

# THE STUDY OF RANGE LAND SUITABILITY FOR OUTDOOR RECREATION AND TOURISM PURPOSES USING GEOGRAPHIC INFORMATION SYSTEM (GIS)

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## ABSTRACT

*One of the important issues in practical and sustainable range management is the study of range suitability. Outdoor recreation in rangelands illustrates the profits of natural attractions. In order to study the range suitability for outdoor recreation two environmental and sub structural parameters were used in tourism model presentation. Current study was performed in rangelands of Velenjak-Darakeh Watershed, north of Tehran province, through integration of FAO (1991) and Makhdoom comparative methods (1993) in GIS software. Among environmental parameters, suitability of slope, elevation, climate, soil and water resources together with suitability of outdoor recreation attractions were considered. Also, the suitability of distance to the city and connective routs were studied as sub structural parameters. Results of the suitability of effective factors in vegetative types as land units show different classes of range suitability for outdoor recreation ( $S_1$  30.47 %,  $S_2$  9.83 %,  $S_3$  43.43 % and  $N$  16.57 %). Basically, among environmental parameters, soil suitability and access to the water resources were respectively known as the sole limiting factor and decreasing factor of suitability. In contrast, sub structural parameters and outdoor recreation attractions were identified as increasing factors of range suitability for outdoor recreation. A GIS can integrate various information layers to support model.*

*Key words: Range suitability, outdoor recreation and tourism, GIS, FAO.*

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## INTRODUCTION

Rangelands, in which exact relations exist among its components, are one of the most spacious natural ecosystems with several services. Outdoor recreation in rangelands, in which spirit requirements are satisfied, is one of the most important uses of this valuable natural recourse. Asgarzadeh (2001) believes that practical management on the basis of sustainable development is possible provided that planning and range utilization is done according to sustainable land use. FAO (1995) defines range suitability as the congruence of rangeland for specific use. Nowadays, most cities of Iran are in neighborhood of the rangelands and these rangelands can be considered as one of the most prominent natural resources for suburban outdoor recreation because of the healthy climate, original and beautiful scenes. Kumar and Datt (2007) Zoned and classified outdoor recreation suitability in India using GIS techniques and integration of data layers like land use, welfare services centers, economic affairs and so forth. The results show that zoning of outdoor recreation suitability with heavy volume of spatial data is simply possible through overlaying the layers in GIS and classification of their suitability according to defined criteria. Miller (1987) classified and zoned outdoor recreation suitability in US using multivariate method and principle of compatibility among land uses. He states that this will result in compatible management to enhance the promenade suitability. Makhdoom (1993) estimated the total potential of Iran lands for different land uses like outdoor recreation using comparative models and integration of effective ecological layers in nature-based ecotourism and physical layers dependant to the condition of the study area. The objective of this research is to determine the constraint and assisting factors and presenting the final range suitability model for outdoor recreation in the study area with the aid of GIS software. GIS inexpensively help us provide and integrate the data layers to produce range suitability maps for outdoor recreation.

## STUDY AREA

The study area is a part of North Tehran watershed with a total area about 3240 ha. The maximum elevation of the region is 3876 m on Tochal mountaintop and the minimum elevation is 1720 m in watershed outlet. The slope is between 0-25 percent in almost 85.58 % of the study area. Average annual precipitation is 308.8 mm and the study area is considered as a semi-humid and very cold climate. *Astragalus sp.*, *Agropyron cristatum* and some sporadic shrubs like *Amigdalus sp.* are famous as the dominant species in the study area. It is worthwhile to note that there is no grazing livestock in the watershed and available vegetation is mainly utilized by tourists as a traditional use and also is grazed by wildlife.

## MATERIAL AND METHODS

This research was conducted according to the integration of FAO (1991) and Makhdoom comparative method (1987) considering necessary local changes and using GIS software on a scale of 1:50000. Firstly, watershed resources were prepared in a set of environmental and structural parameters applying Makhdoom's method (1987). In this method, parameters of the ecosystems are combined to each other as borders can be distinguished on the map. Because Makhdoom (1992) believes that rangeland is constituted from a large number of environmental parameters thus it is better to determine its potential. Consequently, all effective factors in the model were recognized and a map was produced for each factor separately; then suitability map of the parameters were classified based upon FAO method (1991) and were transferred to GIS software for overlaying. Final suitability map for outdoor recreation produced and classified in four orders: high suitable ( $S_1$ ), moderately suitable ( $S_2$ ), marginally suitable ( $S_3$ ) and not suitable (N). Generally, evaluation of outdoor recreation suitability in rangeland is done in five steps. In first step, basic data of environmental or sub structural parameters were provided and according to the objective all descriptive data were scanned and digitized in second step. In third step, data analysis was performed in a 30\*30 raster base and after producing vector map, contour lines, Digital Elevation Model and slope maps (0-5, 5-10, 10-20, 20-40, 40-60 and more than 60 %) were presented. Constraint and facilitating factors also were determined in this stage and in fourth step, according to FAO (1991), outdoor recreation suitability was scored. Finally in fifth step, model of outdoor recreation suitability was produced and also maps of the environmental and sub structural parameters were overlaid in Arc GIS software to present the final map of outdoor recreation suitability (Fig.1).

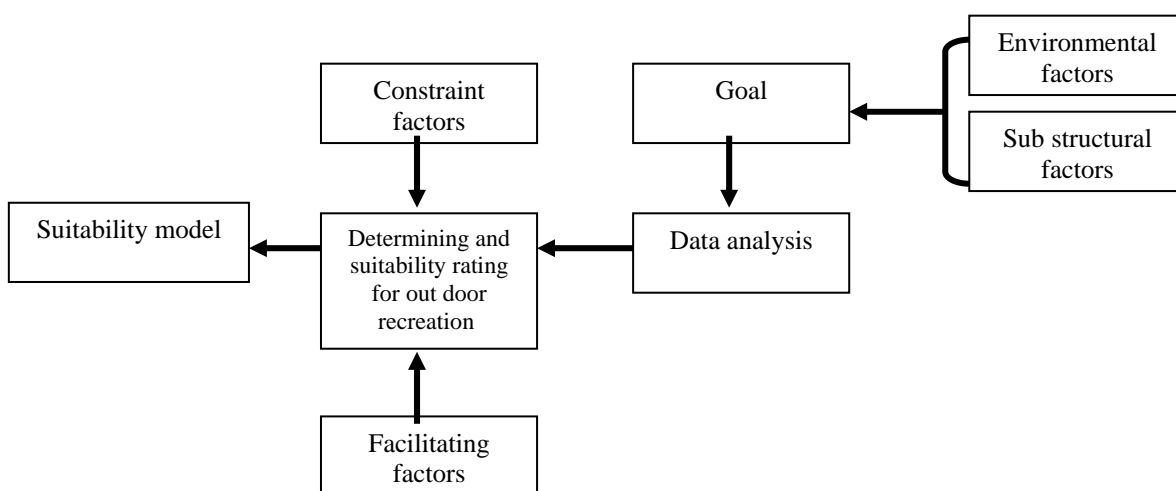


Figure1. out door recreation suitability model stages

## SUB MODEL OF ENVIRONMENTAL PARAMETERS SUITABILITY

This sub model is constituted of six environmental (parameters including slope, height, soil, climate, water resources and outdoor recreation attractions (suitability of vegetation, mountain and wildlife attractions) (Fig.2). To study the mentioned sub models, initially, suitability of the slope for outdoor recreation was classified and presented applying Makhoom's method (1992). Sub model of height for outdoor recreation suitability was classified on the basis of height variations as Amiri (2007) believes that intrinsic attributes of the environment should be considered due to the height variations. Suitability of soil sub model was classified in three classes based upon the soil depth since Gull (2006) states that soil depth can be identified as the effective factor for sub model of soil. To consider the suitability of water resources sub model, map of same distance points were grouped. To determine the suitability of climate, referring to Makhdoom (1992) temperature was the only considered factor. The effect of the snowfall on winter outdoor recreation was ignored in the final model since the study area is considered as a semi-humid and very cold climate. Table 1 shows how environmental factors are scored.

*Table 1. Environmental factors and its suitable classes.*

environmental factors	Suitability class			
	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	N
water resources ( m)	0 -800	800 - 1200	1200 - 1500	1500
temperature ( C ° )	5 - 30	5 - 10	5 - 10	>5
soil (depth )	deep	Semi-deep	_	No deep
( %)slope	0 - 25	25 - 50	50 - 75	75>
elevation ( m)	2700 - 2300	2300 - 2900	2900 - 3500	3500>

To study the suitability of outdoor recreation attractions sub model, suitability of vegetation and wild life attractions were considered. To determine the suitability of vegetation attractions, vegetation map was produced through using vegetation types and land form on aerial photographs. In the mentioned sub model, quadrates of 1\*1 m<sup>2</sup> were used in a randomized- systematic method to measure vegetation parameters. In viewpoint of outdoor recreation, available plant species were classified to four classes that are endangered, vulnerable, endemic and rare species. Then all plant species in the quadrates were scored based upon Majnoonian method (1997) and suitability map of vegetation attractions sub model was prepared in vegetation types. Landscape and silence of the mountain together with tendency to climbing as a sport are of important mountain attractions while in the current research we just focused on suitability of outdoor recreation. Suitability of wild life attraction was classified applying Makhdoom (1993) emphasizing on diversity of wildlife habitats (table 2).

*Table 2. Recreation attractions factors and its suitable classes*

recreation attractions sub model factors	Suitability class			
	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	N
vegetation attractions	65>	50 – 64	35 – 49	34>
wild life attraction (habitat vulnerability)	Low vulnerability	mediocre vulnerability	high vulnerability	Destroyed habitat

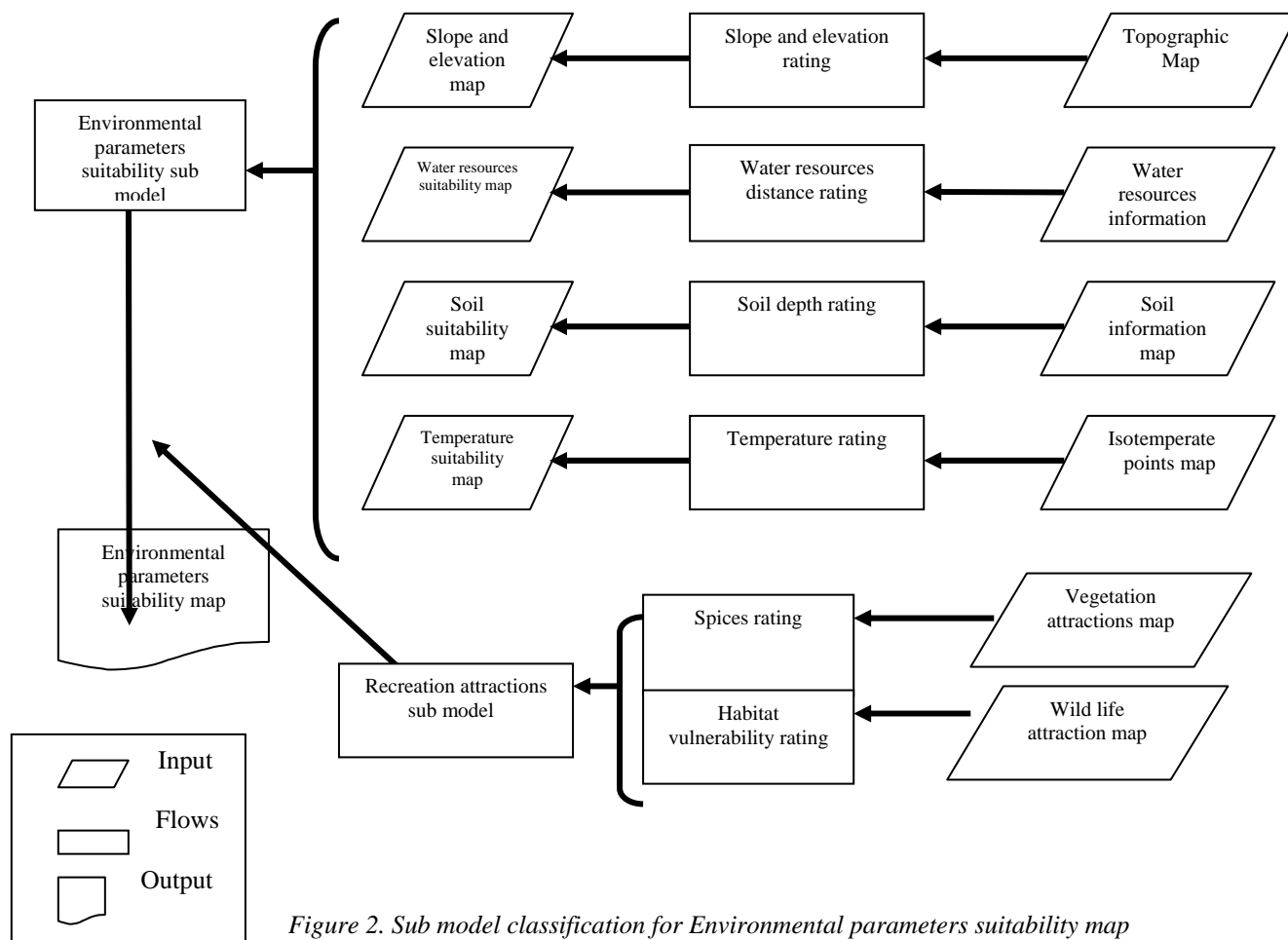


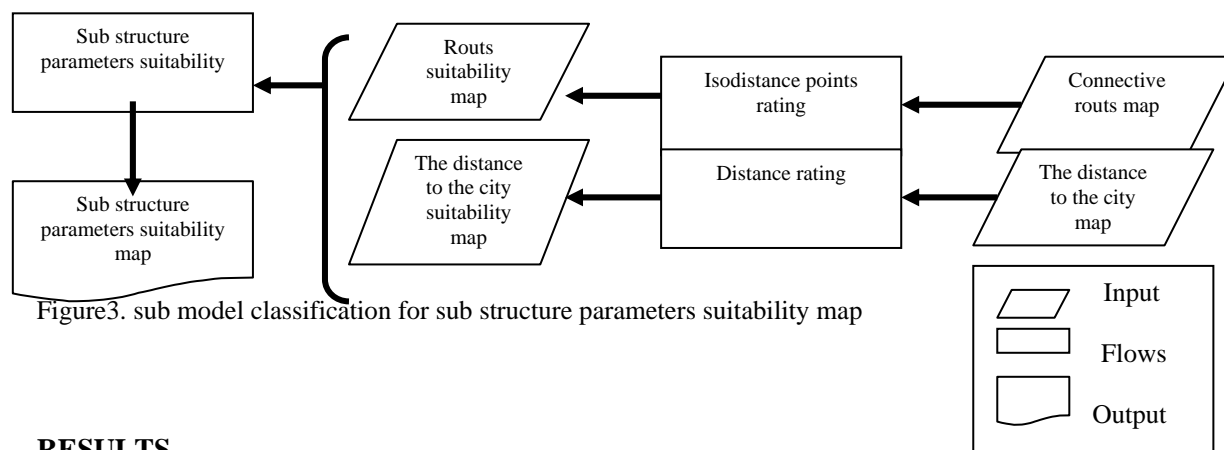
Figure 2. Sub model classification for Environmental parameters suitability map

### SUB MODEL OF SUB STRUCTURE PARAMETERS SUITABILITY

In addition to man made attractions like historical and religious places, nomads and so forth, two effective factors in outdoor recreation suitability that are suitability of the distance to the city and suitability of the connective routes were considered because appropriate routes and vicinity of the study area are complementary and requisite for establishment of fundamental and secure facilities in outdoor recreation (Fig.3). These two mentioned factors were classified and scored based upon Amiri's studies (2007) (table 3).

Table 3. suitability classification of sub structure parameters

sub structure parameters	Suitability class			
	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	N
connective routes (m)	0 - 800	800 - 1500	1500 - 2500	2500 >
the distance to the city (Km)	>100	150 - 100	150 - 250	25>



## RESULTS

The results of the environmental parameters suitability in the study area show different suitability classes ( $S_1$  16/69 %,  $S_2$  9/67 %,  $S_3$  50.74% and N 16 %). Different suitability classes ( $S_1$  520/31 ha or 42/54 %,  $S_3$  509/4 ha or 41/65 %, N 204/7 ha or 16/73 %) also were identified for the suitability of outdoor recreation attractions produced from suitability of wildlife and vegetation attractions. Suitability classes for sub structure parameters were as follows:  $S_1$  366/92 ha or 29/91 %,  $S_2$  118/38 ha or 9/67 %,  $S_3$  239/24 ha or 19/56 %, N 509/41 ha or 41/65 %. Eventually, final map of outdoor recreation were produced by integrating of environmental parameters and sub structure maps and was classified by theoretical combination method. Suitability classes for final suitability of outdoor recreation are coming as follows: ( $S_1$  366/92 ha or 29/91 %,  $S_2$  118/38 ha or 9/67 %,  $S_3$  522/86 ha or 45/2 %, N 195/79 ha or 16/57 %).

Table 4. Recreation suitability for Velenjak-Darakeh rangeland

Vegetation typs	area (ha)	Environmental parameters suitability	Recreation attractions suitability	sub structure parameters suitability	Final suitability for recreation
<i>As.sp-Ono</i>	195/79	N	$S_3$	N	N
<i>As.sp-Cou</i>	118/38	$S_2$	$S_1$	$S_2$	$S_2$
<i>As.sp-Am</i>	313/62	$S_3$	$S_3$	N	$S_3$
<i>As.sp-Ho</i>	239/24	$S_3$	$S_1$	$S_3$	$S_3$
<i>As.sp-Cri</i>	170/06	$S_1$	N	$S_1$	$S_1$
<i>Ro.sp – As.sp</i>	94/88	N	$S_1$	$S_1$	$S_1$
<i>As.sp-Cou</i>	67/81	$S_3$	$S_1$	$S_1$	$S_1$
<i>As.sp-Ag.cou</i>	34/17	$S_1$	N	$S_1$	$S_1$

## DISCUSSION AND CONCLUSION

Tendency to continue outdoor recreation is negatively affected by increase of slope and mostly low slope areas are considered by enthusiastic promenade. This is similar to Makhdoom's studies (1993) who introduces slope as the first factor to study outdoor recreation suitability. Establishment of some welfare service centers in high slope regions was considered as a destructive factor for the nature and even in some low slope areas provided some damages to the natural landscapes due to the colluvial bed of the rangeland but it did not produce any constraints. High altitudes in the study area give interesting landscape to the basin and snow-covered mountains have an undeniable effect in enhancing outdoor recreation suitability. The results are in compatible with Amiri's method (2007) who stated that there is an inverse relationship between height and outdoor recreation suitability. According to Gull's model (2006), soil depth of the rangelands in the study area does not have appropriate suitability for outdoor recreation and tourism because it has a direct effect on vegetation yield and also the movement of surface soil leads to all types of erosion. Shallow soil depth and erosion lead to the soil loss in natural scenes consequently soil depth was recognized as one of the most limiting

factors for outdoor recreation suitability. The results of the investigation on valuable range species and their role in tourism attraction confirm Amiri's model (2007) and Majnoonian studies (1997) but are not similar to the results of Makhdoom's method (1992) in which vegetation attraction is unimportant and species composition and tree density are just considered in his model. Generally, vegetation of the study area does not have and considerable constraints for outdoor recreation. The results of the investigation on valuable range species and their role in tourism attraction confirm Amiri's model (2007) and Majnoonian studies (1997) but are not similar to the results of Makhdoom's method (1992) in which vegetation attraction is unimportant and species composition and tree density are just considered in his model. Generally, vegetation of the study area does not have considerable constraints for outdoor recreation. Makhdoom (1992) also introduces wildlife as a key factor in evaluation and presentation of final outdoor recreation model. In accessible regions of the study area especially in low height basins, habitats have been invaded but it does not show prominent suitability for outdoor recreation. The results are similar to the results of Makhdoom's method (1993) in which wild life suitability was studied to determine the conservation value of the area for outdoor recreation and also confirm Stoddart's study (1975). Generally, there is no water harvest from springs or Main River for drinking because tourists do not aware then, water availability classified as N order suitability. The effect of natural scenes of rangelands on human health has been confirmed by most tourists since they can have a nice out door recreation away from bustle of the cities and generally speaking outdoor recreation attractions of the study area are not only constraint factors for suitability classes but also confirms Amiri's studies (2007). According to the literature review, almost all tourists prefer hiking rather than other transportation systems. All mentioned routes in the study area are of relative appropriate quality and generally there is no constraint in view point of connective routes network. Despite, similar method was used there was substantial difference between our results and the results of Amiri (2007), Noorikia (2006) and Asgarizadeh (2001) due to the inappropriate distribution of the connective routes in the study area. Distance to the city is supplement for other welfare and fundamental facilities since tourist's presence in natural lands requires an appropriate distance to the cities (welfare services centers). There is no constraint in the study area in view point of distance to the city due to the adjacency of the study area to the mega city Tehran and our results strongly confirms Amiri (2007) and Safaiean (2005). Geographic Information System also has many capabilities in functions analysis and spatial models calculation which are difficult to be considered by ordinary methods. To have a better rangeland utilization, having a free access to natural scenes under a continuous management (supervision) is recommended. To present suggestions and for decision making, it is necessary to determine the effective factors in final model of outdoor recreation suitability.

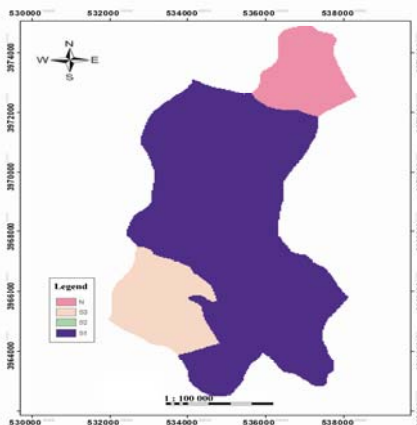


Figure4. Recreation attractions suitability map

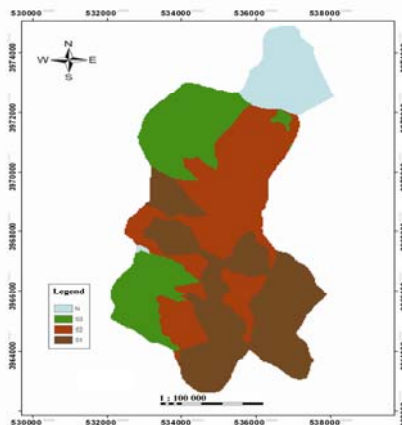


figure5. Environmental parameters suitability map

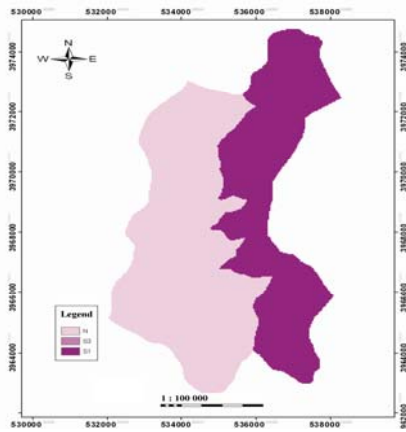


Figure 6. Sub structure parameters suitability map

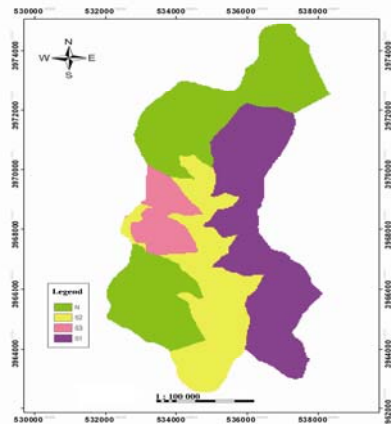


figure7.Final recreation suitability map

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