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Comparison of AHP, network and systemic analysis methods in assessment of ecological capability in Gisum Forest Park

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Abstract

Assessment of ecological capability for the reason necessary of selection and optimal exploitation of land ecological potential has been spatially important for to sustainability development. In this study to determine the ecotourism and recreational potential Gisum forest park in the Giulan Province of Iran used from three methods: Systemic Analysis Method, Analytic Hierarchy Process (AHP) and Network Methods. For systemic analysis method, the ecological resources in the study area were identified. Then making integration and intelligence informational layers and analysis them in geographic information systems (GIS) to be accomplished and identified fit palaces as 2 intensive recreation zones and 1 extensive recreation zone. According to the results, the area hasn't 1 class of intensive recreation (high potential). The area of 2 class of intensive recreation zone obtained 49.55 %, intensive of 3class with 35.9% and 1class of extensive recreation zone 14.55%. In AHP, priority to identified effective factors and then valuation criteria achieved based on pair wise comparison technique and using by Expert Choice software. As the result was evaluated 47.7% of the area with high potential and 52.3% of the area with moderated potential. In the network approach divides initially the study area into 24 networks and associated ecological resources were identified and scored based on several characteristics. In this method 20.67% of the region evaluated with high and 75.16% with well and 3.5% with moderate and 0.67% with weak potential. The results indicated that is incumbent different models are corresponded to local conditions and then used in order to maintain its effectiveness for use in different areas.

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Introduction

Recognition and appointment of proportion and liability of ground for frame and urban development is primary actions in space and environment programs and is a tool for Strategic planning land use (Rossiter, 1996). Land use planning; Space wise management to optimize the distribution pattern of human activities (MirRiahi, 2009) and the only logical solution would break the cycle of poverty from social and environmental crisis and create the conditions for achieving sustainable development (Ramakrishna, 2003).

There are different methods for assessing the capacity of land to determine the appropriate user and prioritize between them that is the systemic method is one of the oldest existing methods and has been used on global scale for long times. But sometimes due to multiple and possibly conflicting criteria have been difficult to assess and makes difficult using existing models and trying to find a solution suitable for analysis on many information layers. At this time obtaining the correct result, unconsciously towards decision-makers to use the system leads in addition to high accuracy in terms of speed and ease of operations is located in the upper limit (Panahandeh *et al.,* 2010).This caused to create the newer methods in the land use planning. Among these methods is using mathematical models to evaluate ecological capability, set priorities land uses based on linear programming, the numerical models to adapt to environment land use and using of analytical hierarchy process (AHP) for determining the weight, the relative importance and prioritization between land uses (Ownegh *et al*, 2006).

Sinun *et al.,* (2002) in Taiwan, Zanin *et al.,* (2005) in Brazil, by used systemic method, and Jinyang and King Thomas (2002) and Gülez *et al*., (2004) in Turkey, Sicat *et al*., (2005) in India, Bunruamkaew and Murayama (2011) in Thailand to assess the ecological potential their own study area by usage AHP method. Also network method is a method that used for the identification, analysis, summary and evaluation of ecological resources. This method often applied to environmental capability evaluation in England and also used to select a suitable location for establishing national and forests parks in Germany and as well can be used in Iran.

Tourism is one of the largest industries of world and is dependent in large part of global economy. To define of Such as phenomenon is difficult with simple words. Because of this phenomenon is mixed in terms of economic, social, cultural and environmental to human life and the states. Tourism because having high potential in the creation and promotion components of national development, regional, urban and rural areas, has been regarded and praised always. Incremental growth urbanization and approach to geography leisure in recent decades has led to be considered by the tourism industry as the largest and most diverse industries, and as well as the attainable goal of sustainable development processes. Many countries know this dynamic industry as the main source of income, job creation, growth sector private and cultural and human exchanges and infrastructure development (Miczkowski, 2006). Necessity using of land use planning methods felt, especially in the conditions that tourism development takes large dimensions in regional scale. Because of the environmental impact of tourism development on environmental has systemic aspects and will affect space, physics, social, and economic and management sciences. Ecotourism is able to increase cooperation in the use of the capabilities of environment and its economic impacts and also to occasion environmental protection and sustainable development and create mobility in the local and regional economy (Fennell, 2008).

In the past, ecological assessment process was done manually and without the use of powerful tools that has been certainly very difficult, costly, time consuming and is associated with the error. If today's Geographic information system (GIS) is Consideration in the identification of resources and efficiency analysis uses as a tool enabling and with high precision. One of the most important capabilities of GIS is ability to combine data for modeling, site

selection and determine coordination land via valuation of land area. Geographic information system is considered with capabilities in data management and presentation new output as an efficient tool in environmental planning assessment of multi-factors evaluation (Hathout, 2002; Kumar *et al.*, 2013; Yousefpour *et al.*, 2013).

The aim of this study was to select the best method evaluated the ecological capability to ecotourism development in the forest parks. In this study were used three methods of systems analysis, hierarchical analysis and network method, for data analysis by using GIS. Finally the determine performance of each method of analysis, we were able to presentation the best area ecotourism in the forest land.

Materials and Methods

The study area

Forest park and reserve with an area of over 1058 Hectare is located in the northwestern Province and in West of Caspian Sea (Fig. 1). In terms of geographic location is located between 49°0′10″ to 49°0′40″ east longitude and 37° 37′ to 37° 39′ north latitude and in UTM coordinates in 39 N zones**.**

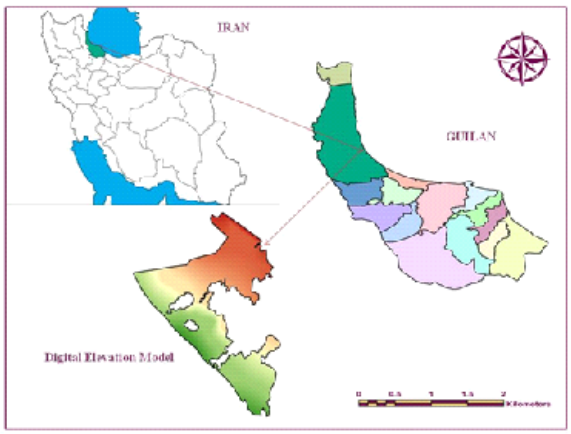

Fig. 1. Site of study.

Methods

In this study has been discussed ecological capability evaluation Gisum, forest park using by systems analysis method, Analytic Hierarchy Process (AHP) and network approach. Based on this review is on the ecological assessment of the methods mentioned and compare them with each other and determine the most effective model for the study area.

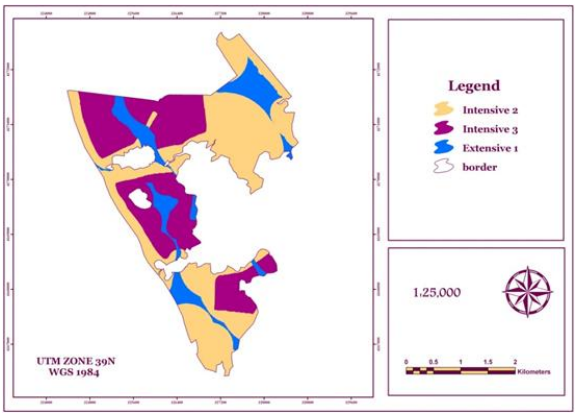

Fig. 2. Map of recreational potential of Gisum forest park based on Iran's ecotourism.

Systems analysis method

In this method at first identified existing ecological and socio-economic resources in the region and since analyzing obtained data prepared environmental units map. Then with considering identified resources, designated special models of region according to the general model of ecotourism in Iran and finally, was determined region's ecological capability for preferred use. To perform this procedure were prepared slope, aspect and height maps and overlaid for in order to obtain landform units map. Afterward listed map integrated with Soil and vegetation maps and obtained environmental units final map. Climate and geological parameters were not entered in the evaluation process due to the uniformity and positive terms and thus be ineffective.

The Analytical Hierarchy Process (AHP)

In order to do this method at first identified effective criteria in tourism based on previous studies and special conditions of region. Then selected criteria that were including: the geographical aspect, pedology, vegetation type and density, distance from water sources, distance from the path -access, recreational facilities and distance from similar park, given to the experts for weighting in the form of the questionnaire. Weighting to criteria performed based on pair wise comparison technique. The import thing about the pair wise comparison matrixes is their incompatibility that according to consideration

Professor Saaty for stability arbitrations is necessary that rate of their incompatibility matrixes be less or equal to 0.1. Otherwise, the respective expert is required to repeat itself adjudication as a stable matrixes (Amiri *et al.*, 2008). Questionnaire properly evaluated in the Expert choice software. After normalized weight of each criterion, calculated geometric mean each cells of pair wise comparison matrix and results to determine the overall priority re-enter the environment in the software Expert Choice. Then respective layers to selected criteria prepared in Arc GIS 9.2 software and based on obtained model were classification and integration.

Networks approach

To perform this method prepared 1:25000 topographic map of the watershed of studied area and then divided the map into square pieces. Dimension of squares considered due to the vastness of region one square kilometer. Finally the whole area covered with 24 squares. Effective parameters in this method are including: landform, percentage of forest to surface area, water resources, climate, landscape and roads that respective score to be considered for any factors in each square based on intended classes. Finally be summed the scores related to various factors in each square. Each square within the area will get more points; will be higher ecological potential for recreational development. The method can be modified with due to local conditions. Some factors that can be removed and others added. For managing water resources due to sea and natural attractions for visitors to score more points than it was intended.

The total steps related to preparation and integration information layers performed in Arc GIS 9.2 software, analysis of AHP questionnaires with Expert Choice software and drawing charts with Excel 2007.

Results

The process of system analysis

Results of the surveying and overlaying of prepared maps based on this method and Comparing with the characteristics of environmental units Iran's ecotourism model is given below. Fig. 2and 3, shows the suitable zones of park for different kinds of intensive and extensive outdoor recreation based on this method.

The area of 2 class intensive zone obtained equal to with 480.04 ha, 3class of intensive recreation 347.84 ha, and extensive recreational zone 140.95 ha.

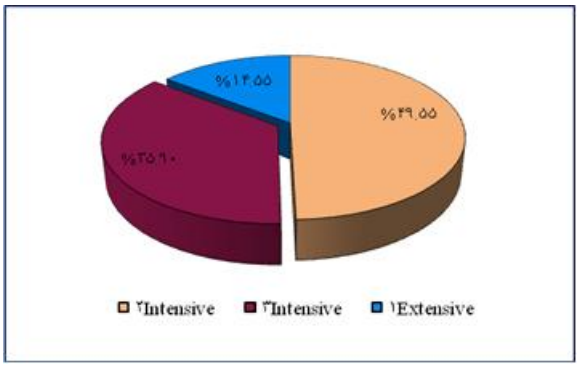

Fig. 3. Chart of Percent area recreational zones of Gisum forest park.

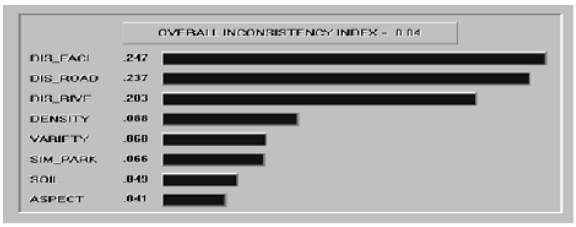

Fig. 4. The overall priority of effective criteria in ecotourism Gisum Forest Park.

The Analytical Hierarchy Process (AHP)

The results of the weighting criteria based on AHP method and analysis was performed using Expert Choice software is shown Fig. 4**.** These weights are obtained based on mathematical relations from sum proportions of criteria data and the standard weight of each criterion was calculated. Inconsistency ratio (CR) calculated equal to 0.04 that is indicating an acceptable level of pair wise comparisons in the AHP matrix.

According to this method in the study area, distance of recreational facilities (with final weight of 0.247), distance from the access route ((with final weight of 0.237), and distance from water sources (with final weight of 0.203) The most effective criteria are in evaluation capability of ecotourism in the Gisum forest park. Density and tip of ground cover, presence

of similar park, pedology and aspect respectively with 0.088, 0.68, 0.066, 0.049 and 0.041 are the next priorities. Then the maps of prepared criteria on the basis of Multi-Criteria Evaluation approach and the investment value of prone areas identified for recreation development**.** In Fig. 5 and 6, is shown recreational zones of the park based on AHP method.

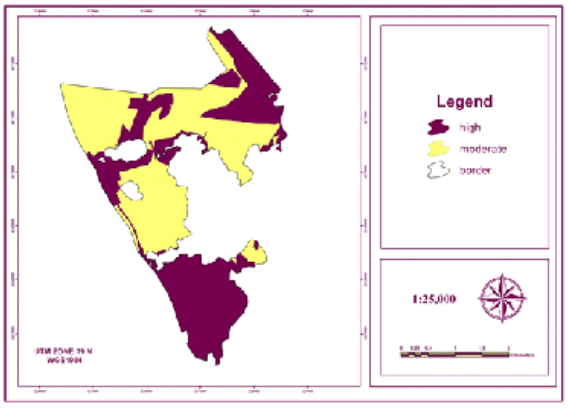

Fig. 5. Map recreational zones of Gisum forest park based on AHP method.

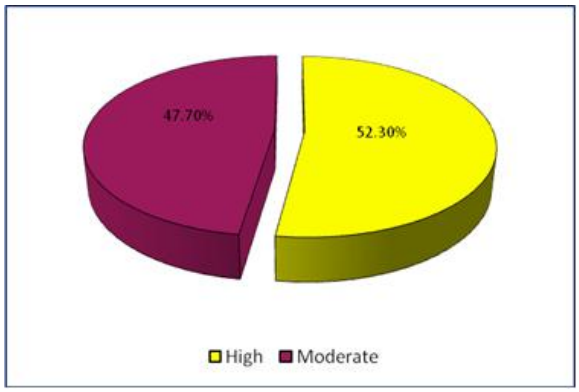

Fig. 6. Map recreational zones of Gisum forest park based on AHP method.

Network Method

Feature map based on where the parks for recreational development zone in the area of the network is shown in Fig. 7 and 8. Under this method was evaluated 20.67% of the region (equivalent to 200.9 ha) with high potential and 75.16% (equivalent to 728.22 ha) with well potential, 3.50% with moderate potential (equivalent to 33.88 ha) and 0.67 with weak potential (equivalent to 6.44 ha) for recreation development.

Discussion

Nowadays, assessment of environmental natural capability for tourism development is necessary because of urban life extension, Lack of green spaces and increasing the human tendency to recreations depend on the nature. The natural forest parks are interested many visitors as a one of tourism development focuses.

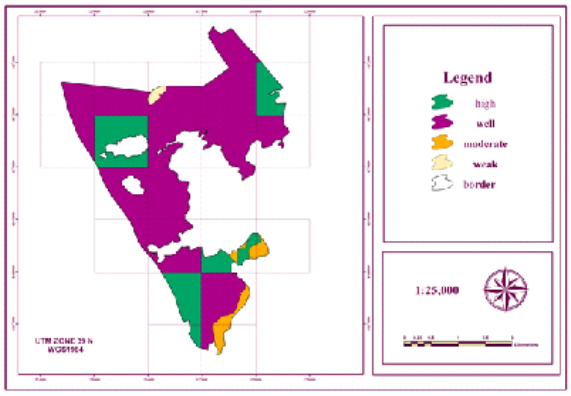

Fig. 7. Map of recreational capability Map of Gisum forest park based on network method.

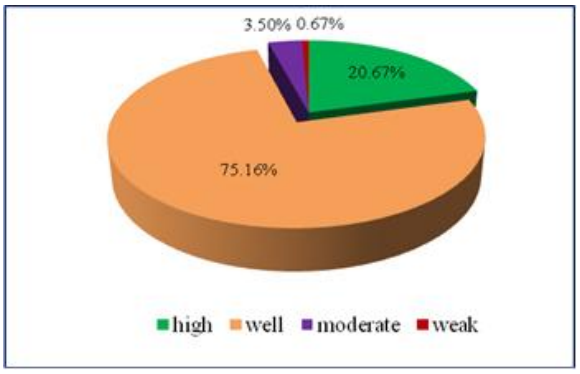

Fig. 8. Percentage of recreational classes of the Gisum forest park based on network method.

According to obtained results in this study, based on ecotourism model of Iran, this region hasn't limit to develop intensive and extensive outing recreation because with slope lower than 5 percent. But despite having the proper conditions slope, aspect and vegetation density, due to the absence of loam soil texture not suitable for the development of first-class of intensive outdoor recreation. But since use from Iran's ecotourism model should be based on special conditions region, thus in defining the appropriate model for region considered third classes for intensive ecotourism. In this way regions with eastern and southern aspects that are appropriate for first-

class of intensive recreation, devoted to second class of intensive ecotourism and areas to the northern and western aspects that are appropriate for the 2 class of intensive recreation; allocated to 3 class of intensive recreation . Other regions with other aspects and other coverage density devoted to 1 class of extensive. Lack of slope above 25 percent has led that the region is not potential for second-class of ecotourism extensive.

According to this method entire surface area is suitable for recreational development. About 50.45% of the study area has enough capability for intensive ecotourism and 45.55% has enough capability for first-class of extensive ecotourism. In order to prioritization areas for recreational planning, zone 2 is recommended as a first priority. In this respect, present study can be similar researches (Xiong *et al.,* 2007).

In the current model although aren't equal weight of parameters but don't considered specific weight for them. But it is not considered to a certain weight, so that the weight of the slope factor, as the most important parameter is not suitable compared to other parameters of this class is not intended to be removed. Soil conditions are a limiting factor in this review. Thus the method is to need changes for obtaining ideal model to the region. Recent result has conformity with result studies (Newsome *et al*., 2004; Li-Wei *et al*., 2008).

In the second method used in this study, AHP, a process that acts systematically, to increase accuracy decision -making, was considered as a hierarchical structure. Then each of the decision criteria in a pair wise comparison weighting process and the role of each in determining the potential was measured logically in the recreation potential of park. Results showed Scio-economic parameters (including recreational facilities, distance from roads and water resources) in the nature park are more effective than ecological factors, so that pedology and aspect appropriate to themselves lowest weight in pair wise matrixes comparison that the results shows consistent with reality. Smailes and smith (2001) in themselves researches to perceive recreational facilities and accessibility effected in the tourism potential of region that to confirm recent results. In this method, areas are not seen without or low potential. 52.30% of region with moderate recreation potential and 47.70% have a high potential for development of tourism.

The network approach, 6 parameters: topography, vegetation along the river, weather, road length and angle are the main role in determining the promenade area. But two main factors, the topography and landscape are two parameters associated with each other. Lack of suitable topography because the area is flat and lack the proper angle due to the lack of significant differences in height caused eliminated these two parameters and added parameter distance of residential places. Result showed because minimum obtained score for networks is 53; this promenade is suitable for tourism development.

As regards to the role and importance of green spaces in human life and limited tolerance capacity of these resources is required in order to protect natural ecosystems and ensure their sustainable before utilization of these spaces, determine their potential for intended use. In assessment of environmental potential for special use is required particular models selected based on local conditions and effective ecological characteristics are recognized correctly and be weighting and effective parameter with more weight to be evaluated that multiplicity of criteria not a problem the assessment and can be concluded properly for land development planning.

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