

Ecotourism Land Capability Evaluation Using Spatial Multi Criteria Evaluation

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Abstract: Study ahead, aims at examination of applicability of multi criteria evaluation in land suitability analysis. In recent years, multiple criteria decision making models have been entered in the field of ecological land evaluation studies significantly. Among the important features of multiple criteria decision-making system can be named its involving with various factors weight, or quantifying experts' opinions in decision-making models. In this study, a region with an extent of 7181 ha was selected in Dohezar Basin (located on northern part of Iran) in which the land capability was evaluated for tourism land use using multi criteria evaluation. All criteria were weighed using experts' opinion and relevant standards and ultimately areas were selected as suitable places for tourism which have the highest suitability. Compared with the traditional model in which some important factors is ignored due to its limited ability in simultaneous consideration of all effective criteria as well as poor integration and weighting, can be easily inferred that such a model can not be held accountable in watershed decision-making levels, especially in small and complex physiographic conditions. In multiple criteria evaluation methods, all the indicators after forming the decision matrix and weighting process, were integrated and classified based on the rating received for tourism potentiality, and the suitability map for the tourism land use was prepared. The results of this approach, while consistent with the existing conditions, also has made possible the appropriate decision making to allocate the land to different land uses.

Key words: Ecotourism, land capability evaluation, land use, multi criteria decision making, tourism

INTRODUCTION

From the past few decades upwards, in lots of countries, the planning of the land based on land use planning and ecological land capability evaluation is considered as the most important tool and factor of sustainable development. In recent decades, tourism has been developed increasingly and in future, will be expanded quicker than today. According to WTO statistics in 2009, America acquiring 70 billion dollar revenue allocated itself the first rank of the world tourism revenue. In the same year, Spain with \$ 48 billion, France with 44 billion dollars, China with 38 billion dollars and Italy with 37 billion dollars allocated themselves the second to fifth positions in the world tourism revenues. Turkey, by attracting 22 million and 600 thousand people tourists is placed in twelfth position considering attracting tourists and by earning \$ 21 billion is located in eighth place in the world regarding tourism income earning. Islamic Republic of Iran can be suitable place for the global tourism industry rise due to owing diverse natural and climatic conditions and rich culture. Cultural diversity of various ethnic and language diversity in every corner from the country has specific characteristics. Despite Iran's potential to attract over 15.5 million foreign tourists moreover than the domestic tourists, in 2007, was placed

at an eighty ninth place among 200 countries of the world regarding revenue from the tourism. Meanwhile, the role of northern regions of Iran can be remarkable as one of the tourism poles considering having a mild and humid climate, unmatched beach landscapes, together with lush plains and mountains with over than 20 rivers and large variety of physiographic conditions. Whereas, according to World Tourism Organization statistics, 60% of the world is assigned to the ecotourism. A part of the tourism which is rapidly growing and outshining from the other parts is called "adventure traveling" including tourism relied on protected areas and ecological tourism or ecotourism. Tourism is the world's largest industry. According to the statistics of World Travel and Tourism Council, this industry creates job opportunities for more than 1500 million people directly or indirectly. In Iran, more than half a century ago, the tourism industry with the formation of an office in the name of Tourism Affairs at the Interior Ministry was formed in 1935. In 1961, Tourism High Council was formed with duty of policy and executive programs determination of Tourism Office of Interior Ministry. In 1979, Tourism & Touring Centers Organization began its activities independently.

Currently, application of MCE methods in evaluating ecological capability is widespread (Ananda and Herth, 2003; Rezaei-Moghaddam and Karami, 2008; Thapa and

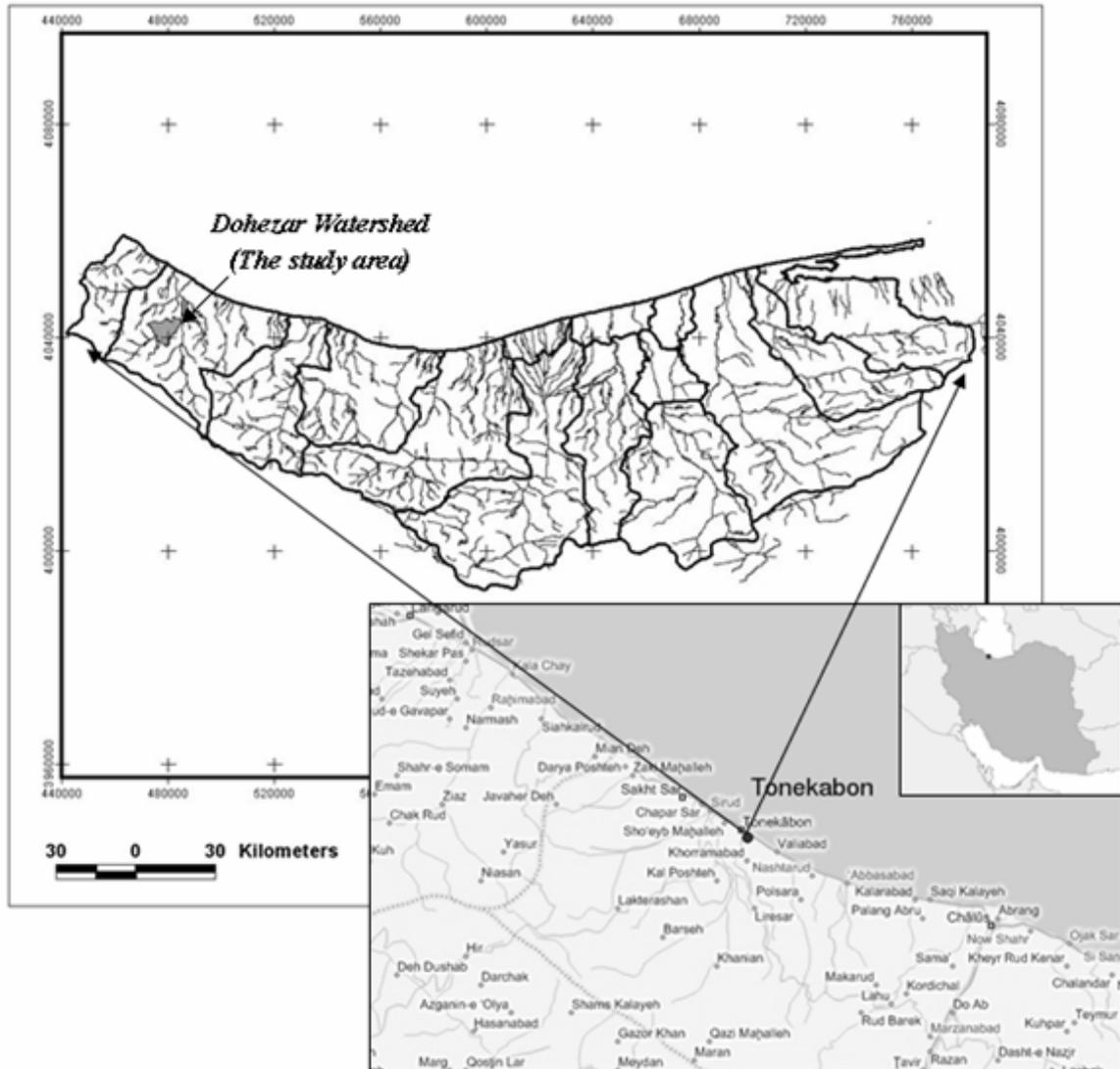


Fig. 1: the situation of the study area in Iran

Murayama, 2007; Tulay and Hayran, 2006). SMCA techniques are used to simply to distinguish acceptable from unacceptable alternatives (Kuyler, 2006; Malczewski, 1999; Pereira and Duckstein, 1993; Prakash, 2003; Zaredar *et al.*, 2010). Meanwhile, AHP as a commonly MCE Method (Zaredar, 2011) can be applied as an appropriate tool in finding inconsistent judgment (Kheirkhah Zarkesh, 2005; Saaty, 1980, 1988, 1990). Compared with the traditional model in which some important factors is ignored due to its limited ability in simultaneous consideration of all effective criteria as well as poor integration and weighting manner, can be easily inferred that such a model can not be held accountable in watershed decision-making levels, especially in small and complex physiographic conditions (Hsu and Hu, 2008; Saaty, 1980; Kheirkhah Zarkesh *et al.*, 2010).

MATERIALS AND METHODS

The study area: The Belas Kuh Hunting prohibited Area belongs to Dohezar Basin in Tonekabon County located between latitudes $36^{\circ}60' - 36^{\circ}70' N$ and longitudes $50^{\circ}80' - 50^{\circ}65' E$. The extent of the study area from its highest elevation 2966 m above sea level to a height limit of 380 m above sea level is approximately 7181 ha situated in the western part of Mazandaran Province (the southeastern side of Tonekabon City). The study area is considered as a focus tourist point of Dohezar Basin in Tonekabon County. Figure 1 illustrates the situation of the study area in Iran.

The current research was conducted within 2 years from 2008-2010. The detailed steps of the research are described as follows:

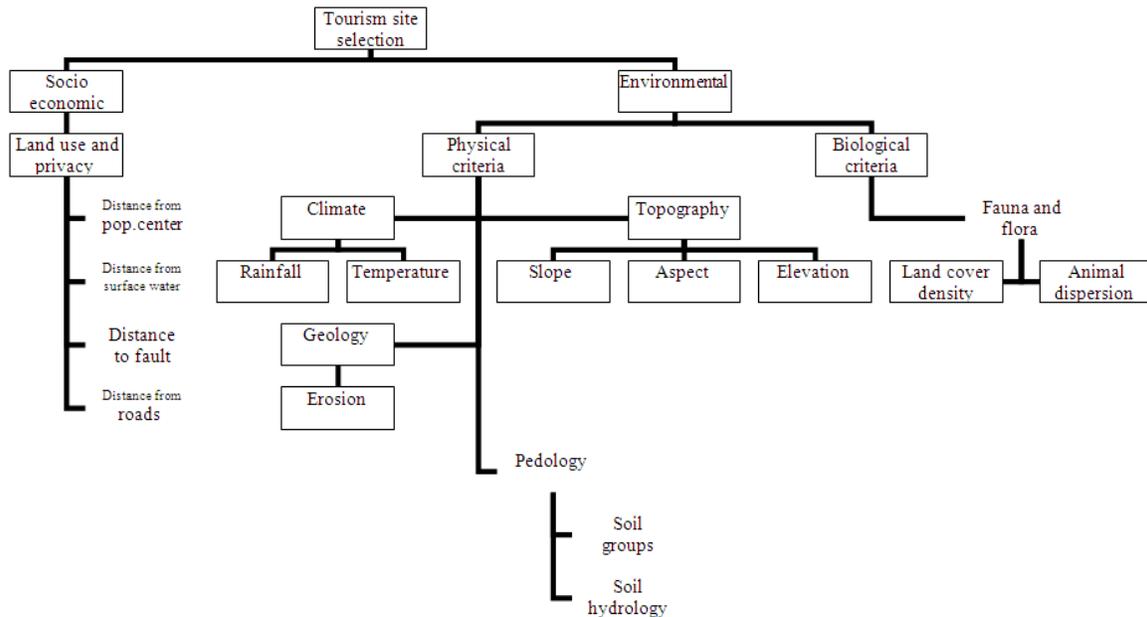


Fig. 2: The hierarchal structure of criteria affected in tourism land evaluation

Criteria affected in selection of tourism areas:

Determining criteria for selecting a region as a tourism area should be comprehensive and measurable. These criteria at macro-level include two main categories, environmental and socioeconomic features. Each of the mentioned categories consists of lots of sub-criteria enjoyed significant importance in tourism land capability evaluation of the land. Environmental features include physical and biological criteria. Physical criteria including climate, topography, geology and pedology are placed at fourth level. Climate is divided into two sub-criteria temperature and rainfall. Topography includes slope, aspect and altitude. Geology criteria consist of erosion and sediment, pedology, soil groups and soil hydrology. Biological criteria in the fourth level contain fauna and flora, and two sub-criteria land cover density and animal distribution. There are several factors in the economic and social characteristics including land uses, buffers and distances. The hierarchal structure of criteria affected in tourism land evaluation is demonstrated in Fig. 2.

Environmental features: Environmental features include physical and biological criteria.

- **Physical criteria:** Physical criteria contain topography, climate, geology and pedology.
- **Topography:** Topography is recognition of physical properties and morphological status of a basin played a determining role in identifying the hydrological and microclimate, and finally habitat status of the basin.

The physiographic features not only affect directly on the basin water regime, including the annual water production rate and volume of flood, the amount and intensity of soil erosion and deposition rates but also affect indirectly on the weather, ecology, status and land cover.

- **Slope:** Watershed slope has a huge impact on hydrological processes in basins. In this study, slope classification (0-5%, 5-15%, 15-30%, 30-60%, >60%) were performed based on the literature reviews relevant to tourism.
- **Height status from sea level (elevation):** Basin elevation affects on the amount and type of precipitation, temperature and its variation, the evapotranspiration rate, intensity of solar radiation and generally on the region weather along with the formation and development of soil, land cover type and density. The minimum and maximum elevations of the basin are respectively equal to 380 and 2966m.
- **Aspect:** The most important effect of the aspect is impact on the amount of received sunlight and its resulting effects as well as the emergence of local climates. North-facing slopes often are shorter and sharper with fewer gaps and failure. While south-facing aspects, due to erosion over the time, have longer and gentler slopes.
- **Climate:** Knowing the temperature fluctuations specify promenade type and tourists return time. Knowledge of rainfall intensity and duration and its estimated calculation cause the better view in choosing the best place for promenade.

- **Erosion and sediment:** Erosion is important for the security of tourists and resort area. Generally, factors affecting erosion and sedimentation can be divided into two broad categories, natural factors and resonator factors.
- **Pedology:** Pedology is significant to determine the type of land cover, land capability regarding constituting formations for construction activity, land drainage rate and water retention and so on.
- **Hydrological soil groups:** Hydrological soil groups are the classification of land units regarding the amount of water permeability deep into the soil which has a reasonable association with amount of runoff produced in the field. In current study, hydrological soil groups were evaluated in four hydrological groups based on available standards.
- **Biological criteria:**
- **Land cover:** Determination of the land cover type is so important due to reasons including sharp slopes, the water resources significance of Dohezar Watershed particularly aquaculture, construction of villa and also economic and social tensions caused by the presence of livestock in the forests.
- **Wildlife:** Dohezar and Sehezar Basins are place of unique animal and plant species. The plain areas in the watershed is an over-wintering place of migratory birds such as swan, ducks and so on from the world's cold regions such as Siberia.
- **Socio-economic characteristics:**
- **Land use and buffer:** Land use maps represent spatial distribution of the land use manner in a region. Based on interpretation of the area, forest encompasses the main land use of the region. Apart from scattered residential areas included a small percentage of whole area, due to sharp hillsides and little width of Dohezar alley through the study area, there is no farmland within the study area but some small hazelnut orchards in the homes courtyard included the residential areas.
- **Distance from the roads:** Roads are considered as the tourism industry arteries. This system makes a communication line between destination, accommodation and natural attractions. On one hand, the existence of roads in the nature leads to rupture in the landscape and reduce the apparent values for tourists. On the other hand, road hazards and noise pollution in surrounding roads will reduce the tourism quality in the region. Thus creating a zone of privacy, according to approved standards is necessary.
- **Distance from population centers:** The importance of considering rural areas is similar to the residential communities. With an emphasis that due to low living standard in villages the presence of tourists can lead to job creation and growth of indigenous

communities' economic trends. Dohezar rural district has 23 villages contained 583 households and 2016 population, of which 50% are nomads having summer and winter quarters while the others have a permanent life. Also, a number of 226 ranchmen owing 35245 animal units live in the watershed.

- **Distance from surface water:** Water quality enjoys an important role in prioritization of criteria for recreational land capability. Determining a contour interval to avoid its quality changes is so important for tourism, local residents and fauna.
- **Distance to fault:** Considering the existence of two faults in the region, this factor was considered so important. A standard contour has been regarded for structures and tourism security.

The basis of research methodology: In study ahead, to evaluate and locate suitable areas for ecotourism activities in Belas Kuh forest mountainous region, Spatial Multi Criteria Evaluation (SMCE) Method was used. The research basis includes recognition of the region and tourism land capability based on usage of Multi Criteria Decision Making method. Initially, descriptive and quantitative data were analyzed in GIS and expert systems and using the relevant softwares various thematic maps and considered tables were prepared. Afterward, the criteria affected on tourism land capability were determined using Makhdom Model, relevant studies and researches and also standards available at Cultural Heritage, Handicrafts and Tourism Organization and Department of the Environment. In the next stage, Multi Attribute Decision Making (MADM) Method was applied. Model used to select criteria is Makhdom Ecological Model. SMCE method offers an appropriate solution to rating data layers and subsequently determining suitable areas for tourism activities. Following criteria selection, the importance of each of them indicating the suitability or unsuitability of each criterion should be determined. This means that the range between the worst to the best conditions to be determined for rating. Analytical Hierarchy Process (AHP) was applied for weighing of criteria (Saaty, 1980, 1994, 1995).

In this method, to determine each criterion weight than the other criteria pair wise comparison method was used. In the next stage, information layers were integrated with the help of GIS system and suitable areas for tourism were specified. Then, the obtained results were adapted with the ground realities. Finally, some proposals were offered for the best place for tourism.

RESULTS AND DISCUSSION

After specifying the goal i.e. selection of suitable places for tourism, environmental and socio-economic characteristics of the study area was examined and placed

Table 1: Weights related to the slope

Slope	0-5	5-15	15-35	30-60	Weight
0-5	1	1/9	1/9	1/9	1.000
5-15	9	1	1/7	1/7	0.186
15-35	9	7	1	1/5	0.067
30-60	9	7	5	1	0.045

C.R = 0/094

Table 2: Weights related to the aspect

Geographic aspect	Plain	North	South	East	West	Weight
Plain	1	1/9	1/9	1/9	1/9	1.000
North	9	1	1/3	3	7	0.129
South	9	3	1	5	7	0.060
East	9	1/5	1/3	1	5	0.307
West	9	1/7	1/7	1/5	1	0.040

C.R = 0/068

Table 3: Weights related to the elevation

Elevation	400-900	900-1200	1200-1500	1500-2000	>2000	Weight
400-900	1	1/9	1/9	1/9	1/9	1
900-1200	9	1	1/5	1/7	1/7	0.551
1200-1500	9	5	1	1/3	1/5	0.062
1500-2000	9	7	3	1	1/3	0.064
>2000	9	7	5	3	1	0.047

C.R = 0/094

Table 4: Weights related to the temperature

Temperature	4-6	6-8	8-10	10-12	12-14	Weight
4-6	1	3	7	7	9	0.062
6-8	1/3	1	3	5	9	0.098
8-10	1/7	1/3	1	3	5	0.248
10-12	1/7	1/5	1/3	1	3	0.333
12-14	1/9	1/9	1/5	1/3	1	1.000

C.R = 0/086

Table 5: weights related to the soil hydrological groups

Soil hydrological groups	A	B	Weight
A	1	1/5	1.000
B	1	5	0.200

at the second level of the hierarchy after the goal as the main criteria. Then, subsidiary criteria influenced on selection of suitable locations were identified. These criteria at the second level include physical and biological properties and privacy. After determining the decision making criteria and providing relevant information layers, each criterion was weighted. Weights related to out door recreation criteria are presented in Table 1-14 separately.

Socio economic subsidiary criteria include distance and privacy layers having distance limitations determined by Cultural Heritage and Tourism Organization and Department of the Environment.

Table 11: Weights related to land use and privacy subsidiary criteria

Land use and privacy	Distance to fault	Distance from surface water	Distance to road	Distance from population centers	Weight
Distance to fault	1	1/3	3	1/5	0.054
Distance from surface water	5	1	3	5	0.259
Distance to road	1/3	1/3	1	5	0.322
Distance from population centers	1/3	1/5	1/5	1	0.365

C.R = 0/097

Table 6: Weights related to the soil groups

Soil groups	1,5,2	1,5,3	1,5,4	2,5,2	2,5,3	Weight
1,5,2	1	3	5	5	9	0/039
1,5,3	1/3	1	3	5	9	0/112
1,5,4	1/5	1/3	1	7	9	0/139
2,5,2	1/5	1/5	1/7	1	5	0/430
2,5,3	1/9	1/9	1/9	1/5	1	1/000

C.R = 0/097

Table 7: Weights related to animal distribution

Animal distribution	1	2	3	4	Weight
1 antelope, leopard	1	9	1/5	1/7	0.255
2 boar	1/9	1	1/9	1/9	1.000
3 bears, ibex, chamois	5	9	1	1/3	0.078
4 bears, forest cat, leopard, ibex, chamois	7	9	3	1	0.050

C.R = 0/084

Table 8: Weights related to topography

Topography	Slope	Aspect	Elevation	Weight
Slope	1	6	5	0.086
Aspect	1/6	1	1/4	0.417
Elevation	1/5	4	1	0.197

C.R= 0/094

Table 9: Weights related to pedology

Pedology	Soil groups	Soil hydrology	Weight
Soil groups	1	3	0.250
Soil hydrology	1/3	1	0.750

Table 10: Weights related to climate

Climate	Rainfall	Temperature	Weight
Rainfall	1	3	0.750
Temperature	1/3	1	0.250

Four distance and privacy criteria are as follows:

- Distance from surface water: 100 m
- Distance to fault: 1000 m
- Distance to road: 100 m
- Distance from population centers: 300 m

Promenade site selection scenarios: Considering the large influence of relative importance of the main criteria as well as dramatic differences in viewpoints associated with weighing of criteria the impact of each main criterion weight in final decision were examined in the form of the following scenarios:

First scenario: In this scenario the highest prioritization is assigned to the environmental criteria (Table 15). Table 16 presents the relative importance of main criteria.

In this case, the areas suitable for recreation are demonstrated in Fig. 3.

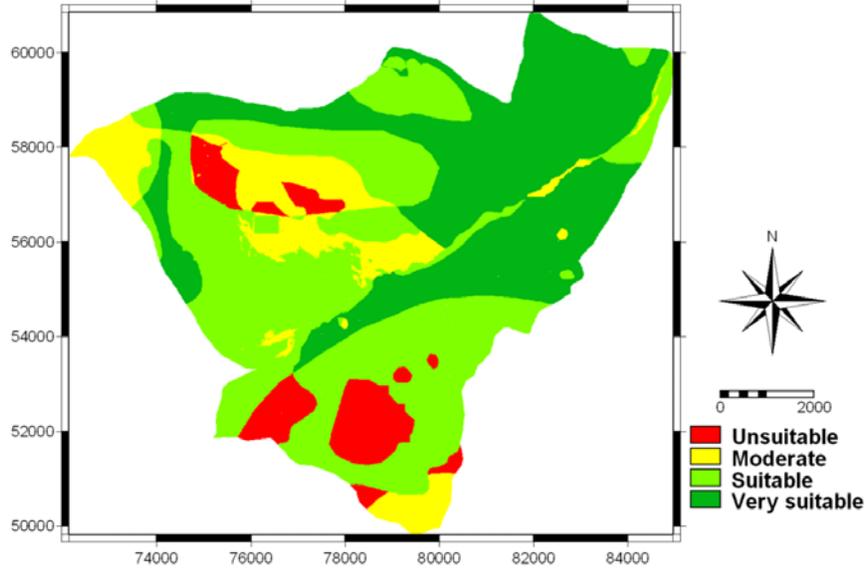


Fig. 3: The final tourism site selection map obtained from first scenario

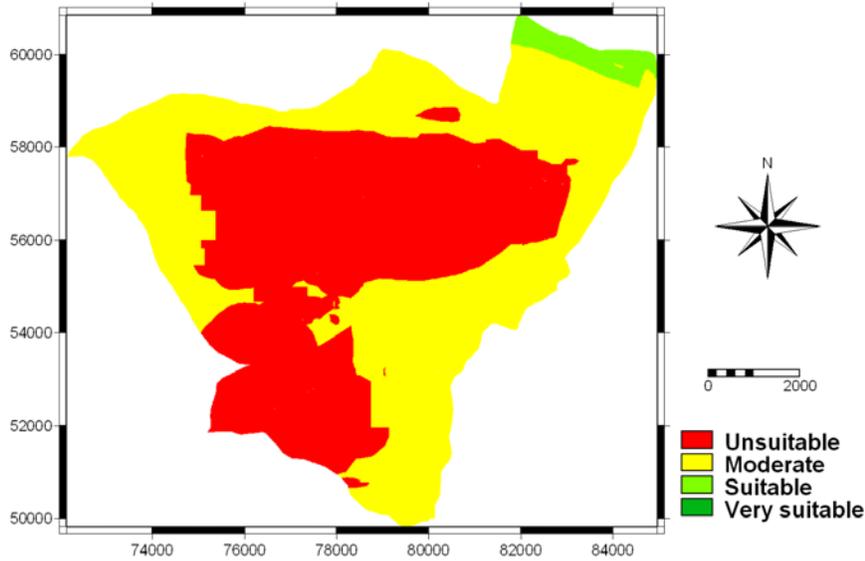


Fig. 4: The final tourism site selection map obtained from second scenario

Table 12: Weights related to physical characteristics subsidiary criteria

	Climate	Topography	Geology	Pedology	Weight
Climate	1	5	9	8	0.063
Topography	1/5	1	5	4	0.110
Geology	1/9	1/5	1	1/7	0.197
Pedology	1/8	1/4	7	1	0.657

C.R = 0/095

The second scenario: In this viewpoint it is assumed that the socio economic criteria enjoy more importance and value rather than the other main criterion absolutely

Table 13: Weights related to the biological characteristics subsidiary criteria

	Land cover density	Animal dispersion	Weight
Land cover density	1	1/5	0/833
Animal dispersion	5	1	0/167

Table 14: Weights related to the second level subsidiary criteria

	Physical	Biological	Weight
Physical	1	1/7	0.125
Biological	7	1	0.875

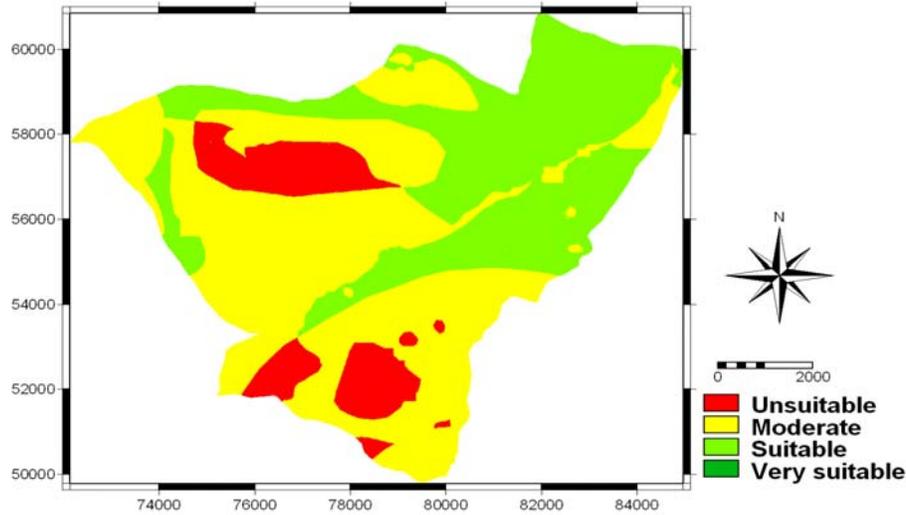


Fig. 5: The final tourism site selection map obtained from third scenario

Table 15: Weights related to the first scenario

	Socio economic	Environmental	Weight
Socio economic	1	1/9	0.100
Environmental	9	1	0.900

Table 16: The area of different suitability categories

The relative importance of the criteria	The covered area (m)
0.00-0.25	7055200
0.25-0.50	8319700
0.50-0.75	29994000
0.75-1.00	21773100

Table 17: Weights related to the second scenario

	Socio economic	Environmental	Weight
Socio economic	1	9	0.900
Environmental	1/9	1	0.100

Table 18: The area of different suitability categories

The relative importance of the criteria	The covered area (m)
0.00-0.25	6543200
0.25-0.50	9289000
0.50-0.75	3258600
0.75-1.00	0

Table 19: Weights related to the third scenario

	Socio economic	Environmental	Weight
Socio economic	1	1	0.500
Environmental	1	1	0.500

Table 20: The area of different suitability categories

The relative importance of the criteria	The covered area (m)
0.00-0.25	5094800
0.25-0.50	4890500
0.50-0.75	25275400
0.75-1.00	0

(Table 17). Based on the pair wise comparison presented by Saaty (1980), in this case, the relative importance of the main criteria is given in Table 18.

In this case, the areas suitable for recreation are demonstrated in Fig. 4.

The third scenario: In this scenario, equal weight is considered for both main criteria environmental and socio economic (Table 20). The weighing result is presented in Table 19.

In this case, the areas suitable for recreation are demonstrated in Fig. 5.

CONCLUSION

The main findings of the current research are summarized as follows:

- There is high sensitivity towards three scenarios first, second and third
- Socio economic criteria applied in the ecological capability evaluation is absolutely necessary and lead to obtaining more realistic options.
- The most suitable areas for tourism development zones belong to the first, third and second scenarios respectively.
- First scenario (biological criteria assign themselves the highest score) has most suitable areas for tourism which indicate that Balas Kuh mountain region, in terms of having biological capability has desirable status.
- Second scenario (allocate further point to the socio-economic criteria) include the most area of poor tourism zone and the least area of suitable tourism zones. This indicates regional limitations in terms of socio-economic criteria such as population centers, distance from rivers, roads and faults to develop tourism land use.
- Model presented in this study can be generalized to other areas required decision making, such as urban

development, selecting industrial areas, selecting appropriate landfill sites and so on to select options.

- By comparing the different scenarios it can conclude that the study area enjoy suitable conditions in terms of biological criteria for tourism development.

RECOMMENDATION

- Suitable areas for tourism presented in third scenario have more appropriate decision-making ability in order to applying equal weight to the socio-economic and biological criteria.
- Since the model is sensitive to the weights, therefore, it is recommended that to be defined upper and lower weighing limits for decision maker in different scenarios.
- In order to ensure of AHP model performance model it is recommended that, the sit selection is carried out once more using the other methods of multi attribute decision making methods such as TOPSIS and ELECTER.
- Since in site selection of areas suitable for tourism, qualitative issues such as beauty, comfort, security and satisfaction etc. are very effective, it is suggested this model combine with the mentioned qualitative criteria.

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