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An Approach for Rangeland Suitability Analysis to Apiculture Planning in Gharah Aghach Region, Isfahan-Iran

[1]Fazel Amiri, [2]Abdul Rashid B. Mohamed Shariff and [3]Saleh Arekhi

[1]Department of Range Management,
Faculty Member of Islamic Azad University, Bushehr Branch, Bushehr, Iran.
[2]University Putra Malaysia, Institute of Advance Technology, Malaysia
[3]Watershed Management Department, Agriculture College, Ilam University, Ilam, Iran

Abstract: The Irano-Touranian biogeography region is exposed to degradation because of anthropogenic activities and overgrazing. One of the important indirect applications of this ecosystem is Apiculture, which can be considered for reduce degradation of land and over coming for indigenous people, that were live in this area. It is possible to increase Apicultural ability in an appropriate area by identifying the essential factors and ranking suitability of the rangeland. After considering the factors affecting range suitability for beekeeping, final suitability map is created by using of suggested method of FAO and GIS software. Random sampling was done in vegetation types using 30 ($1m^2$) quadrates along three 200m long transect. Investigation on quality and characteristics of rangelands showed that three sub models of vegetation cover, environmental factor and water resources had the main role in determination of range suitability for bee keeping. In sub model of Vegetation cover (flowering period, the rate of attractiveness of plants and vegetation cover percent), in sub model of community factors also road and access road to vegetation, elevation and temperature and soil (its indirect influence on vegetation cover),and finally in sub model of Water were most important factors in the model. Decreasing of nectar or pollen vegetation cover, existence of III, IV classes of attractive and shortage of flowering period, soil and road in some vegetation types were most limiting factors of range suitability for bee keeping. In contrast suitable distribution of water resources, good climate condition (temperature, elevation, …) and dominate unpalatable species by over grazing and flowering period increased the rangelands suitability for bee keeping. According to the results from 7158.69 hectares of studied rangelands, 2102.68 hectares (29.37%) classified as S1 class of suitability (without limitation for bee keeping), 3751.81 hectares (52.4%) classified as S2 class (with low limitation), 836.87 hectares (11.69%) classified as S3 class (with high limitation) and 467.55 hectares (6.53%) were classified as N class (non suitable). Generally 82% of the area had acceptable score as excellent suitability for bee keeping. Therefore, considering Apicultural use of the rangeland have important role to increase landholders and promoting rangeland condition.

Key words: Range Suitability Model · Apiculture · Nectar and pollen producing plants · FAO

INTRODUCTION

Rangelands play an important role in Iran's economy because of their significant effect in soil conservation, water cycle in nature and forage production for livestock and wild life [1]. The economic life of a big sector of social groups viz: nomads and villager is depended on rangelands and these people are utilizing it in their own conventional systems [2].

Iranian rangelands were used only as a source for animal grazing in the past. However, with the extended knowledge of human beings, the new aspects of rangeland utilization are also considered in the present times [3]. This new approach to rangeland management has called for the following issues to be taken into considerations: a. Conservation of the basic resources, b. Multiple utilization of the rangelands, c. socio-economic aspects of rangeland utilization and finally the

Corresponding Authors: Fazel Amiri, Fazel Amiri, Institute of Advance Technology, Malaysia,
P.O. Box: 43400 UPM Serdang, Selangor, Malaysia, Kuala Lumpur-Malaysia.
E-mail: famiri@na.iut.ac.ir or amiri_fazel@yahoo.com.

interactions between the rangeland ecosystems and human activities [4]. So, despite the primary emphasis on forge production and utilization from rangelands, the attitude to make multiple utilizations for rangeland is growing among the ranchers [5].

The growing the human demand for apiculture produce asks for further investigations on the physical and environmental suitability of range ecosystems for apiculture activities. Stoddart *et al*., (1975) believe that the most beneficent utilization of the rangeland is achieved when a multiple utilization program is defined for it [6]. Most of the ranchers have found out that by gaming, wild life watch, wood products, apiculture activities and ornamental and medicine plants, they have a good source of income along with dairy products in a rangeland ecosystem [7].

Apiculture has been considered as one of the aspects of rangeland multiple utilization that not only contributes to sustainability of the system, but also helps with the human community in social and economical developments. The ecological as well as the socio-economical aspects of apiculture are so important and effective that the economic products like honey, wax and etc. are considered the minor achievements in this respect.

In this research, Apiculture use model based on method suggested by FAO (1991) and GIS considering factors affecting range suitability for each type of utilization was created [8]. Amiri (2009) by employing the FAO (1991) method evaluated the suitability of semi-arid rangelands for livestock grazing and concluded that the low biomass production, abundance of poisonous plants, frequent topographies, steep slopes, sensibility soils to erosion, temporary water resources and early cold temperatures are among the reasons that made the evaluated rangeland unsuitable for sheep grazing [1]. Arzani *et al*., (2005) employed the same method in assessing the rangelands that besides the same factors as in Arzani and Yousefi (2006), Arzani *et al*., (2006a), Arzani *et al*., (2006b) and Mfitumukisa (2004) studies, the distance from water resources were among the main reasons for unsuitability of the assessed rangeland for grazing animals [9-13]. Amiri (2008) was working on Gharah Aghach rangelands in Semirom rangelands also came up with the same basic reasons for the unsuitability of the rangelands for livestock grazing [5]. However, Safaeian (2005) defined a multiple utilization program based on the suitability of the Class I range plants (seed bank), medicine plants, nectar and pollen producing plants for apiculture and ecotourism [14]. Amiri (2008) Determined of range suitability for multiple uses (grazing, medical and industrial plants, seed bank and ecotourism) in Isfahan province [5].

Not much research has been conducted on rangeland suitability for apiculture activities in Iran. The goal of the present study was to determine the most important parameters which make Gharah Aghach rangelands suitable for apiculture activities. The investigation of the interaction effects between flower and nectar producing plants and honey bees on the sustainability of the rangeland vegetation was the other objective of this research project.

MATERIALS AND METHODS

The Experimental Site: The Gharah Aghach watershed with an area of 7158.69 ha is located in Isfahan province, Iran. More precisely, the area is located between the latitude of 31°26' 19" and 31°30' 28" N and longitude 51° 34' 54" and 51° 45' 53" E and the town Semirom is located at the northern edge of the region (Figure 1). Due to its vast vegetation cover (79.9% rangeland) and diverse climatic conditions, this site is considered as a suitable place for apiculture activities which attracts large numbers of bee colonies every year. About 17 different vegetation types have been defined in Gharah Aghach rangelands. The mean altitude of the site is 2630m above the sea level and the mean annual temperature is about 10.5 degrees Celsius. The mean long term precipitation has been recorded as 358mm per year [5].

Methodology: The main goal was to determine the interaction effects between the nectar and pollen producing plants, environmental factor, road and access road to vegetation, elevation and temperature, water resources and bee population. To achieve this goal a Geographical Information System (GIS) with diverse map resources were employed. Different software packages like ARCVIEW, ILWIS, MICROSTATION and EXCEL were used to interpret the data. FAO (1991) have also suggested three methods to define different degrees of rangeland suitability for especial utilizations [8]. The method introduced by FAO (1991) for range suitability classification used ARCVIEW, ILWIS as GIS Software. The process included 9 steps;

Land evaluation normally requires a comparison between the inputs required and the outputs obtained when each relevant land utilization type is applied to each land unit.

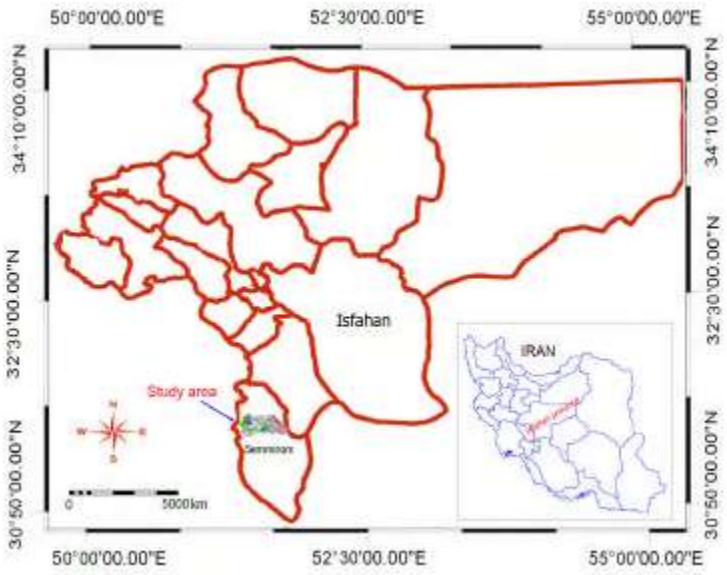

Fig. 1: Geographical position of the studied area

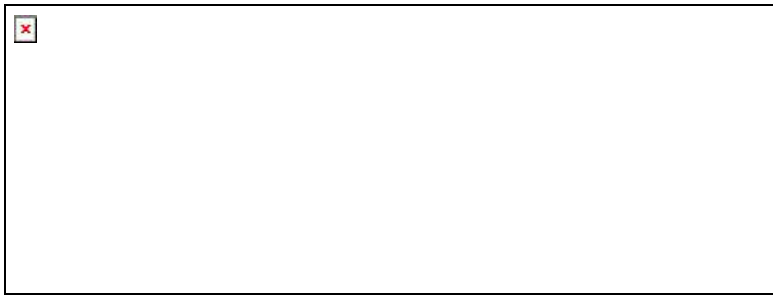

Fig. 2: The process of land suitability evaluation (source: FAO, 1991) [8].

Two orders of range suitability for apiculture use were considered: suitable (S) and not suitable (N). Three classes of suitability were determined including high suitable (S1), moderately suitable (S2) and marginally suitable (S3) (FAO 1991) [8].

In the present experiment the "limited available conditions in land quality assessment" method was used to define different suitability levels (FAO 1991) [8]. According to this method based on the least limiting degree for each determining factor in rangeland suitability, a separate suitability map was created. The simplicity and accuracy of this method is its advantage over the other methods in rangeland assessment.

Gathering the Basic and Primary Information: The sampling for nectar and pollen producing plants started in late April 2007. This provided with a preliminary understanding of potentials of the site for apiculture activities. Different site characteristics such as climatic conditions (precipitation and temperature) were obtained from Gharah Aghach watershed report, to analyze and create the Isotherm maps [15,16]. Also the other primary maps such as vegetation cover, topography, geology, soil, water resources, roads and access paths were provide (Amiri, 2008) [5]. The field notes were taken by application of a GPS instrument along with an altitude meter and taking one square meter quadrate samples. The nectar and pollen producing plants were mainly collected and identified in spring and summer which were then categorized accordingly. The vegetation cover and frequency of each nectar and pollen producing species was determined by taking 30 one square meter quadrate samples which were randomly applied on each sampling site in rangeland. The analysis of the data was done by Multi Variate Statistical Package [17], while the maps were created by ILWIS program. The significance and contribution of any of the vegetation cover (Figure3), environment factors (Figure 4) and water resources

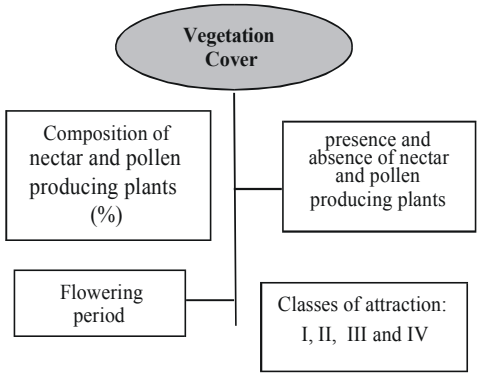

Fig. 3: Vegetation cover sub-model

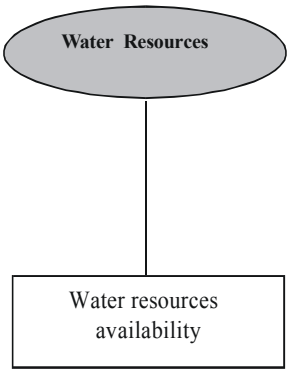

Fig. 5: Water resources sub-model

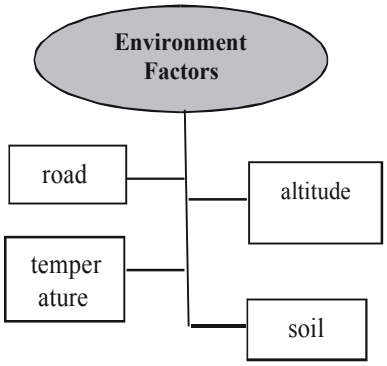

Fig. 4: Environmental sub-model

(Figure5) in range suitability for apiculture activities, were evaluated in a separate sub-model and at end by combining all three sub-models, the final assessment of the rangeland suitability for apiculture activities was achieved (Figures 6).

The Vegetation Sub-model: A randomized systematic sampling method was used to identify the proper plants for honey bee utilization in each vegetation type in the rangeland (experimental site). Two 200 meter long parallel and one crossed transects were assigned to each vegetation type. A sum of 30 one square meter quadrate samples were allocated over all transects at 10m intervals. All the necessary information like percent vegetation cover, growth habit and frequency of nectar and pollen producing plants were recorded accordingly. By frequent 15-day interval field visits during the growing season and referring to similar study reports [15,16], the phenology and flowering period of different species in each vegetation type was recorded. The flowering period was defined as the time that the first flower was fully opened to the time of the last flower was dead. The vegetation covers were classified based on their superiority for apiculture activities (Table 1).

Attractivity index of each plants were determined by direct observation and averaging of the number of bees and the length of time that each bee spent on the flowers. The diversity of attractivity index of nectar and pollen species was determined by Shannon-Weaver (1963) index [18]:

$$H = -\sum_{i=1}^{s} \frac{ni}{N} \ln \frac{ni}{N} \quad (1)$$

Where:

H: Shannon-Weaver index, ni: number of attractivity of each species, N: number of attractivity of total species. The attractivity diversity of nectar and pollen of each vegetation type analyzed and determine by MVSP 2009 software (2009) based on similarity percentage [17].

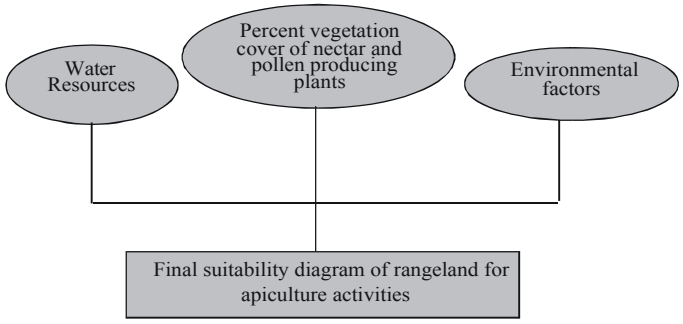

Fig. 6: Integrate of sub-model for classification of apiculture suitability

Table 1: Degree of suitability, percent vegetation cover and flowering period of nectar and pollen producing plants in Gharah Aghach rangeland

	Suitability class			
Criteria	S1	S2	S3	N
Vegetation cover (%)	76-100	51-75	26-50	<25
Flowering period (days)	>75	50-75	25-49	<25
Composition of nectar and pollen producing plants (%)	76-100	51-75	26-50	<25
Attraction index of plant	51-100	31-50	16-30	<15

Table 2: Suitability criteria based on distance from the roads and paths

Criteria	S1	S2	S3	N
Distance from road (km)	0.5-1.5	1.5-2	2.5-3	>0.5 and >3.5

Table 3: Suitability criteria based on thermal limits

Criteria	S1	S2	S3	N
Mean temperature (°C)	20-25	15-19 and 26-37	10-14	>10 and >14

Table 4: Site suitability based on optimum apiculture activity period

Criteria	Apiculture activity period (moths)
S1 Highly suitable	4-5
S2 Moderately suitable	3-4
S3 low suitability	2-3
Not suitable	<2

The final suitability map for apiculture activity was created by the frequency and percent vegetation cover of more nectar and pollen producing plants. The components of vegetation sub-model are presented in Figure 3.

Environmental Sub-model

Roads and Paths: The identification of the main roads and paths for colony owners to access the proper sites in rangeland and market places for their products is of significant importance [19]. The MICROSTATION software was applied to separate the road data layers and the path ways were identified by map scales of 1:25000 prepared by National Cartography Institute. All the data was entered by ARCVIEW program and then the road and path maps at different suitability levels were created by ILWIS software application. At the end the suitability of each plant community was evaluated and categorized based on its distance from roads and paths (Table 2). Some of the plant communities are potentially suitable for apiculture activities; however, because of the lack of road accessibilities, they are not practically suitable for this purpose.

Thermal Limits: The optimum temperature for bee grazing was considered as the base for our evaluations. Since different vegetation types due to the weather temperature and their altitude from sea level, would be ready for bee grazing in particular times of the year, we provided 5 suitability maps for each month and also an overall thermal map for the whole apiculture activity period which is in the first half of the year (5 months). The analysis of the temperature was done by collecting the data from sixteen synoptic weather stations in the region and then by applying a regression analysis between the altitude of the stations from the sea level and mean temperatures from the stations, a thermal gradient equation was calculated. Based on a survey by distributing questionnaire among the bee colony owners and the site temperature fluctuations, the whole year was divided in two active (5 months) and non active (7 months) periods for apiculture activities. For active period of the year, the temperature ranges between 10-37°C [20] and for non-active period it would be less than 4°C. Proper maps were created based on the temperature gradients and the deviation of each vegetation community from the optimum temperature was identified (Table 3). In thermal suitability maps, the isotherm lines and sites with the same altitude would be equally suitable for apiculture activities in each month as well as in 5 months of the first active period of the year. The whole experimental site was classified based on thermal suitability map by ILWIS software application (Table 4).

Table 5: Mean gradient monthly isotherm altitudes in the experimental site

Month	R^2	P*<	Gradient equation
March	0.62	0.05	Y= 18.194-0.0058X**
April	0.52	0.05	Y= 21.695-0.0050X
May	0.59	0.05	Y= 27.464-0.0051X
June	0.65	0.05	Y= 30.734-0.0470X
July	0.58	0.05	Y= 29.770-0.0040X
August	0.52	0.05	Y= 29.511-0.0057X

Statistical level of significance

Table 6: Suitability criteria based on distance from water resources

Criteria	S1	S2	S3	N
Distance (km)	0-1	1-3	3-6	>6

Altitude: The topography factor could be studied based on the slope and aspect because of their direct effects on soil moisture and vegetation composition. However, honey bee can strongly fly across all the slopes and aspects. So, in this regard only the site altitude and thermal gradient will directly affect the honey bee activities [19]. The analysis of the temperature was done by collecting the data from sixteen synoptic weather stations in the region and then by applying a regression analysis through Curve Expert software between the altitude of the stations from the sea level and mean temperatures from the stations, a thermal gradient equation was calculated. The thermal gradient equations are presented in Table 5. If a range of altitudes were suitable for honey bee activities, all of them would be classified as S1 in the software. So, was extrapolated for the other suitability levels of S2, S3 and N. In thermal suitability maps, the isotherm lines and sites with the same altitude would be equally suitable for apiculture activities in each month as well as in 5 months of the first active period of the year. So, the suitability and composition of different vegetation communities would change with the altitude of the site.

Soils: Soil factor was considered as a factor which indirectly affects the distribution, abundance and vegetation cover of nectar and pollen producing species. From this point of the view, soil will play an important role in suitability of a vegetation type for apiculture activities [19]. The sub-model components of environmental factors are presented in Figure 4.

Water Resources: By employing the available water distribution maps and consulting the present experts on the experimental site (Gharah Aghach rangeland), the suitability levels were defined for water resources factor. The MICROSTATION software was used to separate the water data layers. The water resources were identified by map scales of 1:25000 prepared by National Cartography Institute. All the data was pulled by ARCVIEW program and then the water resources maps at different suitability levels were created by ILWIS software application. At the end the suitability of each plant community was evaluated and categorized based on its distance from water resources (Table 6).

RESULTS

There were 175 different species in the flora of the experimental site which belong to 36 plant families. The population of class I plant species have decreased and class III have increased because of livestock overgrazing in the site. A group of 78 nectar and pollen producing species were identified in the site by scientific references [15,16]. The most import Vegetation families utilized by bees in the area were Labiatae, Fabaceae, Asteraceae, Umbelifera, Rosaceae and Cruceferae. Among 114 plant species, 78 species utilizes by bees. These species were unpalatable for grazing animals and were dominant, in degraded rangelands. Therefore it was important to define species and time of flowering which essential for preparing beekeeping calendar and potential of this utilization type in the area. The vegetation types 3, 9, 6, 14, 5 and 8 contained the highest population of nectar and pollen producing species, respectively. The results of cluster analysis show in figure 7.

Three parameters of percent vegetation cover, attraction and flowering period were the main criteria in vegetation sub-model evaluation. The results are presented in Table 7 and Figure 8.

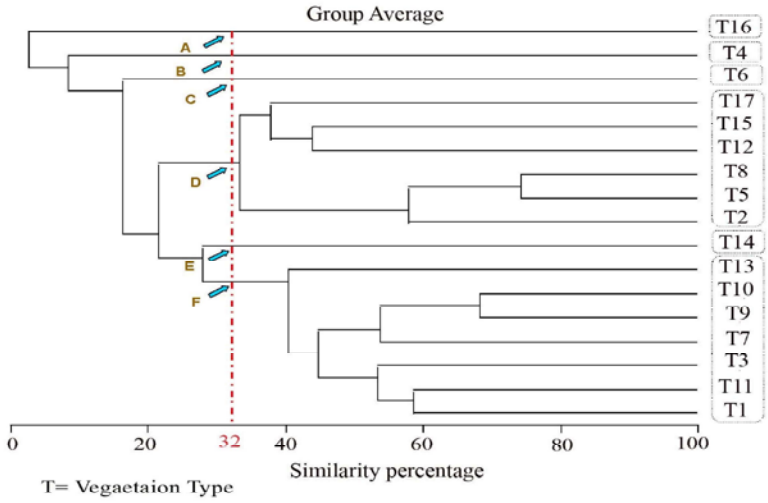

Fig. 7: Cluster analysis of vegetation type

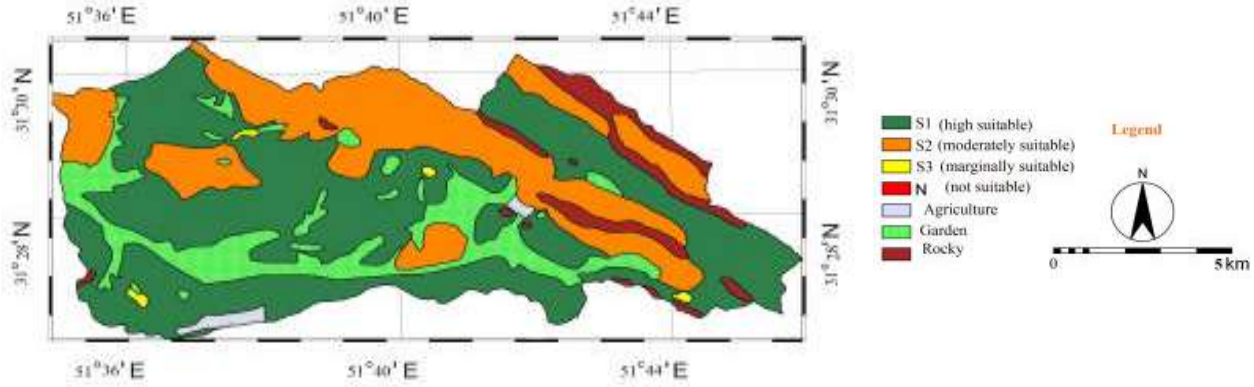

Fig. 8: Sub model of vegetation cover

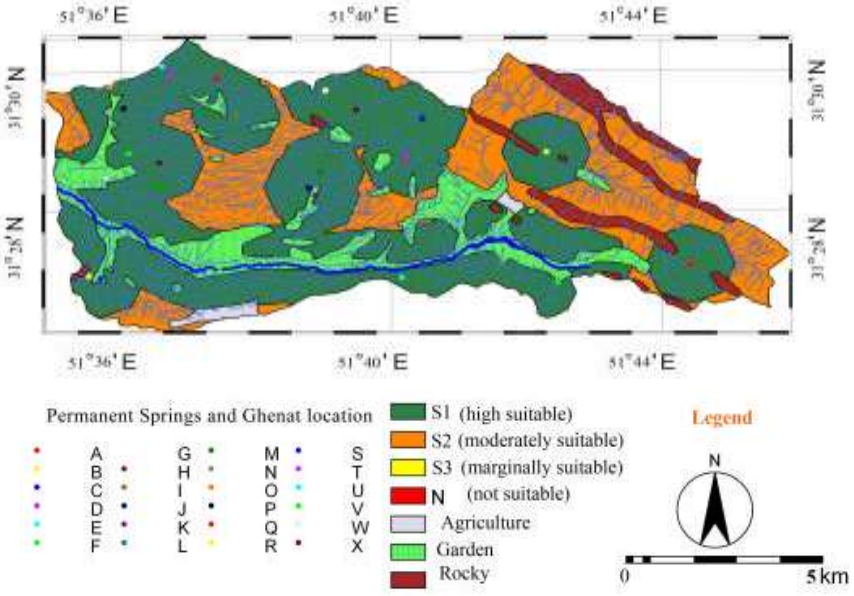

Fig. 9: Sub model of water resources

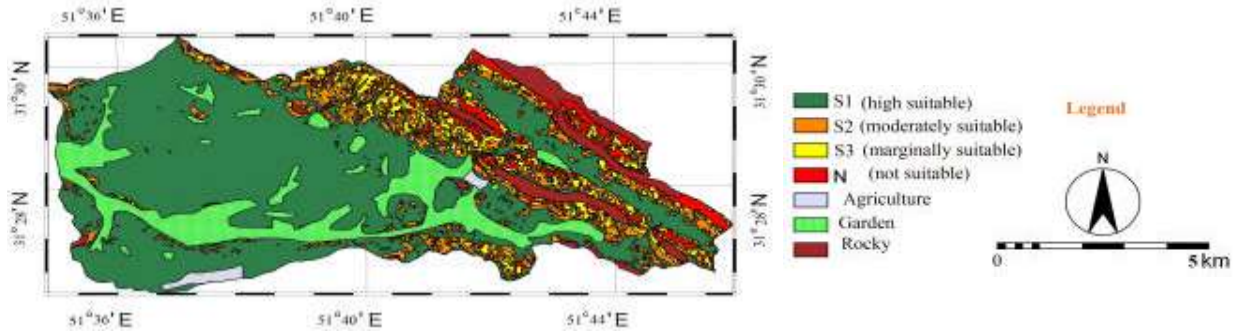

Fig. 10: Sub model of environmental factor

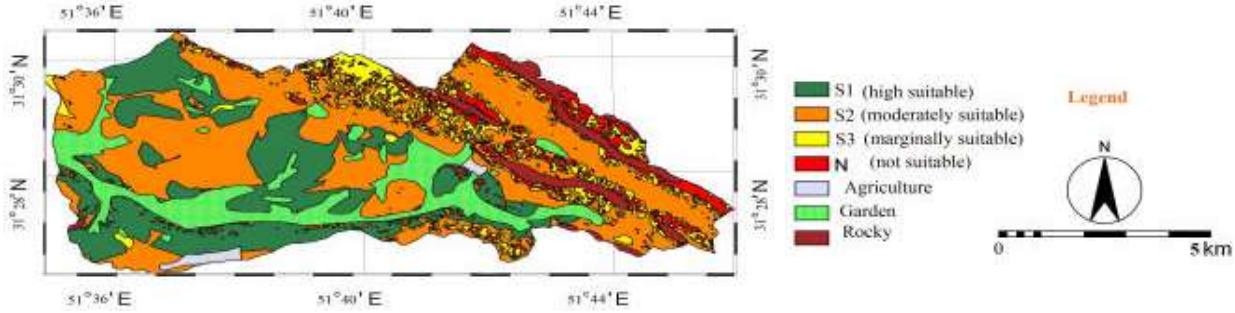

Fig. 11: Final suitability of apiculture use

Table 7: The area of rangeland (ha) at different suitability levels for vegetation composition, attraction and flowering period, parameters

Suitability level	Composition and attraction for honey bee	Flowering period
S1	4656.03	7158.81
S2	2466.02	-
S3	36.76	-
N	-	-

Table 8: The area of rangeland (ha) at different suitability levels for water resources, environmental factors and vegetation composition sub-models

Suitability level	Water resources	Environmental factors	Vegetation cover
S1	4774.55	4463.2	4656.03
S2	2384.26	2054.1	2466.02
S3	-	173.96	36.76
N	-	467.55	-

The evaluation of sub-model of water resources revealed that because of the nature of water resources distribution in the experimental site, there is no site at N (not suitable) category. On the other hand because of the high potential of honey bee mobility, this factor was considered as a positive element in site suitability for apiculture activities. The map suitability of water resource model was present in figure 9. The map suitability components of environmental factors sub-model are presented in Figure 10 and Table 8. The final suitability map of suitability criteria for three sub-models of water resources, environmental factors and vegetation cover are presented in figure 11. The statistical results of the final model are presented in Table 8.

DISCUSSIONS AND CONCLUSION

The results of the study area showed that factors like water resources distribution, temperature and altitude imposed no limitations to apiculture activities in the experimental site during the first 5 months of the year (no N category). The soil conditions as well as roads and paths ways were among the limiting factors in some parts of the experimental area. The vegetation cover in Gharah Aghach rangeland was the most important limiting factor in apiculture activities because the flowering period of most of the nectar and pollen species were short, the Class I plants were substituted by Class III and IV and the attraction of the vegetation cover for honey bee was not high enough.

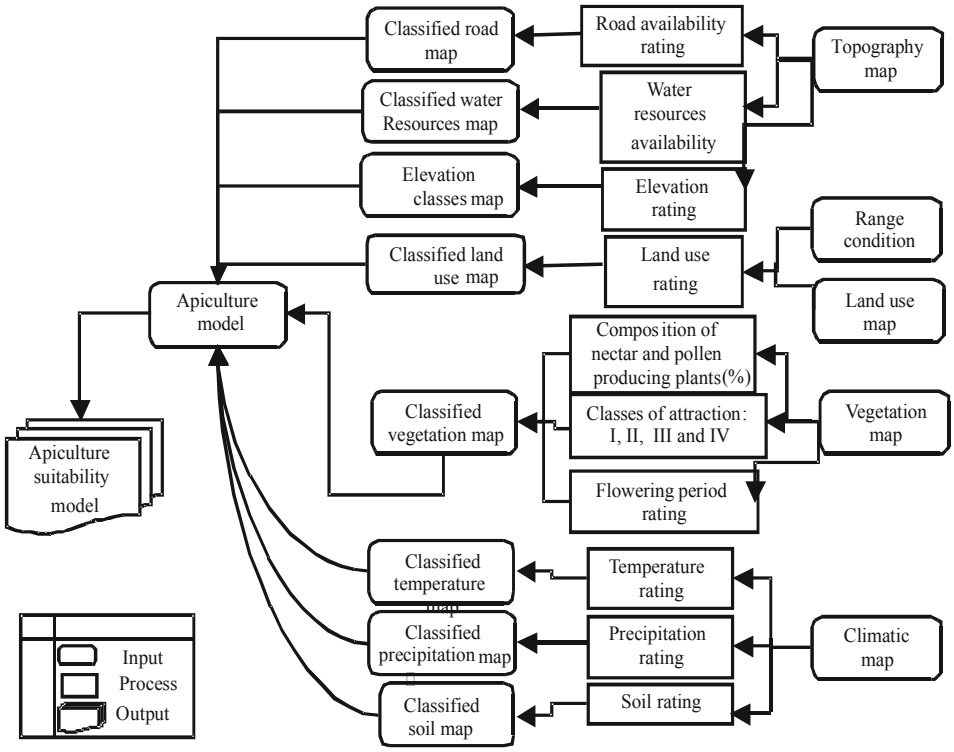

Fig. 12: Final suitability diagram of rangeland for apiculture activities

Based on the overall evaluation, only about 21% of the area was classified as highly suitable for apiculture activities (S1). Safaeian (2005) in his study in the same site reported 31% of the area is highly suitable for apiculture activities [14]. Our model results indicated that vegetation cover (flowering period and attraction for honey bee), soil (by indirect effect on vegetation cover), roads and paths (access to different vegetation types) and altitude and temperature are equally effective in this model. However, the floristic studies of the site revealed potentials for improvement. All vegetation type numbers of 3, 4, 13, 15, 16 and 17 were mostly located around the villages at lower altitudes and were either converted to dry farming lands or were heavily damaged by livestock over grazing. The spares vegetation cover of these sites was mostly comprised of annual, poisonous and roughage plants with low palatability and quality. However, few of the species are useful for honey bee which among them *Thymus kotschyanus*, *Salvia, limbata* and *Astragalus* species are noticeable.

The presence or absence of nectar and pollen producing plants was considered as an important suitability factor in Safaeian (2005) research project [14]. However, in the present project the presence of nectar and pollen producing plants was considered only as a pre-requisite to do the further studies on them. Because along with the presence of a suitable plant, the vegetation cover, composition of vegetation, attraction class, flowering period and amount of nectar production should be measured to have an accurate assessment of suitability of the vegetation community.

Livestock overgrazing has changed the plant composition and reduced the potential production of the rangelands in Gharah Aghach watershed. This phenomenon is reflected in low honey production in hives and presence of unpalatable plants for both the livestock and honey bee grazing. It was found that the honey bee and livestock share more than 50% of the Class I and Class II range plants in their grazing. Early and over grazing of the range plants by livestock not only have resulted in a significant reduction in forage production and soil erosion, but also has caused a destruction of the flowering organism of the plants which adversely affected the apiculture activities in the site.

We suggest that livestock grazing should start after the plants are in full flowering stage to help both vegetation recovery of the site and provide a better opportunity for honey bee grazing. It is mentionable that among the decrease and invader plants some with high essence contents are palatable for honey bee grazing. These results support finding of Ralf (2002) and Theocarpoulos (1995) in western United States rangelands [21,22].

The results of this project revealed that vegetation cover, environmental factors and water availability are the major components in rangeland suitability assessment for apiculture activities. The relationship and the style of Correlation of this component are show in Figure 12.

REFERENCES

1. Amiri, F., 2009. A GIS Model for classification of Rangeland Suitability for Sheep Grazing in arid and semi-arid regions of Iran, Livestock Research for Rural Development, 21(5): 68-82.
2. Amiri, F., 2010. Modeling Livestock Grazing in Rangeland by GIS, World Engineering Congress, 2nd-5th August 2010, Kuching, Sarawak, Malaysia Conference on Geomatics and Geographical Information Science, pp: 77-90.
3. Amiri, F. and H. Arzani, 2010. Rangeland management based on grazing capacity and vegetation index (case study: semi-arid Ghareh Aghach region), Iranian Rangeland Journal, 3(4): 680-698. (in Persian language).
4. Vallentine, J.F., 2003. Grazing Management. Academic Press, San Diego, CA.
5. Amiri, F., 2008. Modeling multiple use of rangeland by using GIS. Ph.D thesis, Islamic Azad University Research and Science Branch, Tehran, Iran, pp: 560. (in Persian language).
6. Stoddart, L.A., A.D. Smith and T.W. Box, 1975. Range Management. 2 nd edition, MC graw hill Book Company. new York.
7. Rastgar, Sh., H. Barani, A. Sepehri and A. Taghipour, 2007. Assessment of the apicultural potential in Polour summer rangelands. Rangeland J., 1(4): 357-369. (in Persian language).
8. FAO., 1991. Guidelines: land evaluation for extensive grazing, soil resource management and conservation service. Soil Bull., No. 58, Rome, Italy. ISBN: 92-5-103028-6. pp: 158. http://www.fao.org.
9. Arzani, H., Sh. Yousefi, M. Jafari and M. Farahpour, 2005. Rangeland suitability assessment by using GIS. J. Environ., 37: 59-68.
10. Arzani, H. and S. Yousefi, 2006. A GIS model of range suitability assessment for sheep grazing (Case study Taleghan Region in Tehran Province). 8th International Conference on: Information Systems in Sustainable Agriculture, Agro-environment and Food Technology (HAICTA 2006), 20-23 September. Thessaly, pp: 911-918, ISBN: 960-89024-0-1.
11. Arzani, H., Sh. Yousefi, M. Jafari and M. Farahpour, 2006a. Production Range Suitability Map for Sheep Grazing Using GIS (case study: Taleghan Region in Tehran province). International Conference of Map Middle East, 26-29 March, Dubai, UAE. pp: 25. from http://www.mapmiddleeast.org/2006/mme 2006report.htm.ISBN:978-3-540-74166-4(Print)978-3-540-74167-1 (Online).
12. Arzani, H., M. Jangjoo, H. Shams, S. Mohtesham neia, M. Agha Mohsen Fashami, H. Ahmadi, M. Jaferi, Darvish Sefat, Ali Asghar and E. Shariari, 2006b. Modeling range suitability Classes for sheep grazing in center Albourz, Ardestan and Zagrous regions of Iran. J. Sci. Technol. Agric. Natural Resources, 10(1): 273-290. (in Persian language).
13. Mfitumukisa, David, 2004. Evaluating rangeland potentials for cattle grazing in a mixed farming system. Master of Science thesis, department of Natural Resources, the Netherlands.p.75.from: http://www.itc.nl/library/Papers_2004/msc/nrm/mfitumukiza.Pdf.
14. Saffianian, R., 2005. Multiple use of rangeland (Case study: Taleghan region). MS.c thesis, Department of Natural Resources, Tehran University. (in Persian language).
15. Shahid, M., 1992. Beekeeping in the North West frontier province of pakistan. Honybees in mountain agriculture, pp: 193-209.
16. Shamei, A., 2000. Study of bioclimatic condition effect on nurture honey bees in Iran. MS.c thesis, Tarbiat Modares University, pp: 220.
17. Multi Variate Statistical Package (MVSP 2009). http://www. Kovcomp.com.
18. Shannon, C.E. and W. Weaver, 1963. The mathematical theory of communications. University of Ilinois press. Urbana, pp: 117. ISBN: 0-252-72548-4.
19. Ebadi, R. and A. Ahmadi, 2006. Honey bee's culture, Arkane denesh press, pp: 572.
20. Faghih, A.R., R. Ebadi, H. Nazarian and M. Noroozi, 2005. Determination of attractiveness of different plants for honey bess in Khansar and Faridan regions of Isfahan province. Iranian J. Agric. Sci., 36(3): 521-536.
21. Ralph's, M.H., 2002. Ecological relationship between poisonous plant and rangeland condition. Journal of Range management, 4: 319-323.
22. Theocarpoulos, D.A. and J.N. Davidson, 1995. GIS as a survey and land evaluation in Greek. Journal of soil and water concervation, 15: 145-150.

Appendix: Vegetation type in study area

Ag.tr	*Agropyron trichophoum*
Ag.tr-As.pa	*Agropyron trichophoum-Astragalus parroaianus*
Ag.tr-As.ca-Da.mu	*Agropyron trichophoum-Astragalus canesens-Daphne macronata*
As.ad-Ag.tr-Da.mu	*Astragalus adsendence-Agropyron trichophoum-Daphne macronata*
As.pa-Ag.tr	*Astragalus parroaianus-Agropyron trichophoum*
As.ly-Ag.tr-Da.mu	*Astragalus lycioides-Agropyron trichophoum-Daphne macronata*
As.ca-Br.to-Co.cyl	*Astragalus canesens-Bromus tomentellus-Cousinia cylianderica*
As.br-Br.to-Da.mu	*Astragalus brachycalyx-Bromus tomentellus-Daphne macronata*
As.go-Co.cyl	*Astragalus gossipianus-Cousinia cylanderica*
As.pa-Co.cyl-Da.mu	*Astragalus parroaianus-Cousinia cylanderica-Daphne macronata*
As.cy-Fe.ov	*Astragalus cyclophylus-Ferula ovina*
Br.to-As.pa	*Bromus tomentellus-Astragalus parroaianus*
Co.ba-As.go	*Cousinia bachtiarica-Astragalus gossipianus*
Co.ba-Sc.or	*Cousinia bachtiarica-Scariola orientalis*
Fe.ov-Br.to-As.za	*Ferula ovina-Bromus tomentellus-Astragalus zagrosicus*
Ho.vi-Po.bu	*Hordeum bulbosum-Poa bulbosa*
Br.to-Sc.or	*Bromus tomentellus-Scariola orientalis*