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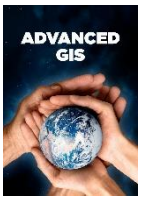

Applying an integrated approach to evaluating ecotourism capabilities in Margavar district, northwest Iran

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ABSTRACT

Ecotourism considered as purposeful travel to the natural and cultural history of nature to understand the environment by avoiding change Ecosystems, environmental degradation, and creating economic opportunities. Moreover, this is one of the new sources of social activities in the field of sustainable development. Our study aims to assess and mapping the ecotourism capabilities of the Margavar rural district, in northwest Iran. In this regard, a set of associated factors were considered. Hence, we want to evaluate the ecotourism capabilities through an integrated approach using the Analytic Network Process (ANP) method, VIKOR technique, Geographic Information System (GIS), and considering the environmental and tourism criteria. A Fuzzy gamma operator was used to overlay the weighted maps and the ecotourism map was obtained. The overall results indicated that 14.50% of the study area is located in a very high potential class, 26.32% in a high potential class, 32% in a moderate potential class, 18% in a low potential class, and 9.18% in a Very low potential class. Due to the pristine nature of the study area and the need to create new investment opportunities, our findings can be useful in identifying the ecotourism potentials of the region and achieving a higher level of local development.

1. Introduction

Tourism as one of the largest and most diverse economic sectors with its rapid growth in recent decades has made a significant contribution to the national interests of countries and is known as a substantial phenomenon in international developments (dos Anjos & Kennel, 2019) and offers real prospects for sustainable development on a global and local level (León-Gómez et al., 2021). Despite some global challenges such as COVID-19, the tourism industry has been able to continue to grow gradually and according to the World Tourism Organization (WTO), the number of international tourists will reach 1.8 billion in 2030 (Uppink & Soshkin, 2022).

Among the various types of tourism, nature-based activities considered as one of the main resources of worldwide tourism industry (Metin, 2019). Ecotourism is one of the main types of nature-based tourism that has become more widespread over the last 20 years with the increasing growth of travel and tourism and highly regarded by tourists and researchers in recent years (Safarabadi, 2016). Ecotourism has a deep connection with sustainable tourism, which stems from the interactions between tourists and the environment (Bunruamkaew & Murayama, 2011). The concept of Ecotourism emphasized the responsible journey to pristine landscapes with the aim of environmental protection and ensuring sustainable development (Seifi & Ghobadi, 2017), which came into reality in order to react to traditional mass tourism and its negative impact on local culture and environment (Sahani, 2019). Ecotourism has emerged as a component of alternative tourism that can improve positive environmental, economic, and socio-cultural outcomes from tourism (Wondirad et al., 2020). Therefore, it can be said that ecotourism is regarded as an efficient strategy for facilitating sustainability that aims to reduce damaging environmental influences on potential sites in developing countries (Kiper, 2013). Accordingly, identifying areas prone to ecotourism, And Proper planning in order to develop ecotourism is critical to maintaining the environmental richness and economic development of the local community.

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Identifying Ecotourism potentials must be performed by using an integrated approach where Geographical Information Systems (GIS) and spatial decision-making tools can act as decision support systems (Jokar et al., 2021). GIS with its great capabilities is a powerful tool, which has been commonly used in ecotourism assessment. GIS can be used to determine the best sites for a new tourist destination while trying to preserve a sustainable natural area (Hai-ling et al, 2011). The use of GIS allows the combination of a large number of spatial criteria in the context of tourism studies, which greatly increases the accuracy and comprehensiveness of the assessment (Šiljeg et al., 2019). Moreover, GIS-based Multi-Criteria decision analysis (GIS-MCDA) has been considered as an effective approach for resolving spatial decision problems (Feizizadeh et al., 2021), and provides a powerful tool to identify the ecotourism potential of different regions (Kumari et al., 2010). In this regard, Fuzzy logic and the Analytic Network Process (ANP), as GIS-MCDA approaches provide the ability to ecotourism capability assessment (Yamani et al., 2017). Fuzzy Analytic Network Process (FANP) is a widely used multi-criteria method for handling interactions between criteria and linguistic variables. (Senturk et al., 2016).

The GIS-MCDA approach has been used in numerous research for assessment ecotourism capabilities in recent years. Ullah & Hafiz (2014) determined suitable areas for ecotourism development by using 5 criteria such as landscape, wildlife, topography, cultural heritage, and social parameters. Aminu et al. (2014) in their research, studied sustainable tourism using the GIS and ANP, and with their conclusions, they have presented a tourism development model to ensure that future generations will also benefit from the natural mountains of Cameroon. Aliani et al. (2017) in their research in order to allocate land for the development of ecotourism have used a multi-criteria evaluation method based on ANP and Fuzzy logic. They concluded that ecological criteria accounted for 64% of the relative weight of the parameters, indicating a greater impact of ecological criteria on the potential for ecotourism. Shaterian et al. (2017) investigated the affecting factors of rural ecotourism development and for this purpose; they used an integrated approach by combining DEMATEL and ANP methods. Fathi & Khorshiddoust (2018) by combining various spatial data in the GIS and evaluating the tourism attractions of Margavar rural district have drawn a map of geotourism and geohiking and mentioned that the use of this map can be a suitable action in the field of achieving sustainable local development goals. Omarzadeh et al. (2021) performed a GIS-based multiple assessment for investigating the ecotourism sustainability of West Azerbaijan province in northwest Iran and mapped the potential for sustainable ecotourism development, using 28 spatial indicators.

Iran is one of the countries that has great tourism potential in terms of unique conditions such as natural attractions, unspoiled landscapes, and a favorable climate in different parts of the country (Makian & Hanifezadeh, 2021). However, The Iranian ecotourism industry is relatively new and studies show that Iran's natural tourism assets are a vast array of scattered, unstabilized, and in some cases endangered resources (Ronizi & Rezvani, 2015). It seems that one of the main reasons for this situation is the existence of traditional tourism management and the lack of assessment of potential studies of different areas. The main goal of this study was to run an integrated GIS-MCDA approach for ecotourism potential assessment in Margavar rural district in northwest Iran. For achieving this goal, an ecotourism potential map, which shows the capability of different parts of the study area in terms of ecotourism, was developed.

2. Method

2.1. Study area

The study area of the current research is the Margavar rural district, which is located in Urmia County in Northwest Iran (Figure 1). Margavar has a natural border with Republic of Turkey and Islamic Republic of Iraq from the west part and covers an area of 450 km^2. The average elevation of this district is about 1952 meters, lowest elevation is 1400 meters in the northern parts, and highest elevation is 3429 meters in southwest. In terms of climate, Margavar has mild and relatively hot summers and very cold winters, and its average annual temperature is 8°. According to the latest population census, Margavar has 40174 inhabitants, who live in 57 villages (Statistical Centre of Iran, 2016). Margavar district with its beautiful nature and unique mountains attracts thousands of tourists from different parts of the country in different seasons of the year, especially spring and summer. Moreover, this area has a very rich cultural landscape and its historical, traditional, and ethnic heritage is of particular interest and has always been a tourist destination. Margavar has not been well evaluated and planned, despite its great potential. The ecotourism attractions of this area have been identified only on a local scale and no effective action has been taken to present its potential on a national or global scale. Therefore, the current study aims to evaluate the capabilities of Margavar rural district in order to take effective action to identify its ecotourism potential and provide suitable places to create facilities with minimal environmental impacts.

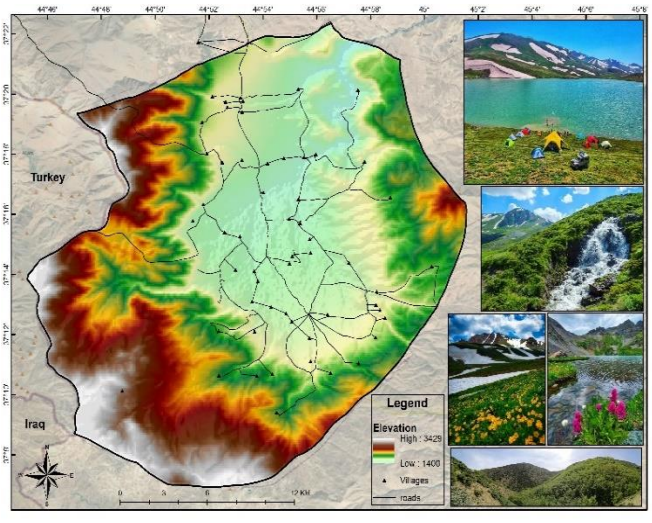

Figure 1. Study area

2.2. Dataset and criteria selection

The current research is an applied research in which various data have been used to evaluate the potential of ecotourism in the study area. In order to carry out a comprehensive assessment of the ecotourism potential of the study area, we selected two major groups of indictors, including tourism attractions with 6 indicators, and environmental indicators with 8 indicators, based on the literature review and interviews with tourism experts and most data gathered using field operations and Google Earth maps. Table 1 shows the dataset and criteria used in the research. As mentioned, GIS-based data is divided into two main groups: tourism and environmental. Within the tourism attractions group, there are indicators such as waterfalls, lakes, valleys, forests, vegetation and touristic villages, and other indicators such as precipitation, temperature, soil, rivers, land use, landforms, roads and service centers are included in the group of environmental criteria. Our data collected in vector format were linear, point, and polygon, and then, layers were converted into raster layers in ArcGIS in order to performing overlay operations. For this purpose, for some polygon layers, such as land use or landforms, the polygon to raster tool is used based on coding and for other layers, the Euclidean distance tool has been used. Figure 2 represent the spatial distribution of tourism indicators, and Figure 3 represent the spatial distribution of environmental indicators.

Table 1. Research criteria

Cluster	Criteria
Tourism attractions	Distance to Waterfalls
	Distance to Lakes
	Distance to Valleys
	Distance to Forests
	Vegetation
	Distance to Touristic villages
Environmental indicators	Precipitation
	Temperature
	Soil type
	Distance to Rivers
	Land use
	Landforms
	Distance to Roads
	Distance to Service centers

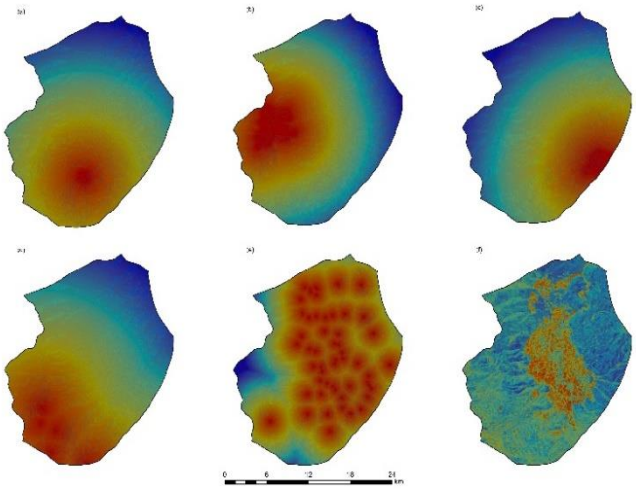

Figure 2. Tourism attractions; (a) Waterfalls, (b) Valley (c) Forest, (d) Lakes, (e) Touristic villages, (f) Vegetation.

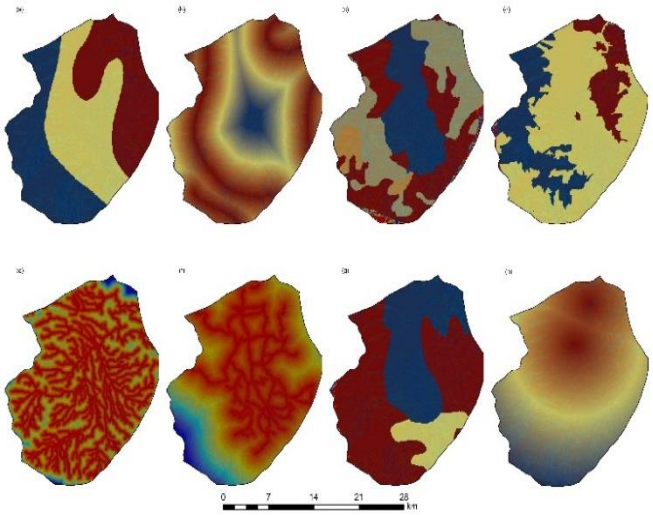

Figure 3. Environmental indicators; (a) Precipitation, (b) Temperature. (c) Landform, (d) Land use, (e) Rivers, (f) Roads, (g) Soils, (h) Service centers

Given the complex nature of ecotourism and the influence of various factors, we must employ an effective method to identify areas suitable for ecotourism development. Accordingly, an integrated approach of GIS-MCDA and the fuzzy technique was applied to extract the significance of each criterion. It is obvious that in the GIS-MCDA approach each criterion has its own significance in terms of ecotourism potential; thus, we employed the analytical network process (ANP) method and VIKOR technique to extract and rank the criteria weights. In this regard, 30 questionnaires were distributed among geography and tourism experts for comparison and rank the fourteen criteria, and by calculating the average of the results for the questionnaires, the ANP super matrix and relative significance of the criteria in the pairwise systems have been determined. Finally, the GIS-MCDA-based fuzzy (Gama Function) method was applied to overlay criteria maps and generate an ecotourism potential map. The general steps of the research are shown in figure 4.

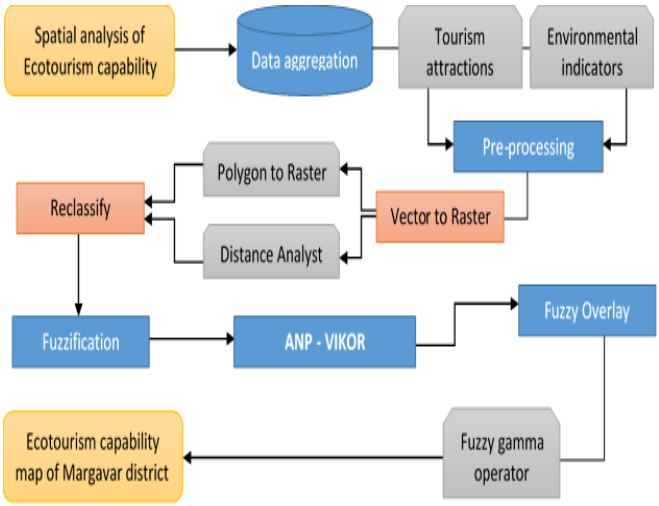

Figure 4. General process of the research

2.3. Analytic network process

Analytic Network Process (ANP) is a MCDA-based technique that can represent the significance of various parties by considering the interconnection between existing criteria and sub-criteria (Feizizadeh et al., 2014). The network structure contained in the ANP reduces the multidimensional problem to clusters and elements, i.e. nodes within clusters. This non-linear "feedback" structure permits interaction and dependence between elements of one cluster (inner dependence), and dependence between elements of another cluster (outer dependence) (Ghorbanzadeh et al., 2019). There are basic steps for implementing the ANP technique and pairwise comparison is one of the most important steps in this process, which is run using the pairwise comparison matrix. The preference relations in the pairwise comparison matrix are filled in by the experts' judgments and presented using different measurement scales. The ratio scale proposed by Saaty (1980), is considered the most common scale in the field of pairwise comparisons between criteria. The structure of a forenamed Scale used for the judgments is given in table 2. Furthermore, the judgments may have a certain level of inconsistency because of the limits of decision makers' expertise and capabilities or the complexity of the decision problems; therefore, various indices have been proposed to measure the consistency of the pairwise comparison matrix. In this regard, the consistency ratio (CR) index has been used to calculate the inconsistency of judgments. The consistency of a matrix is given by CI = (λmax – n)/(n-1), and the consistency ratio (CR) is obtained by forming the ratio of CI and a set of random numbers (Kou et al., 2016). Here, if the CR < 0.1, the consistency value is acceptable, otherwise, some pairwise values need to be checked.

Within this research, pairwise comparisons were carried out using the relative importance scale, and values from 1 to 9 were considered to compare criteria. On the other hand, the overall consistency ratio (CR) was computed to be 0.067, which indicates an acceptable level for the matrix. In the next step, we derived a weight vector for each criterion and for this purpose; the priorities obtained from the pairwise comparison matrix have been entered as parts of the columns of a super matrix, by considering inner and outer dependency between criteria or clusters. Finally, a limited matrix was calculated. To obtain the limit we must raise the matrix to powers. Each power of the matrix captures transitivity of an order that is equal to that power. The limit of these powers is equal to the limit of the sum of all the powers of the matrix (Saaty & Vargas, 2006). The result of limited matrix is shown in table.3. The numbers in the rows of the limited matrix demonstrate the relative importance of the criteria.

2.4. VIKOR technique

VIKOR method is an optimized MCDM technique developed by Opicovic (1990) which emphasized on selection and ranking of alternative sets of conflicting criteria, based on a compromise solution that is the closest to the "ideal" (Mardani et al., 2016). The compromise ranking of VIKOR has four steps, that n and m are the numbers of criteria and alternatives, respectively (Yazdani & Graeml, 2014). Hence, the VIKOR technique was used in order to determine optimized weights for criteria. In this regard, steps 1 and 2 included finding utility measures and regret measures for alternatives regarding each criterion. Then, in step 3 the minimum and maximum amounts of the step 2 results have been computed. In the last step, Qj was calculated as the majority agreement prioritizes the alternatives. Finally, the VIKOR's weights are combined with the weights obtained from ANP and the standard weights of the criteria have been obtained.

Table 2. Saaty's scale of relative importance

Description	Numerical rating	Reciprocal
Equally Preferred	1	1
Equally to Moderately Preferred	2	1/2
Moderately Preferred	3	1/3
Moderately to Strongly Preferred	4	1/4
Strongly Preferred	5	1/5
Strong to Very Strongly Preferred	6	1/6
Very Strongly Preferred	7	1/7
Very Strong to Extremely Preferred	8	1/8
Extremely Preferred	9	1/9

Table 3. Limited matrix

Criteria	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Waterfalls (1)	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189	0.189
Lakes (2)	0.234	0.234	0.234	0.234	0.234	0.234	0.234	0.234	0.234	0.234	0.234	0.234	0.234	0.234
Valleys (3)	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
Forests (4)	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
Vegetation (5)	0.218	0.218	0.218	0.218	0.218	0.218	0.218	0.218	0.218	0.218	0.218	0.218	0.218	0.218
Touristic villages (6)	0.171	0.171	0.171	0.171	0.171	0.171	0.171	0.171	0.171	0.171	0.171	0.171	0.171	0.171
Precipitation (7)	0.134	0.134	0.134	0.134	0.134	0.134	0.134	0.134	0.134	0.134	0.134	0.134	0.134	0.134
Temperature (8)	0.198	0.198	0.198	0.198	0.198	0.198	0.198	0.198	0.198	0.198	0.198	0.198	0.198	0.198
Soil type (9)	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081
Rivers (10)	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153	0.153
Land use (11)	0.099	0.099	0.099	0.099	0.099	0.099	0.099	0.099	0.099	0.099	0.099	0.099	0.099	0.099
Landforms (12)	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077
Roads (13)	0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145
Service centers (14)	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113	0.113

2.5. Fuzzification

Decision making in complex and uncertain environments generally requires dealing with problems in which descriptions of the environment and decision elements as well as judgments are highly subjective, vague or imprecise. Especially, the use of qualitative analytical models such as analytical network process (ANP) may produce unrealistic results with remarkable uncertainty (Asan et al., 2012). Fuzzy logic provides more realistic results which has proven advantages for dealing with uncertain and imprecise decision problems, and implements grouping of data with boundaries that are not distinctly defined (Li & Wang, 2019). Accordingly, fuzzy logic has been applied with ANP to address uncertainties, and in order to improving result's precision. Hence, fuzzy membership defined to all layers in the Arc GIS, and weighted criteria maps converted to values between 0 and 1 by linear Fuzzification function. Then, the overall ranking of the factors was obtained and standardized weights allocated to criteria maps (Table 4). Finally, the overlay of maps was performed using fuzzy gamma 0.9 operator.

Table 4. Weights and values for criteria

Criteria	Layer values	Fuzzy values	ANP weight	VIKOR weight
Distance to Waterfalls	0 – 2295.5	0 - 1	0.189	0.421
Distance to Lakes	0 – 23691.5		0.234	0.529
Distance to Valleys	0 – 16716.1		0.063	0.054
Distance to Forests	0 – 21058.4		0.125	0.262
Vegetation	0 – 255		0.218	0.488
Distance to Touristic villages	0 – 9027.88		0.171	0.363
Precipitation	1 -3		0.134	0.289
Temperature	0 – 0.09258		0.198	0.441
Soil type	1 – 3		0.081	0.118
Distance to Rivers	0 – 2223.02		0.153	0.312
Land use	1 – 3		0.099	0.174
Landforms	1 – 4		0.077	0.097
Distance to Roads	0 – 8824.31		0.145	0.298
Distance to Service centers	0 – 19698.6		0.113	0.241

3. Results and Discussion

The current study set out to evaluate the ecotourism capabilities of the Margavar district of Urmia county in northwest Iran. For this purpose, as mentioned above, different geographic criteria were combined using an integrated approach. Analysis of the relative importance of the criteria used in the study has shown that some criteria are more important in terms of the ecotourism potential of the study area. It has been determined that the lakes (0.234), vegetation (0.218), and waterfalls (0.189) were the most important criteria in the cluster of

natural attractions. Furthermore, among the environmental criteria, temperature (0.198), rivers (0.153), and roads (0.145) were the most important criteria. In general, the evaluation of the criteria has shown that according to the current situation of the region, lakes (0.151), vegetation (0.131), and waterfalls (0.12) obtained the greatest weight and have been recognized as the most important criteria (Figure 5).

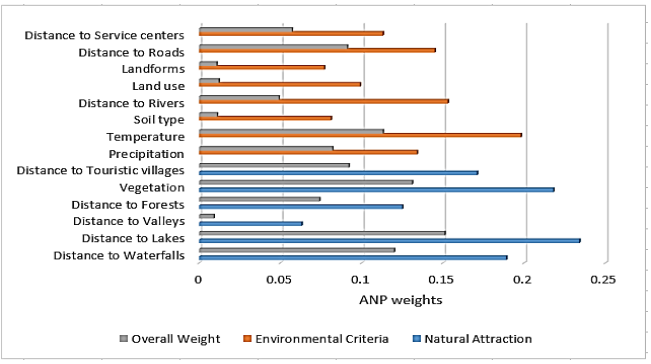

Figure 5. Criteria weights

Figure 6 demonstrates the ecotourism capability map of the studied area. based on the relative weights obtained from the ANP method for the layers and through overlaying the maps using the fuzzy gamma 0.9 operator, the ecotourism potential of the Margavar district has been produced in five classes. Hence, we can classify the ecotourism capability of the Margavar district from very low to very high. The green areas in the map indicate a high potential for ecotourism and the red areas indicate lower levels of potential for ecotourism. According to the evaluations, 14.50% of the study area has very high potential and 26.32% has high potential in terms of ecotourism activities. In general, the analysis of the ecotourism capability of the region shows that 72.82% of its total area, which covers an area of 327.69 km, has moderate to very high potential for sustainable ecotourism development. Moreover, the spatial analysis of the ecotourism potential of the region indicates that the central and south-western parts of the region, which mostly consist of relatively flat lands with low slopes and include natural landscapes such as springs and waterfalls, with infrastructure facilities, and dense pastures and forest lands, are placed as the classes with very suitable areas for ecotourism development. On the other hand, in some parts of the region, the slope of the land is gradually increased and the dense vegetation cover is replaced by semi-arid and partially barren lands, but there are still favorable conditions such as tourist villages or facilities, which have moderate to high ecotourism capabilities. In addition, highly mountainous areas with complex topographical conditions and difficult access were identified as the most unsuitable areas for ecotourism development. However, this situation can provide special tourist attractions and sports activities such as climbing, Skiing, group and adventure tours, etc. can be considered for sustainable ecotourism development.

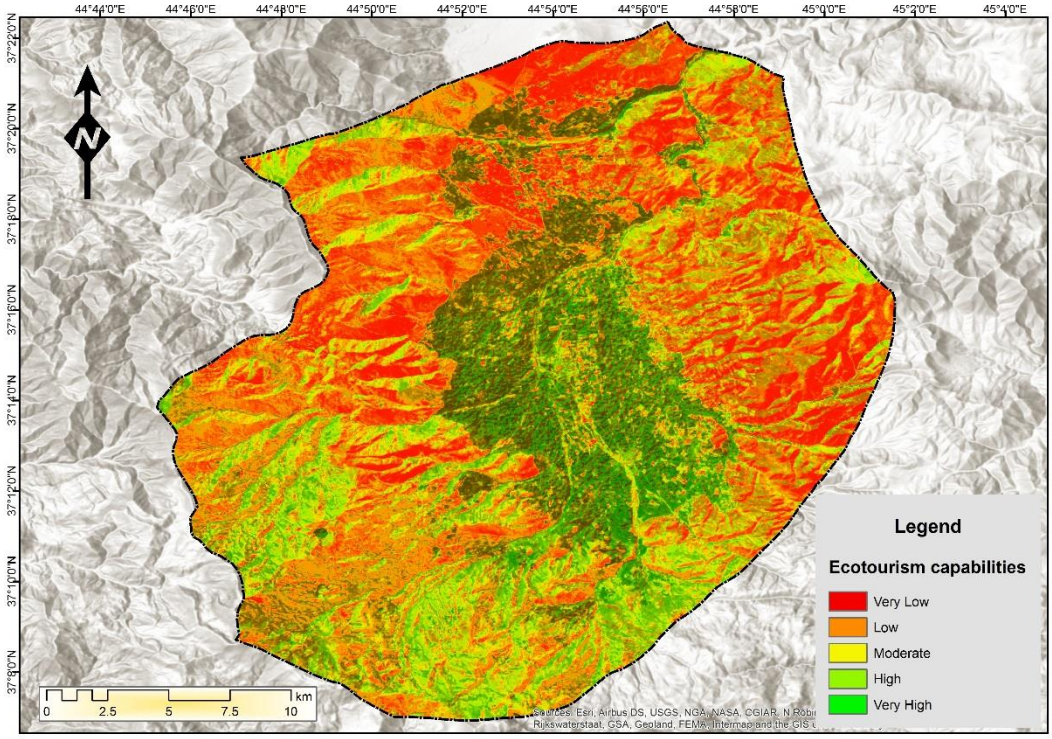

Figure 6. Ecotourism capability map

4. Conclusion

The main objective of the current research was to apply a GIS-based MCDA approach to identify the potential of Margavar rural district for ecotourism development. For this purpose, in the present study, we proposed an efficient integrated approach for ecotourism capability mapping and identifying the potential areas for ecotourism. The results of the research show that the Margavar rural district has great potential in the field of ecotourism development, both in terms of its ability to develop future ecotourism and in terms of its current situation in terms of accepting a large number of tourists. In this regard, it is quite obvious that the adoption of comprehensive planning

and compilation of effective solutions in this field can be a breakthrough and an important step to achieving sustainable regional development at the local level. The use of a multi-criteria integrated approach and the results of the ANP model and the fuzzy logic in this research indicated the great flexibility of these methods and the possibility of defining different scenarios and combining multiple spatial criteria using the analytical functions of the GIS, which considered as a suitable platform for conducting research in the field of qualification, assessment and identification of the natural environment. Therefore, it can be said that considering the potential of the Margavar district, it is essential to review measures and pay more attention to ecotourism development plans and studies in this region. On the other hand, the virginity of this area and the urgent need to provide new opportunities for investment and employment can be considered one of the important findings of this research. In general, the examination of the obtained results shows the high capability of the analytical approach used in the research and its effective application according to the environmental conditions of the region can lead to objective results in the evaluation of the tourism capabilities of the region and lay the groundwork for effective local management and planning for Provide sustainable development.

Author Contributions

The contributions of the authors of this article is equal.

Statement of Conflicts of Interest*)*

There is no conflict of interest between the authors.

Statement of Research and Publication Ethics

Research and publication ethics were complied with in the study.

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