African Journal of Agricultural Research Vol. 6(24), pp. 5551-5557, 26 October 2011
Available online at http://www.academicjournals.org/AJAR
DOI: 10.5897/AJAR11.1020
ISSN 1991-637X © 2011 Academic Journals

Full Length Research Paper

Relationship between plants evening and soil properties in the rangeland, Lar National Park, Iran

Jamil Amanollahi[1]*, Ahmad Makmom Abdullah[1] and Ghasem Ali Dianati Tilaki[2]

[1]Department of Environment science, Faculty of Environmental studies, Universiti Putra Malaysia, UPM 43400, Serdang, Selangor, Malaysia.
[2]Department of Natural Resources, Faculty of Natural Resources and Marine Sciences, Tarbiat Modares University, Iran.

Accepted 22 August, 2011

Important factors in rangeland ecosystem suitability are quality and quantity of herbage products. Negative or positive trend of plants cover in the rangeland is shown by plants evening and plants diversity indexes. In this research, the effects of some soil properties on range evening were studied. In this research to decrease the effects of environment factors on plants evening, three sites consisting of shrub land, grass-shrub land and grass land were selected with the same elevation range and geographical directions. In order to show the evening value in each site, Pit evening index was used and soil elements including Calcium, Magnesium, Phosphorus, Potassium, $CaCO_3$, Ammonium, Nitrate, Organic Matter, Acidity, EC, Moisture, and Soil Texture were measured in the sites. Plant samples were taken in the key areas along the three transects according to number of plant species one by one. Principal component analysis (PCA) was utilized to find the environment gradient. Duncan and variance analyses were used to compare plants evening in the three sites. Results showed that chemical properties such as organic matter and potassium and physical properties such as soil moisture and silt content caused soil fertility to increase and consequently increased ecologic habitats in the soil. This led to the growth of rare species of plants. Because these rare species need high level of soil fertility and consequently causing a decrease in canopy evening. This study reveals that the site with weak soil fertility has more plants evening than the other sites.

Key words: Rangeland, soil, principal component analysis, fertility, Iran.

INTRODUCTION

Relationship between environmental parameter and vegetation cover is important to manage rangeland ecosystems and also helps to determine the main factors which can affect on vegetation cover changes. Vegetation is a main part of rangelands. Existence of each plants need to specific factors like climate, topography and soil (Leonard et al., 1984). The important factor on plants growing is the soil which is a function of topography, organisms, parent material, and climate (Hoveizeh, 1997). Rangeland destruction is generally understood to refer to degradation of plants. Loss of coverage and biomass, replacement of native species by exotic species is a kind of rangeland destruction (Mouat and Hutchinson, 1995). Previous studies in semi arid areas indicate that replacement of perennial herbaceous species by woody shrubs shows the grass land destruction (Schlesinger et al., 1996; Schlesinger and Pilmanis, 1998; Havstad et al., 2000).

The study area in this research is three range land sites including grassland, grass-shrub land, and shrub land. The trend of vegetation cover and soil from grassland to grass-shrub land and continue to shrub land is like desertification process. UNEP (1992) explained that semi arid area, dry semi-humid, and dry climatic area have potential of desertification. Dregne (1998) showed that five main processes create desertification which includes; water erosion, salinization, water logging, vegetation

*Corresponding author. E-mail: j_aman2005@yahoo.com. Tel: 60-173368094. Fax: 603-89467463.

degradation, wind erosion and soil crusting. Soil material deprivation by wind and water erosion (Takar et al., 1990; Zobeck, 1991), soil texture (Lauenroth and Milchunas, 1991), and increasing spatial and temporal heterogeneity of water nutrient (Dunkerley, 2000; Sperry and Hacke, 2002) have an important role to changes in vegetation pattern and structure such as changes from grassland to shrub land. Dodd et al. (2002) showed that the control of shrub and herbaceous species is intervened by soil texture, in addition to climatic factors.

The parameters which were mentioned earlier appear after rangeland destruction. But to find the first stage of destruction process, quantitative analysis of ecosystem diversity is useful. Quantitative data can help to guide sustainable management strategies for ecosystem resources to mitigate adverse disturbances. Archer and Stokes (2000) showed that some serious threats to the ecosystem are unchangeable damage. Ecosystem stability and stretchiness in the face of disturbance, is determined by ecosystem diversity which consist of species richness and abundance. Natural plants cover were used for ecosystem mapping (Witte and Van der Meijden, 2000; Goebel et al., 2001), ecohydrological models (Van Ek et al., 2000) and synecological studies (Witte, 2002). Characteristics of the grazed ecosystem including product sustainability, plants physiognomy and vegetation life forms interact with grazing and can determine plant community structure and diversity (Grace and Jutila, 1999; Waide et al., 1999). In this study, no effort is made to show the species richness or abundance which have been explained in previous studies. The objective of this research is to determine the plants evening in three rangelands which they are under grazing.

MATERIALS AND METHODS

Study area

Sites which are supposed to be studied are located in Lar Protective National Park in the north east of Iran (Figure 4). Park boundary is between 35° 4' and 35° 48' northern latitude and 51° 32' and 52° 4' eastern longitude. Its climate is semi arid with minimum and maximum average monthly temperature of -6.5 and 18.4°C in December and July respectively. In this study, 3 sites including grass land, shrub land, and grass-shrub land with the same geographical elevation and aspect were selected as shown in Figure 1.

Data collection

The sampling points were selected in the area with same elevation and aspect (Figure 1). By this way we decreased many variables which can affect vegetation cover and soil elements due to different elevation and aspect. Vegetation sampling in each site has been done in the key area. Sampling parts were randomly placed along three transects systematically. The plant frequency were obtained along each transect. Vegetation covers were acquired using some plots along each transect. Equation (1) was utilized to determine the amount of plots for each site as follows:

$$N = \frac{t^2 s^2}{p^2 \overline{x^2}} \left[1 + \frac{2}{n} \right] \quad (1)$$

Where: N is the amount of plots, t is determined from student's t-table, S is a variance of samples, P is 1%, and X is a coverage mean of preliminary sampling. In order to do soil sampling, two profiles from 0 to 10 cm were dug along each transect. The soil samples were transported to the laboratory and it characteristics were analyzed. The tests were done as follows: Soil texture by Hydrometric, pH by electrode pH meter, Electric conduction by EC meter, Phosphor by Olson method, Organic Matter by titration method of Walkely-Black, Calcium and Magnesium by titration with EDTA solution, Potassium by atomic absorption with normal 1% sode, Moisture by weight method, and Apparent Specific Weight of soil by paraffin gravel method.

Data analysis

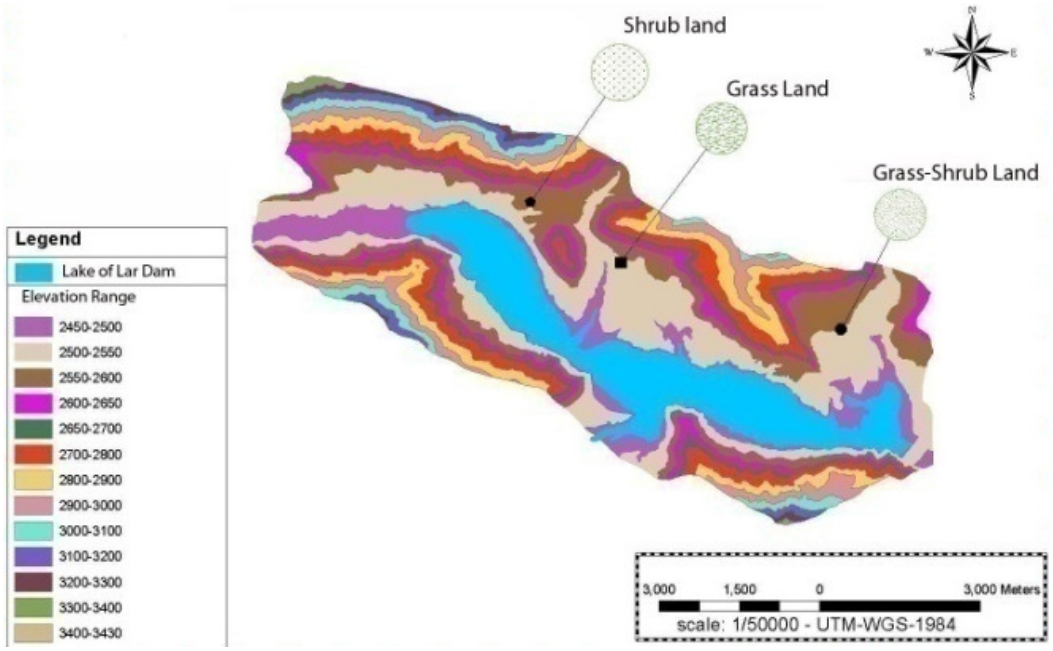
Soil factors were made as matrices and data analysis were done using PCord win ver 4.17 software. In this research for soil factors radiance survey, principal component analysis (PCA) was used. Then some evening indexes were calculated. SPSS ver 16 was used to determine the statistical significant differences between the different indexes in the sites. First, the normality of data was tested using Kolmogorov-Smirnov test and variance homogeneity was tested using Levene's test. Due to data normalization, to analyze general differences between sites, one way ANOVA was used (Cannon et al., 1998; Vujnovic et al., 2002). Because of homogeneity variances, Duncan test was used for differences comparison between sites.

RESULTS AND DISCUSSION

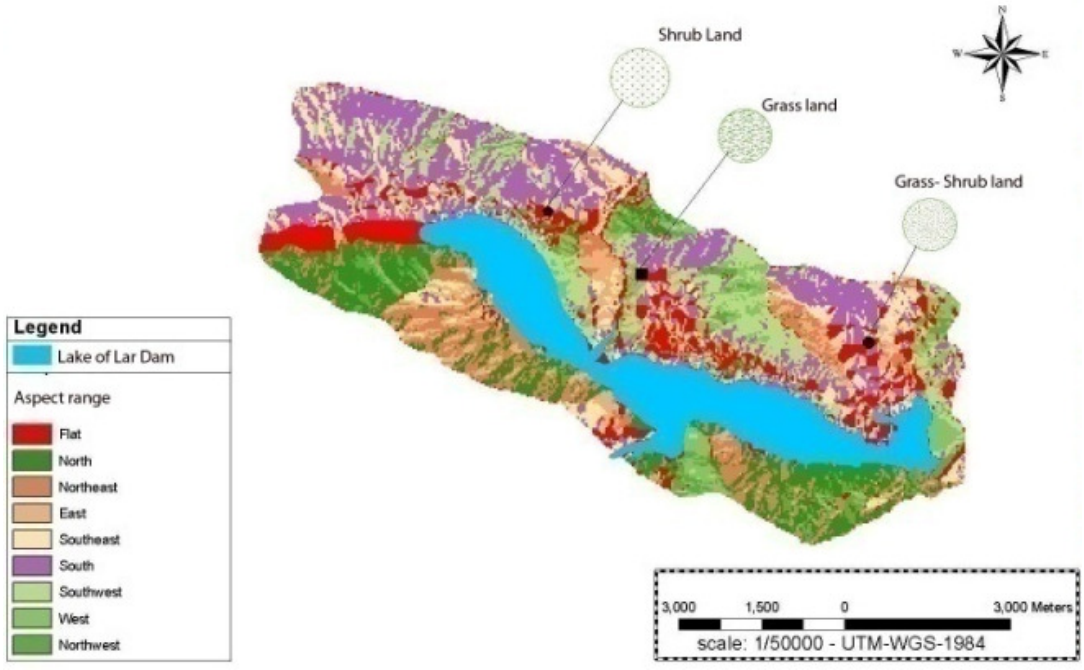
Sampling of vegetation cover shows that *Poa bulbosa* 77%, *Rannculus* sp. 74%, *Platanthera bifolia* 59%, and *Astragalus szauitsii* with 54% have the most frequency in the three sites canopy cover. The characteristics of plants canopy cover is shown in Table 1. As shown in Table 1, the grass land, grass-shrub land, and shrub land with *Astragalus odescendus*, *Talctrum isopyvoides,* and *Astragalus* sp. have maximum canopy cover respectively. Also, in those sites, *P. bulbosa, Chaevophyllum oareum*, and *P. bifolia* have maximum abundance respectively. According to the results, in plants evening indexes, there is not a significant difference between mean value for grassland and grass-shrub land which is shown in Figure 2. But there is a significant difference between mean values of these sites with shrub land site.

Results of PCA

Changes of soil factors in the depth of 0 to 10 cm between the soil profiles to the results of PCA axis is shown in Figure 3. The PCA analysis axis 1 and 2 with



a



b

Figure 1. (a) Elevation map and (b) aspect map of study area.

special value of 5.301 and 2.623 were utilized to explain the results, respectively. Axis 1 shows 35% of the changes in soil factors in the three sites. The results showed that from the left hand side of the first axis which is the grass-shrub land site to the right hand side of the first axis which is shrub land site lime, sand and pH will increase and ammonium, clay and nitrate will decrease. Also, along the second axis toward down which is the grassland site, potassium, moisture and organic materials will increase. Table 2 showed that the correlation rate of soil factors with axes which are used in PCA analysis in the depth of 0 to 10 cm. As it is shown in Figure 3 and

Table 1. Maximum and minimum of plants canopy cover and abundance in three rang land sites.

Parameter	Grass-Shrub land		Grass land		Shrub land	
Maximum canopy cover of plants	*Astragalus adescendus*	9.7%	*Talctrum isopyvoides*	11.81%	*Astragalus* sp	15.06%
	Bromus temontellus	7.8%	*Muscari caucasieum*	8.8%	*Platanthera bifolia*	14.75%
Minimum canopy cover of plants	*Medicago sativa*	1.5%	*Taraxacum officinalis*	0.6%	*Outreyo carduiformis*	0.6%
	Thymus caucsicus	1.3%	*Papaver bractiatum*	0.5%	*Cruciata taurica*	0.9%
Maximum abundance	*Poa bulbosa*	30	*Chaevophyllum oareum*	24	*Platanthera bifolia*	29
	Astragalus adescendus	24	*Talctrum isopyvoides*	20	*Astragalus* sp	28
Minimum abundance	*Medicago sativa*	2	*Taraxacum officinalis*	3	*Cruciata taurica*	5
	Thymus caucsicus	2	*Bellevalia pycantha*	3	*Outreyo carduiformis*	2

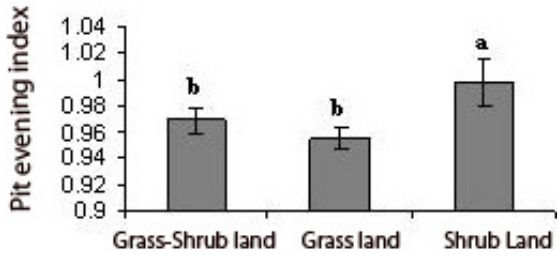


Figure 2. Comparison of plant evening indexes in the three sites (different letters shows the statistical significant difference).

Table 2, the grassland site has positive correlation with organic matter, moisture and potassium which increased fertility of the soil in this site. Abd El-Ghanio, (2003) showed that organic matter content has an important role in the improvement and increasing of the soil cationic capacity. Also, Tavasol (2000) and Azar nivand et al. (2003) have mentioned the important role of the organic matter in the soil improvement. The grass-shrub land site also has positive correlation with the amount of ammonium, clay, and nitrate which ammonium and nitrate are part of nitrogen which is suitable to improve the soil in this site. But shrub land has positive correlation with lime, sand, and acidity than these factors, because the soil is poor in this site and most importantly, the canopy cover is the shrub and grasses are rarely in between the shrubs. The trend of decreasing the soil fertility from grassland to grass-shrub land and shrub land is like the range destruction. When soil fertility decreases, the amount of the shrub increases in the range land and vice versa (Cheng et al., 2007; Li et al., 2006; Norton et al., 2004; Wang et al., 2003). As it is shown in Figure 2, plants evening value in the shrub land is more compared to the others sites. Grassland and grass-shrub land sites due to more soil fertility than shrub land have a high ecologic range to grow the different kind of range vegetations. High ecologic ranges create the different ecological niche and these niches are occupied by different kinds of plants.

On the other hand because of grazing in these areas, a special kind of plant cannot overcome the others. Mesdaghi (2002) has mentioned that grazing causes irregularity in plant covering and creating small nest. As a result, the high amount of plant species with different ecological range can grow in these sites. There are some rare kinds of plants that their creation is because of the soil fertility conditions in the grass-shrub land and grassland sites. This situation will decrease the plants evening value in these sites. The more the soil fertility, it will cause more kinds of rare plants which are sensitive to the environmental conditions. But in the shrub land because of less food, rare kinds cannot grow and some special plants species which are adaptive to this conditions can grow and with the same distance create the plants evening. Mesdaghi and Sadeghi (2000) have achieved the same results and they concluded that plants evening in the key area because of the rare kinds of plants is lower compared to other parts of range land which was under high grazing.

Conclusion

Determining the relationship between soil and plants is a useful way to better understand the ecosystem condition and can help to manage the rangeland ecosystem. In this study, three rangeland sites including grassland, grass-shrub land, and shrub land were selected to determine the relationship between the plants evening and soil elements. To remove other parameter which can affect this issue due to different elevation and aspect, three sites were placed in the same elevation and aspect.

Results showed that the Pit evening index was obtained highest in the shrub land compared to the other sites. Trend of soil factors form grassland to grass-shrub

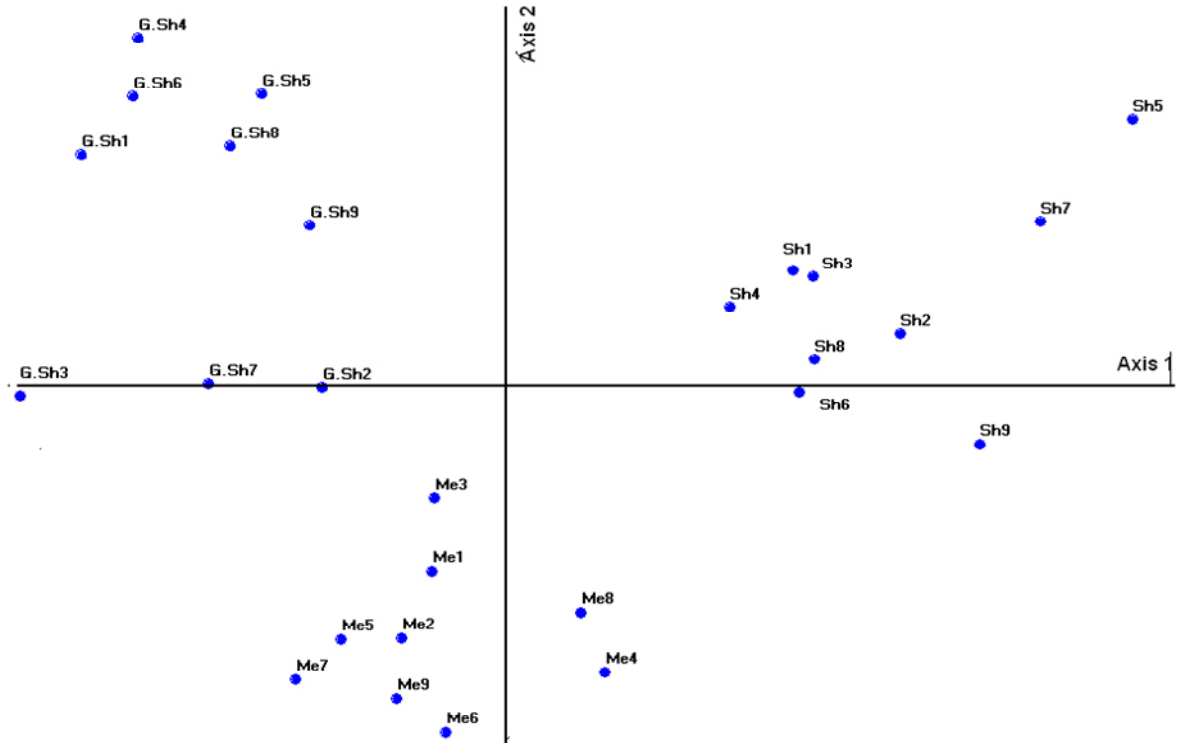


Figure 3. PCA graph in the depth of 0 to 10 cm which the letters present the profiles that G.Sh1-G.Sh9 are about grass- shrub land, Me1-Me9 are about grass land and Sh1-Sh9 are about shrub land site.

Table 2. Correlation coefficient between axis of PCA and soil factors (* and ** shows the correlation significance in the level of 0.05 and 0.01 respectively, and ns does not show significant).

Soil factors	Axis 1	Axis 2
pH	0.74**	-0.43*
EC	0.71**	-0.52**
Phosphor	-0.07	-0.10ns
calcium	0.60**	-0.13ns
Magnesium	-0.40 *	0.43ns
Lime	0.90**	-0.14ns
Clay	-0.62**	-0.06ns
silt	-0.80**	-0.32ns
sand	0.83**	0.25ns
Organic matter	-0.03ns	-0.89**
Apparent specific weight of soil	-0.32ns	-0.18ns
Potassium	-0.02ns	-0.62**
Moisture	-0.68**	-0.64**
nitrate	-0.62**	0.52**
Ammonium	-0.48*	0.15ns

land and to shrub land is decreasing the organic matter, moisture, and potassium also increasing the sand, lime, and EC. This study concludes that the fertility of range land soil can decrease the plants evening and high values of plants evening shows the high range of destruction in rangeland sites.

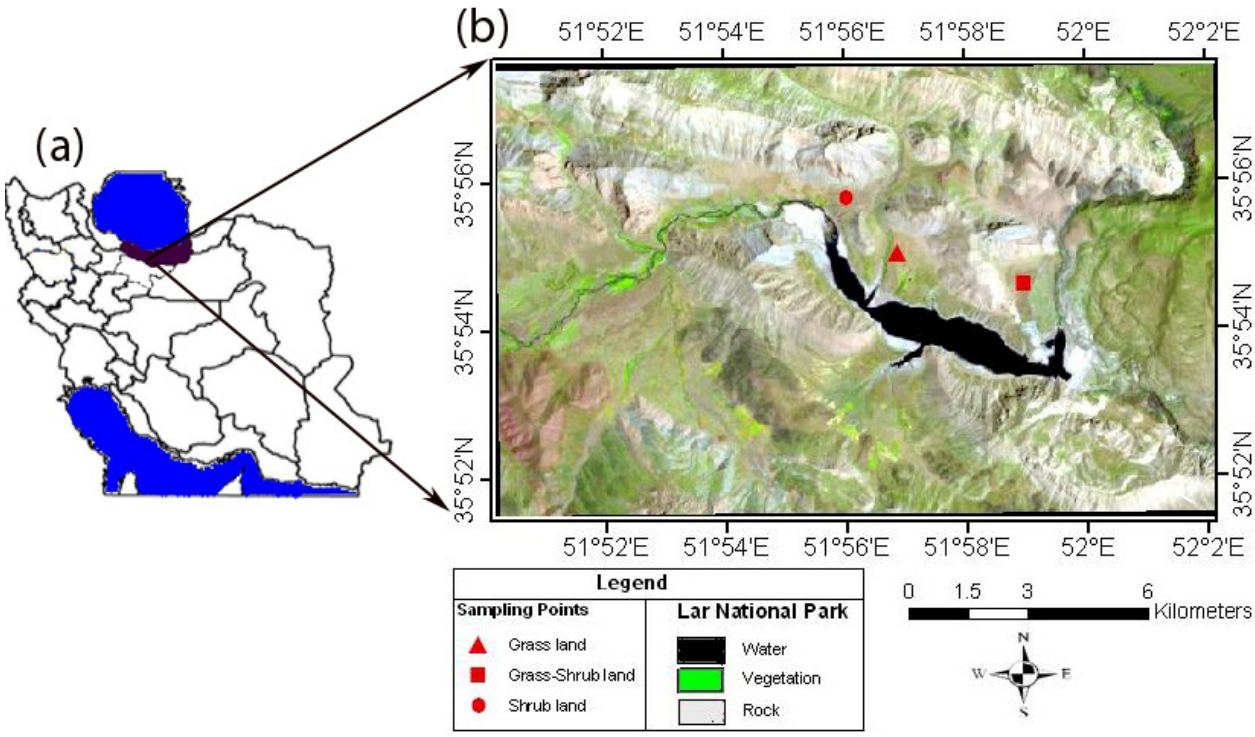


Figure 4. (a) and (b) shows Iran and the study area respectively. Also (b) shows the sampling point in the study area.

REFERENCES

Abd El-Ghanio MM, Amer WM (2003). Soil vegetation Relationships in Coastal desert plain of soutern Sinai, Egypt. J. Arid Environ., 55: 607-628.

Archer S, Stokes C (2000). Stress, disturbance and change in rangeland ecosystem. In: Arnalds, O., Archer, S. (Eds.), Rangeland Desertification. Kluwer Academic Publishers, London, pp. 17-38.

Azar nivand H, Jafari M, Moghadam MR, Jalili A, Zare Chahoki M (2003). Survey of soil specification effects and elevation changes over distribution of two species of *Artemisia* , case study: range land of Verv Avard, Garmsar, and Semnan regions. Iran Nat. Source, 56: 93-99.

Cannon HC, Peart RP, Lighton L (1998). Tree species diversity in commercially logged Borneon Rainforest. Science, 281: 1366-1368.

Cheng X, An S, Chen J, Li B, Liu Y, Liu S (2007). Spatial relationship among species above – ground biomass, N and P in degraded grassland in Ordos Plateau, northwestern China. J. Arid Environ., 68: 652-667.

Dodd MB, Lauenroth WK, Burke IC, Chapman PL (2002). Association between vegetation patterns and soil texture in the shortgrass steppe. Plant Ecol., 158: 127-137.

Dregne HE (1998). Desertification assessment. In: Lal, R., Blum, W. H., Valentine, C., Stewart, B. A. (Eds.), Method of Assessment for Soil Degradation. CRC Press, New York, pp. 441-458.

Dunkerley D (2000). Hydrologic effects of dryland shrubs: defining the spatial extent of modified soil water uptake rates at an Australia desert site. J. Arid Environ., 45: 159-172.

Goebel PC, Palik BJ, Kirkman LK, Drew MB, West L, Pederson DC (2001). Forest ecosystems of a Lower Gulf Coastal Plain landscape. Multifactor classification and analysis. Torrey Bot. Soc. J., 128: 47-75.

Grace JB, Jutila H (1999). The relationship between species density and community biomass in grazed and ungrazed coastal meadows. *Oikos*,85: 398-408.

Havstad KM, Herrick JE, Schlesinger WH (2000). Desert rangelands, degradation and Nutrients In: Arnalds, O., Archer, S. (Eds.), Rangeland Desertification. Kluwer, Dordrecht, pp. 77–87.

Hoveizeh H (1997). Studyof the vegetation cover and ecological characteristics in saline habitats of Hoor-e-Shadegan. J. Res. Constr., 34: 27-31 (in Pesian).

Lauenroth WK, Milchunas DG (1991). Short- grass steppe. In: Coupland.

Leonard SG, Miles RL, Burkhartdt JW (1984). Comparison of soil properties associated with basin wildrye and black greaswood in the Great Basin region.

Li XR, Jia XH, Dang GR (2006). Influence of desertification on vegetation pattern variation in the cold semi-arid grassland of Qinghi-Tibet Plateua, North- West China. J. Arid Environ., 64: 505-522.

Mesdaghi M, Shadeghi Nezhad MR (2000). Comparison of diversity index in the range lands under three different utilization in semi steep grass land in northern east of Iran. J. Agric. Sci. Nat. Res., 7: 63-76.

Mesdaghi M (2002). Vegetation description and analysis. Jahad daneshgahi. Press, 287pp.

Mouat DA, Hutchinson CF (1995). Desertification in developed countries. Environ. Monit. Assess., 37: 1-137 (special issue).

Norton JB, Monaco TA, Norton JM, Johnson DA, Jones TA (2004). Soil morphology and organic matter dynamics under cheatgrass and sagebrush- steppe plant communities. J. Arid Environ., 57: 445-466.

Schlesinger WH, Pilmanis AM (1998). Plant– soil interactions in deserts. Biogeochemistry, 42: 169-187.

Schlesinger WH, Raikes JA, Hartley AE, Cross AF (1996). On the spatial pattern of soil nutrients in desert ecosystems. Ecology, 77: 364-374.

Sperry JS, Hacke UG (2002). Desert shrub water relations with respect to soil characteristics and plant functional type. Funct. Ecol., 16: 367-378.

Takar AA, Dobrowolski JP, Thurow TL (1990). Influence of grazing, vegetation life- form, and soil type on infiltration rates and interrill erosion on a Somalian rangeland. J. Range Manage., 43: 486-490.

Tavasol MH (2000). Evaluation of the connection between some unique species of range land with soil characteristic in the semi arid region of Taleghan. Master Thesis, Tarbiat Modares University, Iran.
UNEP (1992). World Atlas of Desertification. Edward Arnold, London.
Van Ek, R, Witte JPM, Runhaar J, Klijn F (2000). Ecological effects of water management in the Netherlands. The model DEMNA. Ecol. Engine., 16: 127-141.
Vujnovic K, Wein RW, Dale MRT (2002). Predicting plant species diversity in response to disturbance magnitude in grassland remnants of central Alberta. Can. J. Bot., 80: 504-511.
Waide RB, Willig MR, Steiner F, Mittelbach GL, Dodson SI (1999). The relationship between productivity and species richness. Annu. Rev., Ecol. Syst., 30: 257–300.
Wang J, Fu B, Qiu Y, Chen L (2003). Soil nutrients in relation to land use and landscape position in the semi-arid small catchments on the loss plateau in China. J. Arid Environ., 48: 537- 550.
Witte JPM (2002). The descriptive capacity of ecological plant species groups. Plant Ecol., 162: 99-213.
Witte JPM, Van der Meijden R (2000). Mapping ecosystems by means of ecological species groups. *Ecological Engineering* . 16: 143–152.
Zobeck TM (1991). Soil properties affecting wind erosion. J. Soil Water Conserv., 46: 112-118.