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Prioritizing the Appropriate Criteria for the Location and Design of Hydrothermal Centers by Using AHP Analysis

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Abstract

In recent years, due to urban and industrial development in human societies, there has been a change in lifestyle and industrialization. Maybe, the result of these changes can be relative prosperity for mankind but it could have destructive effects on the natural environment without neglecting the man. In addition to protecting the environment, with awareness of the location of various places, appropriate action should be taken for urban management. Identification and prioritization of the criteria and location of urban centers are critical in planning and urban design. Qeshm Island is one of the regions, due to geographic and strategic position in the country, and historically significant natural features, can be regarded as a good area to attract tourists, but it has not been successful so far. Hot springs on the island have not been used much and equipment and specific applications are not considered for them. In this study, we tried to locate a suitable space for the construction of village health tourism in Qeshm Island and create a good potential strategy to revitalize the area around Qeshm Kargah spring. The method used in this study is descriptive - analysis that required data related to coastal areas of Qeshm Island and springs Kargah , which was conducted through field interviews. In this study, by using data obtained from the three areas around springs, we weigh important criteria to select the best area and then with Analytical Hierarchy Process AHP and EC software, a perfect place is suggested to build sports, health and tourist centers.

Keywords: Prioritization, measurement, location, hydrothermal sites, Qeshm, Analytical Hierarchy Process (AHP)

Introduction

The accelerated urban growth in recent decades has been carried out in a way that urban spaces and infrastructure needed has not been equipped proportional to it. The most important impact of urban growth is the destruction of services' distribution system and its insufficiency that broadly speaking can be seen in all of Iranian cities (Hooshyar, 2011). Since healthcare is one of human societies' first basic needs, its supply and control with the aim of improving the quality of life and welfare is considered as one of the most important tasks of governments. According to the principle of social justice, equitable distribution of healthcare services is one of the main goals of urban planners. Providing this principle leads in to the realization of the other two principles namely availability of the services (Taghvaei, 2007).

On the other hand, according to the surveys conducted, Iran is one of the top 10 countries in terms of tourist attraction (honarvar et al., 2006) but Iran's share of the industry equals 1777 billion dollars which is about an eighth of turkey's tourism revenue, Iran can help the revitalization of the lake and the stable economy in the region by attracting the capital of medical tourism. One of the areas that has the potential of attracting foreign tourists is Qeshm Island that could not have been as successful as it was expected till now. Although Qeshm island could not compete with its neighborhood in export and industry, but has a better touristic feature than those areas. By

identifying the existing problems and barriers, you can attract more tourists. It should be noted that creating new touristic centers with therapeutic approaches requires lots of spending and you should ensure the investors that in case of the right choice of the center, return on capital will be guaranteed and citizens can be a reliable guarantee of these investments by quick, easy and timely access to them. Therefore, in locating these centers, access to specialized and cheap labor for athletic hotels is necessary, the location of these hotels is better to be chosen close to the centers that have the ability to support professional services in terms of providing expert labor. One of the effective factors namely the access radius of the city center and the surrounding population in present study is that these centers should benefit from airport and the appropriate communication. Also the vicinity of the desired area to expert and cheap labor is an important factor for weighting and selection.

The above mentioned and the assessment of health services necessitates the selection of healthcare services and the required social and cultural infrastructure. It is required that the lack of coordination in the distribution of health services be checked, an appropriate locating with better performance is provided, by showing the existing deficiencies and strengths. Therefore, with the hypothesis and system test namely analytic hierarchy process based on weighted information and according to the existing standards and criteria, you can provide a suitable positioning for touristic centers. Therefore, this study plans to determine optimal places for the establishment of sports hotels construction priorities. We have used the analytic hierarchy process weighting method to determine the exact layout and eventually some suggestions have been provided to locate new recreational health and touristic centers.

The Necessity and importance of localization Hydro thermal centers

Every area with suitable ground in the field of locating and building sports hotels and residential centers has limitations and failures as follows:

- Lack of proper placement according to the infrastructure of the region and plan's requirements.
- Failure to abide the proper distance from plan's sample touristic centers
- Lack of perfect solution for domestic and foreign investors
- Mismatch between spatial distribution of residential centers with tourists

Investigating in centers providing services like residential centers can be done in the framework of two separate concepts, quality and quantity. The existence of these kinds of centers has a great effect on an area's tourism in so far as sometimes these centers also become the target of passengers' tourism (Taheri Demneh et al., 2010). Since hotels are considered as the origin and destination of daily trips, and their development can be a significant milestone in the development of tourism industry. According to the officials' emphasis on maintaining natural resources, supports are needed to remove the obstacles and create the necessary infrastructure for the attraction of tourists, especially Therapeutic Tourism for monetization in the area and health department and tourism organization's emphasis on creating health resorts , creating and positioning therapeutic tourist centers justified with the sustainable development approach.

Objectives of localization hydrothermal center

The main objectives of this study are:

- introduction of appropriate places for implementation of projects
- Providing an appropriate model for locating residential centers using analytic hierarchy method (AHP)

- Providing proper solutions to choose a health care hotel by using regulations and standards of in locating

The process of development of tourism in cities

By studying the spatial patterns of the tourism industry, it can be seen that there is a focus on tourism in the large urban centers and surrounding areas that are tourist attractions. To find out how the formation and evolution of patterns is , understanding of Butler fundamental principles for the development of tourism in the city seems necessary. Phases and processes of development of tourism in the city are as follows:

- Discover
- Action
- Development
- Consolidation
- Downturn
- Reduction
- Renewal

Sustainable development of urban tourism

Addition of sustainable to urban tourism is because of the extent of the side effects of tourism development projects within the city, and world heritage and this discussion is efficiently logical just when four economic development, social, environmental, cultural, are discussed together in transnational and national levels and in mutual communication with citizens. What is emphasized in the development of sustainable tourism city, In addition to the industry's economic and social achievements for the citizens and cities, is the importance to continued development of tourism in time (note to future generations) and the development of the geographical location (environmental impact) (Hamdi et al., 2008).

Access radius

There are many factors affecting the debate within accessible including their population density and the size of the space. Access radius cannot be higher than a certain amount. Access time is also an important factor than the distance according to the rules and criteria should be considered to be minimal access.

Analysis of the place

Most of feasibility studies , as an introduction to business analysis , show some information that indicate economic situation of the region from the entire city or region. Most critics consider this information unimportant, but still this information is very beneficial in providing the necessary records to lenders that are from out of the local community and also to obtain relative information about hotel accommodation market. In general, analyzing the location consists of the following issues:

- Population growth, employment, income, taxation, new construction, etc. of important public and private buildings that includes educational, health, administrative, sports, transportation, religious and tourism facilities, etc
- Analyzing the trips including the volume and percentage of trips that take place with car, plane, train, bus and ship.

The main subject of the study must reflect the possible type of hotel project. For recreational hotels, it should only be indirectly under the influence of industrial and commercial penetrations, even to the extent that we consider them as secondary markets, when the season is not for traveling

patients. Generally, this study should focus on natural attractions and other recreational opportunities in the area and contact with centers of attracting customers through airlines and highways. For this reason, regional analysis, for hotels near a university or a major medical complex should preferably deal more with the procedures related to these institutes than the ones related to the larger industrial and commercial sector.

Area assessment should also include a detailed analysis of the website. In addition to visible features of the website like dimensions, limits, typography, etc, this analysis should investigate the ability of being in sight, easy access and its suitability for use as a hotel. The first two items are super critical and important for hotels and motels on the way that attract their customers mostly on the road and without previous reservation. The subject of the location's suitability for hotel construction may focus on the advantages of the website or potential limitations such as its view, natural features, its proximity to that region's observable places or working centers, nearby users, enough space for the development plan and zoning or access to infrastructure.

Criteria for functional localization

In determination of place characteristics, any use of place and any urban activities are evaluated as two leading factors including social and economic prosperity. Based on these two factors, six criteria in locating the municipal urban are important in planning: Compatibility, comfort, performance, utility of health safety standards.

Compatibility: From the perspective of urban development, each user in the city is in contrast with some of the uses that are compatible with the others. That is why the most important planning efforts is positioning for a variety of applications in the city and separated from each other incompatible applications (Aghababei , 2008).

Safety standards: The goal is to protect lives, their affiliation and urban infrastructure against natural disasters and human (Zangiabadi , 1998).

Comfort: Distance and time are important factors in measuring human comfort because by providing them easy access to urban services, one of the main goals of urban planning is possible (Pourmohamadi , 2008).

Performance: In order to create the appropriate space and function, the activities of localization as well as providing connections between performance and users to increase efficiency in the functioning of municipal strategies and principles are needed. Urban land price pattern is the main factor in determining of land use location. Any use of the economic and investment is outcome of the price of land situation in terms of the preparation and the development that cost-benefit analysis will be determined.

Utility: Purpose of utility is preserving the natural landscape, open spaces, etc (Ziyari , 2001).

Healthy: Applying Environmental conditions and hygienic to reduce pollution from various applications and observance of health standards to improve the health of the human environment is the goal of positioning use**.**

The neighboring uses: From the applications that are involved, the location of the hotel in sports can be mentioned as follows:

- Access to the site of hot mineral water
- Access to cultural and religious centers
- Access to parks and green spaces
- Easy access to business centers
- Observance of from the industry
- Easy to population centers for skilled workers

Table 1: View of the neighborhood of the sports hotel location (Derakhshan , 2007)

Use application name	Appropriate Proximity	Neighborhood restrictions	Appropriate neighborhood
Health Treatment	Near to Family accommodation and the scale of independent medical health center Maximum access to urban facilities on the main street , being on the flat lands	The minimum distance of 1000 meters annoying of industrial Workshops away from the sport lands and Privacy of town's main street (hospitals and large health centers) away from the noise , fuel storage and unloading and loading of waste facilities	User adjacent with residential , educational , commercial , cultural , sports , business critical and industrial facilities and outdoor access network, In neighborhood a green open space with a maximum availability of traffic and the city center (hospital)
Tourist	Water and mud and salt lake shores , Parks , recreation centers , cultural centers , major centers of medical waste another hotel	away from the cemeteries , Hospitals , Centers and of industrial noise	Proximity to roads Near to the airport and railroad Commercial and leisure centers

Methodology

Examining the Analytical Hierarchy Process (AHP)

The technique of couple comparisons is used for selection by AHP process; This means that to make a decision and a choice a case among a few options available , compared them as mutually based on given criteria and obtain once preferably to any measure. After weighting to criteria by the techniques on the results , an option that has the highest score, is selected. This method is based on four principles are described in the following (Shakeri , 2004).

In general, decision-making by using AHP has three main steps that should be taken.

• Making hierarchy
• Calculating weights
• Controlling compatibility or incompatibility of process

Making the hierarchy

The first step in the analytic hierarchy process is a graphic representation of the problem that on top of them, is the main objective and in the next level are the criteria and options. Considering that there is not a final rule to draw the hierarchy but a set of general rules conducted by Diar and Forman, which is one of the following ways:

- Objective-criteria-options
- Objective-criteria- under criteria-options

In a general perspective, we can say that making a hierarchical method depends on the type of decision that should be taken.

For example ,if objective decision, is to choice an option , we can start from options and show them in lower level and in next level , the criteria that are considered for choosing alternatives should be placed and on top level , the purpose of the hierarchy that is an element is placed (Asgharpour , 2007).

Sometimes the criteria should be more detailed to be analyzed that in such cases , another level including under additional criteria will be added to the hierarchy. There is no limit to the number of levels in a hierarchy.

Modeling

In this step, the problem and the aim of decision making is made hierarchically through elements of decision that are related to each other. Elements of decision include "decision indicators" and "decision options". Analytical Hierarchy Process requires a problem with some indicators to be broken down to a hierarchy of levels. The top level represents the main objective of decision-making process. The second level represents major indicators (that might be broken down to more detailed sub-indices in the next level). The last level also provides decision levels (Qudsi pour, 2006). Conversion of the investigated issue to a hierarchical structure is the most important part of Analytical Hierarchy Process. Since, in this part , Analytical Hierarchy Process analyses difficult and complex issues and explains them in a simple way that conforms to human mind and nature. In other words , Analytical Hierarchy Process makes complicated problems simpler through its analysis to minor elements that are related to each other hierarchically and the relationship between the main objectives of the problem with the lowest level of hierarchy is clear.

Calculating the weights

To calculate the weight at first , and to obtain the importance of criteria and sub-criteria, all criteria and sub criteria are compared to each other by the paired comparison matrix and through different methods, the weight of each criteria and sub criteria should be computed and they are called relative weight. For example if in a hierarchy, there are 5 main criteria that its 4 main criteria each have three sub-criteria, in total to obtain the importance of criteria and sub criteria we should form a 5 x 5 matrix for main criteria and four 3x3 matrix for sub criteria. In the next step, all options is compared using the paired comparison matrix compared to its high level elements that can be a sub criterion or directly a criterion. The weight of each of these options is obtained compared to each of criteria or sub criteria which are called the relative weight. In previous sample to obtain this weight, we should form (3x4+1) 13 paired comparison matrices only for the options which have the same number of rows and columns as the options. The next step is the calculation of each option's absolute or final weight that is obtained from the total multiplying of each criterion's weight by the weight of the related item towards that criterion and in the last step by obtaining the absolute weight, options prioritization is determined. Generally , a paired comparison matrix is shown through the following equation in which aij is the preference of element i^{th} to element j^{th}.

(1)
$$A=\begin{bmatrix} a_{11} & a_{12} & a_{1n} \\ a_{21} & a_{22} & a_{2n} \\ a_{n1} & a_{n2} & a_{nn} \end{bmatrix}$$

In this comparison, decision makers use verbal judgments. In this state if option i is compared to option j , the decision maker decides that the importance of I to j will be a quantitative value between 1 to 9 which will be studied in the following (Asghar-pour 1387).

Consistency in judgments

Almost all the calculation related to hierarchical analysis is done based on the decision maker's initial judgment which appears in the form of a paired comparison matrix and any errors and inconsistencies in comparison and determining the importance between options and indicators will undermine the final results obtained from calculation. Inconsistency rate which is explained later is a tool that determines the consistency and indicates to what extent we can trust the priorities of comparisons.

Table 2: Evaluation of the intensity of superior by comparing the measurements for the analysis of AHP (Asgharpour , 2007)

The intensity of priority	Comparison of i to j	Explanation
1	Equal importance	I to j has equal importance and there isn't prioritye
3	Relatively important	I to j is more important
5	more important	I to j index options is important.
7	Very important	I has more priority to j
9	Quite important	I is quite important and isn't comparable to j
10	Special importance	I is absolutly important from j and has very more important
2,4,6,8	interstitial Preferred	Intermediate values between the preferred values shows. 8 For example , the importance of more than 7 and less than 9 for i to j.

For example if option A is more important than option B (preferred value 5) , and B is relatively more important (preferred value 3), then we should expect that A is much more important that C (preferred value 7 or more), or if A's preferred value towards B is 2 and B's towards C is 3 , then A's value compared to C should provide the preferred value 4. Perhaps, the comparison of the two options at first seems like an easy job, but when the number of comparisons increases, certainty of comparisons' compatibility is not be easy and we should earn this certainty by applying the compatibility rate. Experience has shown that if the compatibility rate is less than 0.10, the compatibility of comparisons would be acceptable and otherwise comparisons must be revised. It is worth noting that in the modeling followed above also compatibility rate is 0.07 and it shows that the data are compatible. Generally , the following steps are used for the calculation of incompatibility rate (Asghar pour 1387).

- Step 1: calculating the weighted sum vector: multiply the paired comparison matrix in ((relative weight)) column vector and the new vector achieved is called sum weight vector (SWV).
- Step 2: calculating the compatibility index: we'll divide the elements of weighted sum vector by the relative priority vector and the result we'll be the compatibility index (CI).
- Step 3: calculating λ_{max}: we can calculate λ_{max} , by calculating the average of compatibility index elements.
- Step 4: calculating compatibility index: compatibility index is defined as follows:

(2) $$I.I = \frac{\lambda_{Max} - n}{n-1}$$

In this equation , n is the number of available options in the problem.

- Step 5: calculating the compatibility ratio or compatibility test: the mechanism used to study the incompatibility in judgments is the calculation of the factor called compatibility ratio that is obtained by the division of incompatibility index in random index according to the following equation.

(3) $$C.R = \frac{I.I}{R.I}$$

If this index is smaller than 0.1 or equals 0.1 , compatibility in judgments is acceptable , otherwise we should revise the judgments (Asghar pour, 2008).

Findings of the study

The analysis of the selected location on Qeshm Island

Qeshm Island along with some failures has remarkable potential opportunities, facilities and capabilities (Bayat, 2009). However, in attracting investments, Qeshm has a high potential in tourism and other fields like mining (Elahi, 2009) that shows a promising future in economic and social development in case of sustainable management and proper planning. Creating sports hotels (hydrothermal) can help in attracting tourists in addition to the development of the island's design.

The desired area to design the sports hotel is an area known as kase salakh in southern coast, which is a wilderness with the approximate length of 7 and approximate width of 5 km that has no vegetation. In the depths of this desert, there is a curative sulfur spring.

Kargeh sulfur spa is located in the middle and the core of anticline structure near Salakh fishing port (Salakh natural gas field, known as wilderness). The spring water is relatively warm (temperature about 30 C0), this spring is the artesian kind and in fact erupts upward because of the basic level differences in the underground water source and its bedrock. Because of the minerals and its proper temperature , this spring can have health properties including treatment of skin diseases , and calming the nerves and this point is a good reason to organize it and provide opportunities for people to use it. The following pictures provide the area's location.

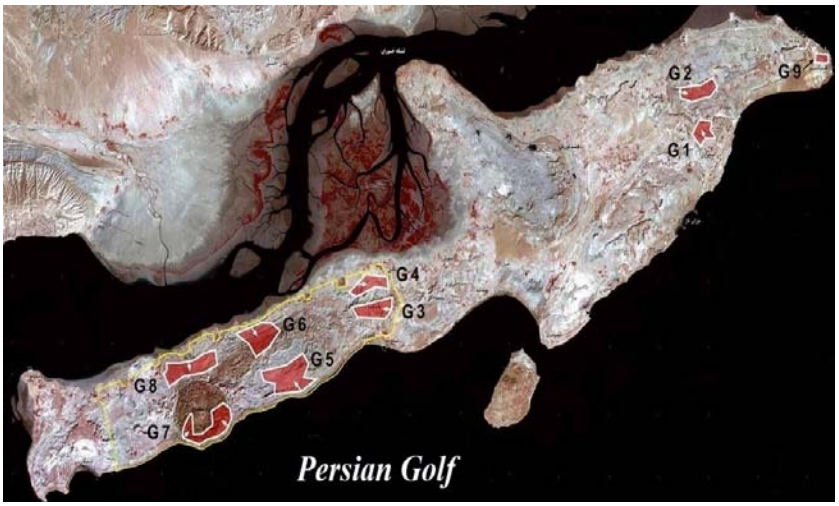

Figure 1: Qeshm Geopark, G5: Wilderness Salakh (G1: Stars Valley, G2: Kurkura Mountain, G3: Qeshm roof, G4: Statues Valley , G5:Barahoot WildernessG6: Cha Mountain, G7: salt Dome, G8:Doulab G9:Geopark)

Figure 2: Salakh Qeshm, Spring Kargah

Evaluation of the current situation surrounding the hotel area

According to the conditions of hydrothermal center , it can be examined surrounding hotels aspects of activities in the field of tourism activities and equipment and passengers.

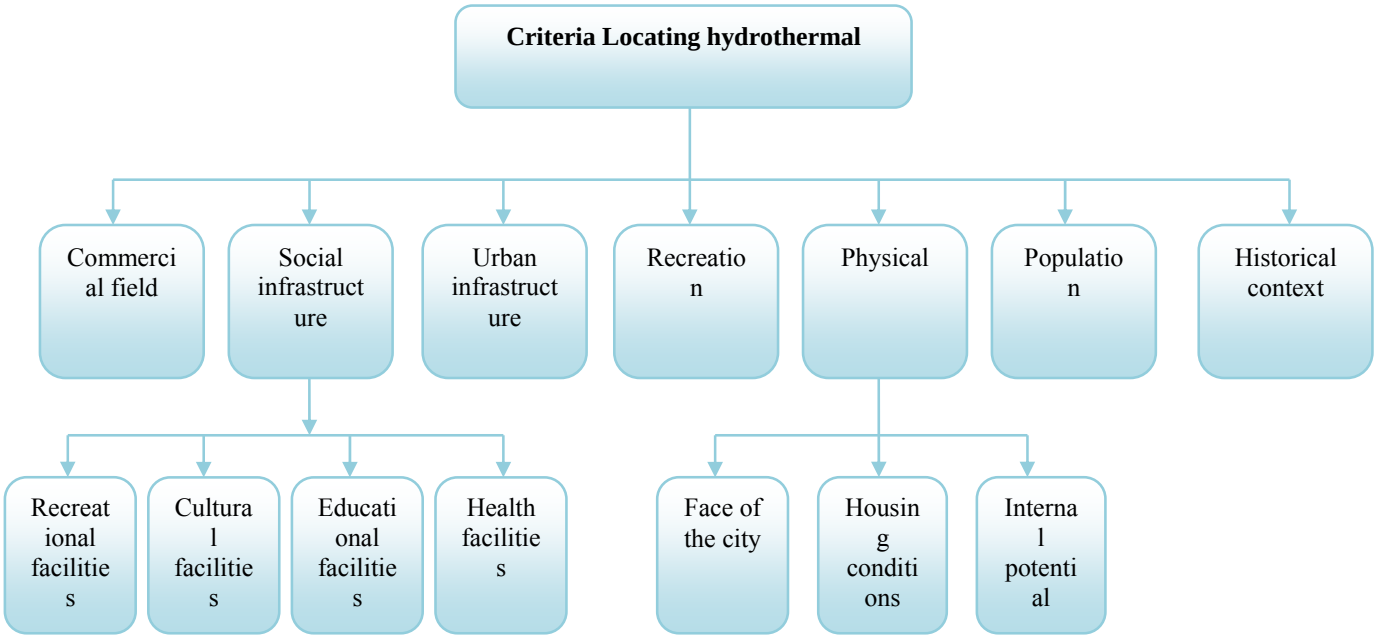

Figure 4. Diagram of hierarchical of criteria and indicators localization hotel sports (Source: author)

Historical context, population, physical location, urban infrastructure, circulation (transportation), social infrastructure and industrial areas. Each criterion According to important priorities, divided to sub criteria completely presented in the following graph. AHP process is as follows:

- Step one: creating hierarchy of decision making
- Step two: paired comparisons and criteria Options

- Step three: The conversion of weights and Controling the rate of weight change adaptation
- Step four: Rating of the different options and criteria and the final decision

Step five: Sensitivity Analysis

Locating new hotels

Identifying parameters affecting the localization

According to the above results, based on research purposes that is locating of spatial distribution of hotels, it seem necessary to examine a number of parameters and indicators. In this study, to locate a suitable place to build a hotel, sports therapy (village health) layers of the following is used:

Layer Data Valuation

In this study, the valuation of information layers of the AHP model is used. In this method of weighting the criteria is done Expert Choice 2000 software. Process is as follows:

- create a binary comparison matrix
- weight calculation criteria and sub-criteria
- compared consensus estimates
- the incompatibility rate calculation

Rates of compatibility by software is easily visible at every step. The table below shows Rates of adjustment in different stages where IR index is random, Random indicator is a binary comparison matrix that is created by agreement. It can be shown that, depending on the number of components compared to IR. Agreement ratio (IR) is designed in such a way that if IIR≤0.1, the acceptable level of agreement than binary show But if IIR≥0.1 indicates judgment is inconsistent. In such cases , the amounts should be revised and corrected binary comparison matrix (Nikmardan , 2006).

Table 3. IIR standard

n	1	2	3	4	5	6	7	8	9	10
IIR	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.45

Determining criteria and sub criteria for AHP to locate Sports hydrothermal hotel

Historical context: If the area has a variety of historical sites. According to priorities of the most historical places, the maximum weight belongs to place with more history attractive.

Population: It is considered according to the role of population in providing services to tourists and access to a better facility as basic criterion.

Physical location of regions: Considering the current use of land and analysis for various applications such as residential, commercial, office, industrial, recreational and road, selected regions structure, problems and usefulness potential of implementation of the sport hotels should be studied and due to the importance of sludge as a major factor, the more weight is allocated. The following sub criteria in addition to the main criterion (physical location) are allocated as follows:

- Urban Landscape
- The status of lands and settlements
- Area potential including the another sub criteria such as sludge , mineral waters , natural beauty and national tourism zone.

Urban Infrastructure: Electricity , gas , water , phone and e-waste fire as an important decision-making criteria are weighted. According to options, with the construction of tourist hotels in areas with poor urban infrastructure will have frequent problems that one of the main causes of the current absence of accountability hotels in the region is ignoring this important factor.

Recreation: One of the main factors in attracting tourists is the needed facilities in resort's roads, streets, waterways, rail transportation systems and other terminal facilities to transport tourists goods and services are an important measure of decision-making.

Social infrastructure: The sub criteria such as health care , education , recreation and culture as the social structures in this study is considered as an indicator of decision-making. Using the expertise and facilities in the region is also one of the most important features to attract tourism.

Commercial and industrial field: Proximity to shopping centers , supermarkets , wholesale markets and retail locations and market position within the space and nearby towns were examined.

Data analysis

By using Expert Choice software, the weighting of criteria and sub-criteria is specified. The selected cases of the results of each phase of software options are presented in Table 4:

Table 4. Matrix criteria and weighting the criteria to Locating Sport hydrothermal hotel

Information Layer	Historical	Population	Physical	Urban infrastructure	Recreation	Social infrastructure	Commercial business field
Historical	1	1	0.25	0.33	1	0.5	1
Population	1	1	0.2	0.25	0.33	0.5	1
Physical	4	5	1	2	3	2	3
Urban infrastructure	3	4	0.5	1	3	2	3
Recreation	1	3	0.33	0.33	1	1	2
Social infrastructure	2	2	0.5	0.5	1	1	3
Commercial business field	1	1	0.33	0.33	0.5	0.33	1

In this project, it has been used Expert Choice 2000software which the end result leads to the fact that the best option for the construction of a therapy sports hotel has what criteria. The following table provides information on the weight of the layers of AHP model for to show localization of therapy sports hotel.

With the conclusion of data Software , area A was chosen as the best option and Then Area C and Area B, have been next orders. Regarding the IIR = 0.04 and IIR <0.1 indicates that the judgment is consistent (Figure 6).

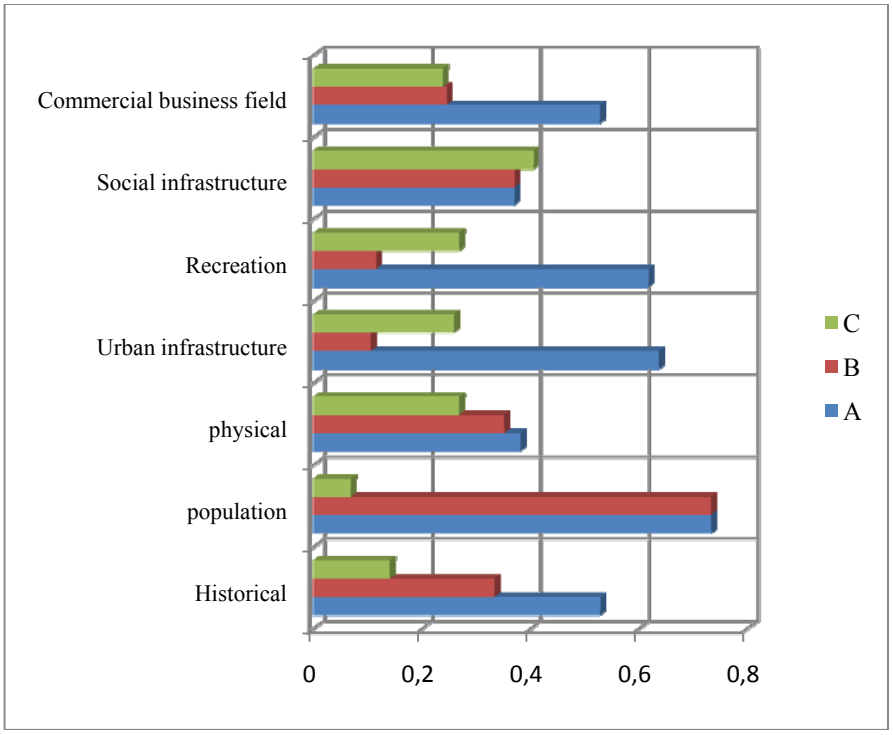

Figure 5: The final weight Diagram data layer for three regions

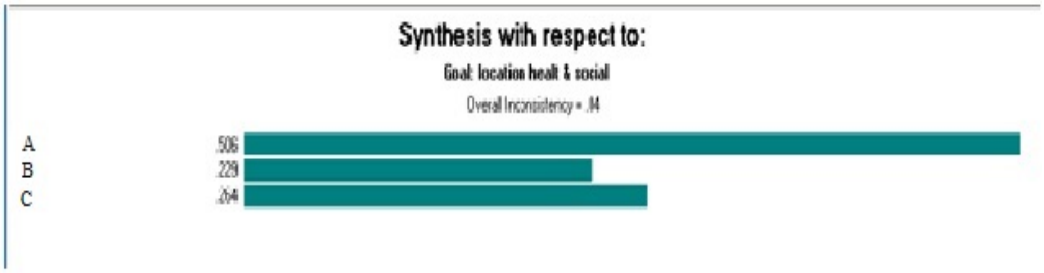

Figure 6: Information extracted from the software EC on locating Sports hydrothermal hotel

Discussion and Conclusion

Assessment and spatial distribution of residential applications like sports hotels in each area based on standards and criteria, seems necessary for recruiting investors. Accordingly, by studying the important criteria in locating and studying the area's infrastructure and effective factors in forming a sports hotel , it was concluded that a large part of the beaches despite several tourist attractions lack therapeutic hotels which requires correct positioning and promotion of access level to recreational and health centers. Therefore, by collecting the effective data in the form of information layers like communication network, distance from touristic centers, distance from industrial centers and by using EC software and AHP model, the most appropriate place for the construction of sports hotels in the form of three distinct floors suitable for the construction of hydrothermal hotels , hydrotherapy and mud cure camps and ecotourism in Qeshm island were introduced.

Based on the results of the analyses and charts, zone A is the best option for building sports hotels and then zones B and C are the next options for building such hotels respectively. According

to the researchers in Salakh port, option A has more attractions and has allocated a higher ratio to it, but in the selection of therapeutic hotels having the appropriate infrastructure is the most important factor in the selection of these kinds of hotels which zone A has allocated lower value in this regard. To build ecotourism hotels, pristine and untouched areas are the best options , which in this respect zone A can be an appropriate option given the natural potentials.

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