (effective) carrying capacities (Farhoudi & Shourcheh, 2007).

VI. FINDINGS & ANALYSIS

This study aims to introduce the method for estimating the nature tourism carrying capacity in the mountain areas. In this regard, some tourism sites, such as Abinam, Sardabi, Larikhani and Gavdilan in the mountain path of Siahkal-Deylamn, were selected. These districts with different kinds of forest and mountain ecosystems have many capabilities for Ecotourism. Determination of the carrying capacity at each district that has been focused is necessary. Therefore, in the first step, in order to determine the useable limited-area in each site, the underground points requested for ridging each area have been extracted by using a GPS. Then, in order to prepare the map and to estimate the sites area, these points were entered into the GIS software and the recreation site map was prepared. In the next step, all of the effective factors on the general operation of the tourism sites-such as Abinam, Sardabi, Larikhani and Gavdilan that include the physical, biological, social and cultural factors-have been identified and evaluated in order to develop the tourism.

In this step, in order to collect the cultural and social data, we prepared a questionnaire and provided it to the tourist in the recreational seasons to determine the visitors' impacts on the district and their satisfaction of it. Finally, the carrying capacity of recreational sites has been estimated by using TCC method in three levels of physical, real and permissible (effective) ones.

VII. ESTIMATION OF PHYSICAL CARRYING CAPACITY

Physical carrying capacity refers to the maximum number of tourists that can have a physical presence at a given time and location (Busby et al, 1996; Baud-Bovy and Lawson, 1998). This capacity can't be considered as a basis for planning, but it shows the capacity of district physical environment, regardless of limiting factors and elements. These numbers can be computed for appropriate tourism fields based on the following formula (Farhoudi & Shourcheh, 2007):

\[ P_{cc} = A \times \frac{V}{a} \times R_f \]

where, A: Appropriate area for the tourism (by using GPS filedworks, 2012), V/a: The space required for each tourist so that she/he can move easily and there is not any interference between her/him and the others and physical phenomena. This amount for the ordinary people has been regarded as 10 square meters in a horizontal area with a recreational activity (Nahrli & Rezayi, 2002).

Rf: The number of daily visits of a place and it will be computed by the following formula:

\[ R_f = \frac{\text{period for the site availability}}{\text{average period length of a visit}} \]

VIII. RF METHOD OF CALCULATION

According to the standards, the availability period for the tourists in the recreational season is 12 hours and according to the questionnaires filled by the tourists and the researcher interview with the native service providers, the average time to visit has been extracted.
IX. REAL CARRYING CAPACITY

Real carrying capacity refers to the maximum number of tourists of a recreational place who can visit a place with respect to the limiting factors that are resulted from the place specific conditions and their impacts on the physical carrying capacity (Busby et al., 1996).

This number will be calculated by the following formula:

\[
R_{cc} = P_{oc} + \frac{100-Cf_1}{100} + \frac{100-Cf_2}{100} + \frac{100-Cf_3}{100} \quad (\forall)
\]

where, \(Cf\) is the correction factors or the limiting factors resulted from the place specific conditions. These limiting factors are calculated considering the biophysical, ecological, social and managerial variables and conditions.

It should be noted that the limiting factors of each district can just be allocated to it. For example, flood can be a limiting factor at a district, while it isn't a threat at another district. In other words, the limiting factors are quite dependent on the certain characteristics and conditions of each district. The limiting factors can be expressed as the percentage (Farhoudi & Shourcheh, 2007).

In the tourism sites, such as Abinam, Sardabi, Larikhani and Gavdilan, the following parameters have been regarded as the limiting factors with respect to the district conditions:

a. Number of rainy days
b. Number of ice days and snow-covered lands
c. Number of sunny days

each limiting factor was calculated by the following formula:

\[
Cf = \frac{M_1}{M_2} \times 100
\]

where, \(M_1\) is a limited amount of a variable size
\(M_2\) is the total size of a variable

Table 1 Estimation of Physical Carrying Capacity

<table>
<thead>
<tr>
<th>District</th>
<th>Area (m²)</th>
<th>V/a</th>
<th>Time of availability (hour)</th>
<th>average period length for visiting (hour)</th>
<th>Rf</th>
<th>PCC (P/D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abinam</td>
<td>46260</td>
<td>10</td>
<td>12</td>
<td>571</td>
<td>21</td>
<td>9715</td>
</tr>
<tr>
<td>Sardabi</td>
<td>57260</td>
<td>10</td>
<td>12</td>
<td>721</td>
<td>166</td>
<td>9505</td>
</tr>
<tr>
<td>Larikhani</td>
<td>14506</td>
<td>10</td>
<td>12</td>
<td>697</td>
<td>171</td>
<td>2481</td>
</tr>
<tr>
<td>Gavdilan</td>
<td>97856</td>
<td>10</td>
<td>12</td>
<td>672</td>
<td>179</td>
<td>17516</td>
</tr>
</tbody>
</table>

Table 2 Limiting factors and calculating the Real Carrying Capacity

X. PERMISSIBLE (EFFECTIVE) CARRYING CAPACITY

Effective or permissible carrying capacity refers to the maximum number of tourists of a place that the existing management has the ability to control there as sustainable. Managerial skill (ability) includes a set of conditions that a district management needs them to achieve the necessary operations and goals (Busby et al. 1996).

This number is calculated by the following formula:

\[
E_{cc} = R_{cc} + \frac{100-FM}{100}
\]

Where, FM (Management Adjustment Factor): includes a set of conditions that management needs them to achieve the necessary operations and goals. Frequency variables play an important role in the quantitative estimation of these abilities that we can mention the strategies and policy-making, terms and conditions, infrastructure facilities and equipment, manpower, financial resources and etc. Lack of the managerial skills (abilities) is one of the most serious problems in the tourist regions management of developing countries. However, it should be noted that the effective carrying capacity never exceeds the real carrying capacity and the managerial skills (abilities) can lead to use an area as far as the real carrying capacity and not more than it (Tabiban et al., 2007).

The managerial adjustment factors used in this study are as follow:

a. Access Path
b. Facilities (e.g. parking, camping, buffet and grocery store, oven, drinking water, health service, recycle bin and security)
c. Sites maintenance budget

Management adjustment factor can be computed by multiplying the ideal management capacity (Imc) by the actual management capacity (Amc).

\[
FM = \frac{Imc - Amc}{Imc} \times 100
\]
Imc: The numbers of ideal facilities for the sustainable tourism management (Ideal management capacity)
Amc: The numbers of existing facilities (Actual management capacity)

<table>
<thead>
<tr>
<th>FM/ Districts</th>
<th>Access Path (FM)</th>
<th>Facilities (FM)</th>
<th>Maintenance Budget (FM)</th>
<th>ECC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abinam</td>
<td>5278</td>
<td>7809</td>
<td>2857</td>
<td>430</td>
</tr>
<tr>
<td>Sardabi</td>
<td>5833</td>
<td>7778</td>
<td>2593</td>
<td>392</td>
</tr>
<tr>
<td>Larikhani</td>
<td>697</td>
<td>7273</td>
<td>39</td>
<td>98</td>
</tr>
<tr>
<td>Gavdilan</td>
<td>6047</td>
<td>7212</td>
<td>474</td>
<td>618</td>
</tr>
</tbody>
</table>

Table 3 Management Adjustment Factor and Calculation of Effective (Permissible) Carrying Capacity

<table>
<thead>
<tr>
<th>Sites</th>
<th>Area (m²)</th>
<th>PCC (P/D)</th>
<th>RCC</th>
<th>ECC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abinam</td>
<td>46260</td>
<td>9715</td>
<td>5857</td>
<td>430</td>
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<tr>
<td>Sardabi</td>
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<td>9505</td>
<td>5731</td>
<td>392</td>
</tr>
<tr>
<td>Larikhani</td>
<td>14506</td>
<td>14504</td>
<td>8626</td>
<td>489</td>
</tr>
<tr>
<td>Gavdilan</td>
<td>97856</td>
<td>17516</td>
<td>10416</td>
<td>618</td>
</tr>
</tbody>
</table>

Table 4 Comparison of Physical, Real and Effective (Permissible) Carrying Capacities of the Sample Regions

XI. RESULTS

With respect to the specific characteristics of these four sites in the mountain areas of Deylaman and in terms of limited supplying the tourism facilities and infrastructures and high and increasing demands of tourism in the mountain areas as well as their natural features, we can say that there is an essential need to develop and improve the supply elements and demand management in this district in order to avoid the negative effects of tourism. The results indicate that the environmental quality of the district mentioned above has played a major role in the amount of regional carrying capacity and due to lack of facilities, necessary services and infrastructures as well as an adequate manpower to manage and provide the tourists with the tourism services, the effective (permissible) carrying capacity has decreased. It should be noted that we can increase the regional effective carrying capacity by an appropriate planning in order to supply the necessary infrastructures, facilities and services as well as the skilled manpower.

XII. RECOMMENDATIONS

a. Conducting some studies on the whole Deylaman tourism region
b. Conducting some studies on the whole Deylaman tourism region for 4 seasons
c. Considering the environmental factors, such as air quality, regional soil type, slope and so on, to estimate the regional real carrying capacity
d. Publishing detailed expenses on the web-sites by the related unites, which it leads to a more detailed estimation of the regional effective carrying capacity.

XIII. REFERENCES

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