Spatial Prioritization of Hydrotherapy Tourism of Hot and Mineral Springs in Kerman Province, Iran

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ABSTRACT

Based on the definition of World Tourism Organization, one of the goals which can motivate tourists is travel for health. Tourists’ use of therapeutic equipment and obtaining health and recovery through mineral waters can be regarded as the goals of hydrotherapy tourism which is one type of health tourism. This research was conducted to prioritize suitable hydrotherapy tourism zones using analytical hierarchy process (AHP), hot-spots analysis, and kernel density estimation function to achieve the most appropriate place for investment in hydrotherapy tourism in GIS environment. The research type was analytical—applied and faculty members of 3 Iranian universities in geography were selected as the statistical population. Twenty-three of them were selected for responding by Cochran formula as the sample size. The obtained results indicated that most of the hot and mineral springs of Kerman province had the necessary potential for attracting hydrotherapy tourism. These springs were dispersed in the entire province; but, superior springs were located in the south toward the central cities of the province according to the density estimation. Considering hot-spots analysis, the springs which were significantly more prominent than other ones included Laria, Abbad Maskoon, Mohammad Abad Maskoon, Sirch, and Barf Anbar Sarmosh. Also, due to the commonality of these 5 springs in all the analysis cases, they should be considered in the priority of investment for developing hydrotherapy tourism in the province.

INTRODUCTION

Tourism is an ancient phenomenon which has existed in human societies since a long time ago and has been gradually converted into a technical, economic, and social issue during different historical stages. Tourism is based on the main factor of travel and displacement. As a result, its transformations are a function of different changes such as those caused by travel motivation and transportation means. Some factors such as industrial revolution, rapid growth of urbanism, vehicle ownership, increased leisure time, income levels, and consequently security have the highest effect on the growth of tourism industry [16].

Increasing and fast growth of tourism industry has caused many theorists to call the 20th century as tourism century. According to the authorities of tourism affairs, a revolution in tourism would occur in the late 20th and early 21st centuries, the waves of which will influence all parts of the world [30].

Today, the phenomenon of tourism, owing to its high income, has led many countries in the world to make high investments in this sector [28]. Tourism is a strategy for development and a suitable substitute for other economic sectors, particularly when their profit is decreasing [26].

Necessity of serious attention to the issue of travel and tourism is regarded as a new phenomenon in mechanical life of the 21st century and its importance is increasingly growing, because cities have faced abundant problems due to the increasing trend of technology and mechanical life in societies and expansion of new inventions and discoveries which have made humans dependent on cities (as centers of transformation) [5].

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On the verge of the 21st century, the deterioration of life conditions in large cities which is accompanied by the continual reduction of nutritional value of daily foods, tendency to unhealthy lifestyles, increased addiction to all kinds of narcotics, and affliction with all kinds of dermal and respiratory allergies has converted the development of resorts, which have pleasant landscapes and temperate climate along with natural treatment characteristics, into an inevitable action on the agenda of the organizations responsible for social security and rehabilitation of labor force. All over the world, regions with hot and mineral waters have proved their very important function in such cases. In the structural design of these regions, something can be found for all age groups and tastes, from therapeutic advantages of natural mineral waters to the silence of valleys with pleasant climate and all kinds of recreations. In fact, pleasant and natural environment around these springs is regarded as a suitable place for spending leisure time and relieving spiritual crises and mental distresses (Zargham, 2000).

Water has always played an important role in the leisurely activities of humans. Hydrotherapy tourism is a sub-branch of health tourism, in which people travel to healthy villages and regions with mineral water and hot water springs (spas) to get released from stresses of routine life, get refreshed, and treat most of diseases, or for convalescence [13].

Hot waters have been accompanied by comfort and physical refreshment of humans since long ago. In the international language, the word spa which is originally Bulgarian (or has been derived from Latin word *spara*, meaning spring, or *sparr*) has turned into a generic name for the regions with mineral and hot water, to which tourists resort for resting and treatment [20].

Hot water springs are related to volcanic activities. In many cases, a huge amount of different gases and minerals is transferred to the ground surface along with the water of these springs. Temperature of these springs is different and sometimes reaches 100°C. Hot water springs usually flow a long time after volcanic activities [14]. When the temperature of a spring is higher than average annual temperature of the environment of a region by at least 5 to 6°C, the spring is called a hot spring.

Mineral waters refer to the waters that have at least 1000 mg salt or 250 mg free carbon dioxide per kg. Each of the mineral waters which are available at different spots has a special effect that is related to that water, because compounds of each mineral water are peculiar to the zone in which it has appeared [18].

Despite high therapeutic, chemical, and biochemical progress, mineral waters have kept their therapeutic and hygienic value and are mostly used in the countries which enjoy them (particularly developed countries) [11]. Travel for hydrotherapy can have a considerable effect on the prosperity of tourism industry of a destination. Development of hot and mineral springs is very important for creating employment, earning proper income, achieving public health, increasing regional income, and treating many potential and actual patients [23].

Hot and mineral waters and health tourism have rapidly grown in recent years so that the number of hot and mineral springs has grown by 52% in the USA between 1997 and 1999 and the number of their visitors has grown by 70% during a similar period [4]. Studies by Elliot and Touch have also shown that the number of hot and mineral springs is more than 2000 in Japan, about 450 in Italy, and between 250 and 300 in Germany and the USA. In Asia, the highest tourism growth of hot and mineral springs occurred in the countries which had cultural activities. In these destinations, massage, yoga, reflexology, and relaxation were used and presented in hot and mineral waters all over the regions. This measure has attracted many capitals; in Europe, the highest growth has occurred in tourist villages via properly renovating facilities of hot and mineral waters in cities such as Baden-Baden and Karlovy Vary [7].

Economic factors have caused the involved organizations and countries which are interested in the development of this industry to pay special attention to this sector. Many studies have also been conducted in the world and in Iran on different types of tourism, particularly hydrotherapy tourism, using GIS which are as follows:

Boroviv and Markovic [3] studied utilization and tourism valorization of geothermal waters in Croatia. This paper has been analyzed based on data gathering and observations in a period of 16 years with special attention devoted to their use for tourism purposes. Early 2014 geothermal water was utilized at 26 locations (15 springs and 11 deep boreholes) for 10 different purposes. The traditional modalities of use – recreation and balneotherapy – remain dominant. From 26 Croatian localities where geothermal waters are being utilized 23 are situated in the Pannonian part of the country which is characterized by high surface heat flow and geothermal gradient. In conclusion, threefold benefit of geothermal resources and tourism integration has been identified. Tourism gets significant financial benefits in the form of cheap electricity and heat, at the same time profiling itself as an environmentally conscious sector of economy. Also, many tourism destinations wish to have an attraction which separates them from similar destinations, and that makes them a fruitful environment for innovations.

Papageorgiou and Duquenne [25], conducted a research to confirm that spa tourism is now in a period of transition following extensive, questionnaire-based fieldwork in Greece’s prime spa destinations. The research sought primarily to profile the different types of spa visitors today, and secondarily to identify the visitor-type who will predominate in the years ahead. The paper’s ultimate aim is to use its conclusions and the trends it
uncovers to draw up general guidelines for contemporary spatial planning in spa tourism destinations in accordance with contemporary views and needs.

Mungiu-Pupazan and Vasilescu [21], said that Spas are a solution to relaunch Romanian Tourism. Spa tourism represents that type of tourism, regularly used by a broad range of tourists, motivated by people’s wish to maintain or regain health. Romania has a high natural potential for spa treatment of various diseases, given the background of available resources. Romanian subsoil currently contain over a third of the European mineral water resources, and an important number of unique or mineral resources very little spread throughout Europe: mofettes of Oriental Carpathians, sapropelic mud from Salt Lake or Techirghiol. Romania’s climate is particularly suitable for therapeutic treatments, including areas with tonic, sedative, marine and saline bio-climate.

Jian, Li [15], studied significant relationship between health tourism and travel health. Travel health includes health of tourists, tourism sources, environment, and providers of tourism services which should be physically and mentally healthy. Health tourism also shows the ways of achieving this health.

Tshibalo, Ernest [28], studied Sagole mineral-hot spring in Limpopo province, South Africa, and stated the applied potential of this spring for therapeutic tourism. In this paper, an ideal model was stated for welfare sites around the springs.

Different researchers have conducted studies on mineral springs in their countries; for example, works by Oguz et al. [24] in Turkey, Zhu and Hu in China, Yusmani, in Malaysia, Georgiev and Vasiliva in Bulgaria, and ibrahimova in Azerbaijan can be mentioned.

One of the privileges of Iran in terms of natural and therapeutic tourism is in hydrotherapy so that more than 1000 mineral springs have been identified thus far. Some studies have been conducted on the mineral springs of Iran; for example, the study by Nemat Nejad (2008) investigated the position of tourism of Sareyn, Iran, in terms of its mineral springs as one of the main branches of health tourism.

Bahman [2] studied Bagh-e Salamid hydrotherapy complex, Bojnourd, Iran, and mentioned that this complex can be used as a therapeutic tool in the case of suitable utilization.

Azizi and Motahari [1] studied natural attractions and privileges of therapeutic tourism in Iran and completed their study on hot and mineral springs of Damavand region.

Ebrahim Zadeh [8] studied mineral springs and their spatial scope in Iran. In this report, in addition to introducing distributional, chemical compounds, and therapeutic effects of mineral springs of Iran and mentioning the existing challenges, suitable strategies were sought for their better utilization.

Kerman province, as the largest province of Iran, is rich in terms of historical, cultural, artistic, and natural attractions and has about 56 mineral and hot springs and unique natural landscapes. Thus, it is a very suitable place for investment in tourism, particularly hydrotherapy tourism.

Scientific analysis and evaluation of the existing powers and capabilities are among the necessities of today's world. In this regard, few studies have been conducted in this province, as follows:

Shojaei [27] collected a set of information about hot springs of Kerman province (hydro-geo-chemical study) supervised by Kerman Regional Water Company. In this study, attempts were made to describe the condition of all hot springs of the province after their observation.

Jahanshahi [14] authored a book and introduced hot and mineral springs of Kerman province which had been identified since then.

Malek Pour Afshar et al. [19] evaluated the geo-tourist potential of hot springs in Kerman province by scoring method. In this research, 13 out of 56 springs of the province were introduced as the selected springs. Considering the scoring method, they concluded that Sirch hot spring ranked first and Laria, Dimand, and Mohammad Abad Maskoon springs were in the following ranking of geo-tourist activities, respectively.

Therefore, the goal of this research was to prioritize suitable zones of hydrotherapy tourism with an emphasis on hot and mineral springs of this province using geographical information system (GIS) to realize the goals of tourism development in Kerman province. Also, attempts were made to introduce therapeutic and tourist capabilities of these springs and determine their relative share in the tourism industry of Kerman province. Finally, they were prioritized in terms of investment in hydrotherapy development tourism of Kerman province.

MATERIALS AND METHODS

To conduct the present research, different layers such as morphology (slope and elevation), vegetation, climate, communication ways, remoteness and proximity to population centers (city, villages and emergency centers) and data relating to properties of springs such as water temperature, therapeutic properties, EC, PH, and hydration rate were used. The sample size in this research was 32 faculty members in geography from 3 universities in east of Iran, which were selected from 25 people as the total number of statistical population using Cochran formula. To determine the relative weight of the components involved in zoning, analytical hierarchy process (AHP) was used. According to paired comparison using hierarchy tree (Fig.1 and Table 1), Copeland method, and Expert Choice software, the overall weight of each component was specified.
Table 1: Nine-point scale for paired comparison.

<table>
<thead>
<tr>
<th>Types of preferences (lingual variables)</th>
<th>Numerical equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completely preferred, more important, or more desirable</td>
<td>9</td>
</tr>
<tr>
<td>Strongly preferred, more important, or more desirable</td>
<td>7</td>
</tr>
<tr>
<td>Preferred, more important, or more desirable</td>
<td>5</td>
</tr>
<tr>
<td>Moderately preferred, more important, or more desirable</td>
<td>3</td>
</tr>
<tr>
<td>Equally preferred, important, desirable</td>
<td>1</td>
</tr>
<tr>
<td>Preferences between the above distances</td>
<td>2, 4, 6, 8</td>
</tr>
</tbody>
</table>

Fig.1: Hierarchical tree of AHP model for prioritizing suitable zones for hydrotherapy tourism.

To prepare maps considering the weight of each sub-criterion, the required layers were first obtained based on the classification of Table 2 and then the considered criterion layer was prepared using overlapping operations. As an example, layers of slope and elevation levels were obtained from digital elevation model (DEM) of Kerman province for morphology criterion; layers of remoteness and proximity to population centers were prepared for access criterion through making limits around cities, villages, roads, and emergency centers, the geographical position of which had been formerly specified on the layer of Kerman province; and layers of vegetation and climate were obtained from the relevant offices. Afterward, the final map of the surrounding attraction criterion was extracted considering the research classification. Finally, overlapping operations were performed for obtaining zoning layer or spatial desirability of the environment according to the layers of access, surrounding attractions, and morphology.

To rank the springs, in addition to their location in the zone, SPSS software was used. As far as the attraction criterion of springs is concerned, all factors are related to a single spot, properties of one spot are studied, which are in the form of a vector layer, and Arc Map environment cannot be used for such ranking, because the previous layers are raster and this layer is vector; thus, ranking of the springs was separately done using SPSS software and, after valuing according to the classification in Table 3, weighted averaging was performed. Then, the ranked springs were placed on the spatial suitability map using Extract by Mask function (which is used for determining the pixels or cells of the raster layer with a spot or defect) in order to identify the springs that are in priority on the fully suitable zones and use them for investment.

By analyzing kernel density which is one of the very important spatial analysis functions for estimating density, the placement density and dispersion of the prioritized springs were determined. This function estimates density in the search radius considering the known and valued spots and also the definition of search radius. One of the most suitable methods for showing linear, particularly point, data in a continuous manner is kernel density estimation test. This test makes a flat surface of changes in the density of points and lines on the zone (Fazel Nia et al., 2012). In this stage, after recalling layer of springs and layer of Kerman province, kernel density route was followed, the layers were entered, and the desired search radius of 50000 m² was determined; this radius can vary considering the studied region and desired goals. To identify hot spots or the most attractive springs which are superior to others, hot-spots analysis was used. At present, this analysis has turned into one of the most well-known mass analyses, which displays the most superior points by averaging them relative to each other and finding their significant relationship. Steps of performing hot-spots calculation in Arc GIS are as follows:
Preparing a grade or column of data
2- Calculating weight of each column using Relation (1)

\[
G_i^*(d) = \frac{\sum x_j W_{ij} x_j - W_i^* x^2}{s^2 [(n s_i^2) -\frac{W_i^* x^2}{(n - 1)}]^{1/2}} \text{, for all } j \neq 0
\]

3-Activating \( G_i^* \): Hot Spot Analysis Getis and Ord \( G_i^* \)
4-Obtaining results and final analysis (Chainey et al., 2008)

Considering the average standard value or Z-scores, significance level of the springs can be studied; accordingly, the most superior springs which are significantly more suitable than others can be selected for investment in hydrotherapy tourism.

The studied region:
Kerman province is located in the southeast of Iran (Fig. 2) Plateau between latitude of 54’ 21’ and 59’ 34’ east and longitude of 26’ 29’ and 31’ 58’ north with an area of 183285 km\(^2\) that covers more than 11.5\% of the area of Iran. Kerman province is limited to South Khorasan and Yazd provinces from north, Hormozgan province from south, Sistan and Baluchestan province from east, and Fars province from west. This province had 23 counties, 58 districts, 64 cities, and 151 villages until 2011. According to the latest General Census of Population and Housing in October 2011, population of Kerman Province was equal to 2938988 people (50.43\% male and 49.57\% female) and, compared with the 2006 Census, average annual population growth was equal to 2.07\%.

Climate of Kerman Province is hot, desert, and semi-arid. This province is among arid provinces in Iran, which is due to lack of participation and high evaporation rate of water resources. Annual rainfall in this area is low and about 145 mm, which is 58\% of average annual rainfall in Iran (251 mm) and about 19\% of average global rainfall (i.e. 750 mm).

Kerman Province is a highland and mountainous area so that height difference of 4265 m can be observed between Lut Desert and Jazmoryan Pit with the height of less than 200 m and heights of Kouhbandan, Hezar, Joupar, and Lalehzar with the height of more than 4465 m from sea level. Such differences have formed great topographic variations, diversity of climatic conditions, and many ecological conditions in this province. This Province also has 56 Hot and Mineral Springs (Fig. 3).

**Fig. 2:** Position of Kerman province in Iran.

**RESULTS AND DISCUSSION**

In the first step, the questionnaires which were responded to by the experts were investigated using Copeland method and weight of the criteria and sub-criteria was specified through the paired comparisons. This method is applied for different subjects which aim to select the superior choice using paired comparisons. For example, to select a capital or determine the best shop or the best urban zone in analytical network process (ANP) and AHP, this model plays an important role in calculating the results of paired comparisons.

Then, score of each one of them was extracted using Expert Choice software. In this research, the score of sub-criteria of all the criteria was first calculated and then they were prioritized. Each map of the sub-criteria was prepared based on the classified layers (Table 2).
Fig. 3: Position of hot and mineral springs of Kerman province in Iran.

First step: Score of sub-criteria:
Morphological criterion:

Regarding the morphological criterion, sub-criteria of slope with score of 87.5 had the highest rank and elevation with the score of 12.5 ranked the next. Inconsistency rate of this factor was obtained as 0.0, which was acceptable (Fig. 4).

Inconsistency rate is the consistency index of a pairwise comparison matrix which is randomly made. Consistency ratio is determined such that, if CR<0.1, this ratio will indicate acceptable consistency level in pairwise comparisons; if CR>0.1, values of the ratio will indicate inconsistent judgments (other criteria are also performed in the same manner).

Fig. 4: Score of morphological sub-criteria.

The following classified layers were used for preparing the map:

Table 2: Classification of layers for preparing the desired maps in the research

<table>
<thead>
<tr>
<th>Row</th>
<th>Information layers</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Complete suitable (5)</td>
<td>Suitable (4) Medium (3) Almost suitable (2) Unsuitable</td>
</tr>
<tr>
<td>1</td>
<td>Slope (%)</td>
<td>0-1.33 1.33-5.25 5.25-13.04 13.04-21.82 21.82-49.09</td>
</tr>
<tr>
<td>2</td>
<td>Elevation (Meter)</td>
<td>100-605 605-1667 1667-1839 1839-2554 2554-4473</td>
</tr>
<tr>
<td>3</td>
<td>Distance to city in km</td>
<td>15 30 40 50 max</td>
</tr>
<tr>
<td>4</td>
<td>Access to road in km</td>
<td>10 20 30 40 max</td>
</tr>
<tr>
<td>5</td>
<td>Proximity to village in km</td>
<td>10 20 30 40 max</td>
</tr>
<tr>
<td>6</td>
<td>Proximity to emergency centers in km</td>
<td>15 30 40 50 max</td>
</tr>
<tr>
<td>7</td>
<td>Wilderness</td>
<td>Quality pastures and steppe Moderate mountainous pastures Irrigated agricultural lands Moderate pastures Mountains Desert Brakish marsh Sandy place Swamp</td>
</tr>
<tr>
<td>8</td>
<td>Suitable climate</td>
<td>Semi-humid (warm and semi-humid) Mild and humid semi-arid (cold and mountainous moderate) Medium semi-arid (mountainous semi-moderate) Severe semi-arid (warm and dry) Arid (warm and extra arid)</td>
</tr>
</tbody>
</table>
According to Table 2, the required maps were obtained in each stage; then, they were combined with each other and the final one was extracted.

**Preparing morphological criterion map:**
Considering two classified layers of slope and elevation, overlapping operations were performed (Fig. 5). Here, layers of slope and elevation had scores of 87.5% and 12.5%, respectively.

![Fig. 5: Morphological criterion map (located at hot and mineral springs of Kerman province).](image)

**Preparing access criterion map:**
Considering classified four-layer access of city, village, road, and emergency centers, overlapping operations were performed (Fig. 6). Here, each one of the layers had the percent score of 39.8, 30.6, 20.3, and 9.3, respectively, which was included in the related function and the final layer was extracted.

![Fig. 6: Access criterion map (to hot and mineral springs of Kerman province).](image)

**Preparing surrounding attraction criterion map:**
Considering two classified layers of vegetation (wilderness) and suitable climate, overlapping operations were performed (Fig. 7). Here, layers of wilderness and climate had scores of 14.3% and 85.7%, respectively, which were put in the desired function and the final layer was extracted.
Second step: Preparing zoning map of environment or spatial suitability:
To obtain zoning plan with spatial desirability, overlapping operations were performed. Here, the obtained points for each one of the layers was as follows:
Morphology: 5.8%, access: 17.2%, and surrounding attraction: 30.4%, the sum of which was 53.3%. Springs attraction layer included 46.7% considering the results extracted from the first step using Expert Choice software. To perform the three-layer overlapping operations and to combine them with the layer of springs, score of these three layers out of 100% were obtained; the three overlapped layers had score of 53.3% out of 100% and layer of springs had score of 46.7%. Therefore, because score of these three layers was 53.3%, they were scored out of 100% using fitness measurement method and it was concluded that the morphological layer had score of 10.8%, access 32.2%, and surrounding attractions 57%. Therefore, these new number were placed in the related function and the final layer was extracted (Fig. 8).

Third step: Ranking hot and mineral springs:
To rank the mineral springs, SPSS software was used. As far as the attraction criterion of springs is concerned, all factors are related to a single point, properties of one point are studied, which are in the form of a vector layer, and Arc Map environment cannot be used for such ranking, because the previous layers are raster and this layer is vector; thus, ranking of the springs was separately done using SPSS software and weight averaging. Then, the ranked springs were placed on the spatial suitability map using Extract by Mask function in order to identify the springs that were in priority on the completely suitable zones and use them for investment.

According to Table 3, scoring, which was the classification of springs into 5 classes, was done to rank the springs (Fig. 9).

Table 3: Classifying the selected criteria of hot and mineral springs of Kerman province.

<table>
<thead>
<tr>
<th>Row</th>
<th>Selected sub-criteria</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Completely suitable (5)</td>
<td>Suitable (4)</td>
</tr>
<tr>
<td></td>
<td>Medium (3)</td>
<td>Almost suitable (2)</td>
</tr>
<tr>
<td></td>
<td>Unsuitable (1)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Water temperature in degree</td>
<td>45-73</td>
</tr>
<tr>
<td>2</td>
<td>Suitable PH</td>
<td>35-45</td>
</tr>
<tr>
<td>3</td>
<td>Suitable EC Micromhos/s</td>
<td>28-35</td>
</tr>
<tr>
<td>4</td>
<td>Hydration rate L/s</td>
<td>23-28</td>
</tr>
<tr>
<td>5</td>
<td>Therapeutic properties</td>
<td>1-23</td>
</tr>
</tbody>
</table>

Table 4: Ranking hot and mineral springs with investment priority in Kerman province.

<table>
<thead>
<tr>
<th>Row</th>
<th>Name of spring</th>
<th>Spring ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Laria</td>
<td>4.95</td>
</tr>
<tr>
<td>2</td>
<td>Barl Anbar Sarmosik</td>
<td>4.62</td>
</tr>
<tr>
<td>3</td>
<td>Sirch</td>
<td>4.54</td>
</tr>
<tr>
<td>4</td>
<td>Abbad Maskoon</td>
<td>4.53</td>
</tr>
<tr>
<td>5</td>
<td>Mohammad Abad Maskoon</td>
<td>4.49</td>
</tr>
</tbody>
</table>

Fig. 7: surrounding attraction criterion map of hot and mineral springs of Kerman province.
After performing recoding stages, weight averaging function was implemented for the selected sub-criteria of the springs. It was similar to the overlapping, which was performed for the layer of zones; but, here, it was done for point or vector layers.

Score of each sub-criterion for averaging was as follows:

Therapeutic properties: 53.6%; Suitable PH: 11.9%; Water temperature: 21.2%; Hydration rate: 8.5%; and suitable EC: 4.8%.

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Fig. 8: Zoning map of the environment for hydrotherapy tourism in Kerman province

Fig. 9: Ranked hot and mineral springs for hydrotherapy tourism in Kerman province

Fig. 10: Diagram of spatial desirability ranking and ranking hot and mineral springs of Kerman province.
Fig. 11: estimating the density of hot and mineral springs in Kerman province.

Fig. 12: Hot and cold spots map for the environmental zoning of hydrotherapy tourism in Kerman province.

Fig. 13: Position of hot and mineral springs with investment priority in Kerman.

*Step 4: Preparing final zoning map for hydrotherapy tourism:*

To prepare the final map, environmental zoning layer (Fig. 8) was overlapped with the layer of springs ranking (Fig. 9). Because one layer was in raster and another in point, Extraction option was used. After this step, the ranked springs were located on the raster layer of environmental zoning and, since the zone in this
section was shown in pixel, the layers had to be observed at higher magnitude. Thus, they are shown in (Fig. 10).

**Step 5: Estimating kernel density function:**
Finally, the desired map was obtained after other steps. Fig. 11, demonstrates the density of hot and mineral springs on the zone of Kerman province.

**Step 6: Analyzing hot and cold spots:**
The values which can take standard average or Z-scores:
As far as the desired points were concerned, significance levels of 99%, 95%, 90%, and 85% of standard average value were higher than 2.58, 1.96, 1.65 and -1.65, respectively.
Fig. 12 indicates that, according to this analysis, Laria, Mohammad Abad Maskoon, Abbad Maskoon, Abaregh, Hormak, and other springs were the hot spots for hydrotherapy tourism at the significance level of 99% and had the necessary potentials for investment in this field. Sirch spring with significance level of 95% and Barf Anbar Sarmoshk spring with significance level of 90% were at the next levels. Other spots were regarded cold spots, which did not have the required potential for attracting tourists as much as the hot spots.

**Step 7: Introducing investment priorities:**
Considering Fig. 10, 11, and 12, the 5 springs which were superior to others can be specified and separately shown. These springs can be introduced considering the studies by models as the first priorities of investment (Fig.13 and Table 4).

**Conclusion:**
According to the present research, most of these hot and mineral springs had therapeutic properties and enjoyed from the necessary potential for attracting hydrotherapy tourism. These springs were dispersed in the entire province; but, according to the density estimation, they were more dispersed in the southern cities toward the center.
Regarding the environmental zoning for hydrotherapy tourism, most of the zones which had completely suitable ranking were extended from the south and southeast of the province toward the center according to Fig. 11 and suitable zones were mostly located in the central, northern, slightly toward northwest, and southwest of the province.
In the first phase of this study for investment, about 9 out of 56 springs were included in the completely suitable class in terms of properties and spring attraction potentials, which were Dimand, Laria, Abbad Maskoon, and Goor springs in Jiroft, Barf Anbar Sarmoshk, Chehel Tan, and Gazeno in Bam, Dig Rostam in Ravar, and Sirch Spring Complex in Kerman.
In terms of location in the zone, Laria, Abbad Maskoon, and Barf Anbar Sarmoshk were in the completely suitable zone, Sirch and Goor were in suitable zone, and Gazeno was in medium zone; other springs were located in unsuitable zones.
Since attempts were made in this work to study the springs in terms of both zone and attraction of every single spring, therefore, the springs which had investment priority can be introduced as Laria, Abbad Maskoon, Mohammad Abad Maskoon, Barf Anbar Sarmoshk, and Sirch Spring Complex in the first phase (Fig. 13).
Moreover, considering hot-spots analysis, the springs which were significantly superior to others included Laria, Abbad Maskoon, Mohammad Abad Maskoon, Sirch, and Barf Anbar Sarmoshk. Owing to the similarity of these five springs in all the cases of analysis, it is better to first consider them in terms of therapeutic tourism.

**ACKNOWLEDGMENT**
Since tourism therapy is a new issue in Iran, this paper was aimed to use hierarchical techniques to appropriately weigh environmental and communication variables and also determine investment priorities in tourism therapy (with an emphasis on spas and hot springs). Simultaneous use of analytic hierarchy process (AHP) and geographic information system (GIS) techniques was one of the innovations of this work, because they not only identify appropriate location for tourism development, but also present solutions for developing selected regions with the purpose of investment in tourism hydrotherapy.

Investigating the resources and conducted research in Iran shows that no studies have been done on this specific topic with the mentioned research approach; therefore, this work was a novelty in itself.

**REFERENCES**


